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Global economic trends in the context of investor relations and strategic management. A longitudinal analysis of trends utilized in annual reports of German blue chip corporations.

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PREFACE

In 2008, I have read an inspiring article about the topic of megatrends that caught my interest at the first moment of contact. That was during the time of my part-time MBA studies. At that time, I was working as a project manager in the chemical and pharmaceutical industry in the field of process automation and information technology. I realized the potential of global economic trends as I have come across the topic during my daily work. At this time, publications with the focus on "The internet of things" or "Industry 4.0" were the main drivers that motivated my research. After I completed my thesis, my thirst for knowledge was not satisfied. At the beginning of 2011, I have searched a way to intensify my academic knowledge in a part-time Ph.D. programme. At this time, only a few universities offered such a programme in Germany. In addition, most of the places were already reserved. It was striking to me that the academic institutions in Germany were not prepared to offer motivated students to have a full-time job and to conduct a Ph.D. at the same time. Finally, I have found an option at the doctoral programme of FOM-UCAM. The initiative allowed me to tap into the field of research and science and keeping my job at the same time.

Taking part in such a programme is an intensive experience that comes with a huge demand for the participants. That was my key learning after the first year of the programme. Especially problematic was keeping my private and business life stable and in-sync with my studies. Without the support of my family, I would not have been able to conduct my studies. One of my biggest challenges in the programme was to cope with the level of stress, as even the smallest negative circumstance in life distracted me from working on my topics, or even put me into a state off inability that I have not experienced beforehand. This experience forced me to develop more resilience in business and in private life to develop the foundation that enabled me to work on my topics. My learning is that completing a Ph.D. thesis does not only require to handle the workload that comes with the research; it requires, even more, to cope with the emotional distractions and stress. The stress that comes with a Ph.D. does not only affect the researcher but also his surroundings. Latter is often difficult to perceive which might lead to severe complications without one even recognizing about the tense condition. That meant for me that I needed to adapt and to reflect on my behavior, which includes accepting many compromises. These circumstances were not foreseeable for me at the planning phase of the thesis, were the research questions and the design of the study was my main concern. Luckily, I was able to manage the challenges in my way, and to complete my research. At the same time, my colleagues who have stopped participating in the program due to their individual reasons still deserve as much respect as they have taken the challenge, instead of rejecting the opportunity. My deepest belief is that anyone who has participated in this program will benefit from the experience.

During the research, I was lucky to have strong supporters at my site that helped me and took away some of my private workload and a lot of stress that would distract me from my journey. These supporters were the inner circle of my family, which are my mother and father. In addition, I had strong support from the supervisors of my thesis. I have to thank Prof. Dr. Thomas Christiaans, who always provided a critical view on the work and motivated me to take the necessary steps required to complete the work. Our working experience was very fair and corporative. In addition, I thank Prof. Dr. Pablo Salvador Blesa Aledo for accepting me as his student in the programme and for supporting the thesis. In conclusion, I have to say that taking part in such a part-time programme requires a lot of mutual trust and respect from the student and the coordinators. I was lucky to have both.

Mülheim, June 12, Frank Bezjak

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ABBREVIATIONS

Abbreviation	Description
ABMS	Agent based modelling system
ANN	Approximate Nearest Neighbor
ANOVA	Analysis of variance
APEC	Asian-pacific economic cooperation
AR	Autoregressive
ARMA	Auto regressive moving average
ARP	Annual reports
BAA	Before and after studies
BLUE	Best linear unbiased estimators
BMBF	Federal Ministry of Education and Research of Germany (Bundesministerium für Bildung und Forschung)
BRIC	Brazil, Russia, India, and China
CAGR	Common average growth rate
CCI	Conference Board's Consumer Confidence Index
CRI	Confidence ranking index
CSA	Cross sectional analysis
DAX	German stock index (Deutscher Aktienindex)
Destatis	Federal statistical office
DF	Degrees of freedom

Abbreviation	Description
EBIT	Earnings before interest and taxes
ERM	Entity relationship model
EU	European Union
FDI	Foreign direct investment
FSS	Foresight support system
GDP	Gross domestic product
GDPpc	Gross domestic product per capita
GEE	Generalized estimating equation
GET	Global economic trend
GIS	Geographical information system
GPL	General public license
GSS	Group support system
GT	Google Trend
IAS	International Accounting Standards
ICS	Inductive category system
ICT	Information and communication technology
IFRS	International Financial Reporting Standards
IT	Information technology
LR	Literature review
LTA	Longitudinal analysis
LWA	Long wave analysis model
MA	Moving average

Abbreviation	Description
MNE	Multinational enterprise
MSCI	Michigan University's Consumer Sentiment Index
OC	Operationalizable conclusion
ODBC	Open database connectivity
OH	Operationalizable hypothesis
OI	Operational Income
OLS	Ordinary least squares
PEST(LE)	Political, economic, social, technological, (legal)
PFE	Perfect foresight equilibrium
QCA	Qualitative content analysis
QIC	Independent model information criterion
QICC	Corrected quasi likelihood under independence model criterion
RAHS	Risk assessment and horizon scanning
RAND	Research and development
RC	Research conclusion
RI	Regional index
ROE	Return on equity
RTD	Real-time delphi
SE	Shareholders' Equity
SIG	Significance
SME	Small and medium enterprises
STEEPV	Social, technological, economic, environmental, political, values

Abbreviation	Description
SVI	Searching volume index
SWOT	Strength, weaknesses, opportunities, threats
TIA	Trend impact analysis
TP	Trend passage
TSA	Time series analysis
UK	United Kingdom
US	United States
US-GAAP	United States Generally Accepted Accounting Principles
XOR	Exclusive or

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1 INTRODUCTION

1.1 BACKGROUND AND RESEARCH CONCEPT

Besides being confronted with fierce competition, today's corporations are confronted with macroeconomic driving forces that constantly change the configuration of existing and future markets. Examples of these forces, which are called "megatrends" or "global economic trends" (GETs), are the scarcity of resources, the changing financial landscape, the power-shift from developed to developing economies, the aging of Western societies, and the increasing influence of technology (Bezjak, 2010). However, research does not provide a coherent view of these types of trends, which often leads to misinterpretation and an unclear and abstract view of them in the academic field. Publications provided by corporations and other forms of management practitioners, such as consulting companies, seem to provide their own individual interpretations of trends. This variation results in disagreement between researchers in academics and business, and provides room for the research of trends in the organizational context. In addition, the information value behind the concept of GETs or megatrends has been questioned, and is perceived as having no added value for business and research (Groddeck and Schwarz, 2013; Rust, 2008). In other words, terms like GET or megatrends seem to be used arbitrarily in research. This lead to the idea that terms like megatrend, global trends, or GET are vehicles to assume and to communicate possible future developments from the perspective of the individual author. Liebl and Schwarz (2010, p. 314) point out that the usage of term "trend" ranges from statistical models that are employed in marketing, strategic management and economics, to intuitive arguments about the development of trends (e.g. Naisbitt's megatrends), to organizations that apply models of trend research of environmental scanning and strategic issue management. Trend research studies draw on a wide variety of trends and agree on the description and impact of these trends, but differ in the labelling of the trends. Larsen (2006, p. 8) states that "future researchers always work with the three types of futures: the predictable, the possible, and the preferred". The latter type of future, “the preferred,” reflects the role of emotions in deciding what type of future might be beneficial in the eye of the beholder. As Barrett (2007, p. 937) points out, “functional and dysfunctional effects of feelings are equally acknowledged and simultaneously managed to maximize their positive effects and minimize their negative effects.”

Regarding GETs, this approach leads to the assumption that GETs effect all entities of an economy, but are mostly important to the business of multinational enterprises, and the decision-making processes on the political level in economically developed countries (Stiglitz, 2002, p. 11). Therefore, the use of trends by multinational enterprises (MNEs) is considered an ideal ground for empirical research. The rationale is that (a) stock-listed companies are especially dependent on the development of the globalized financial market, and that (b) these corporations have the relevant size and financial power to operate in international markets. Consequently, trends that are important to these corporations are assumed to deliver a holistic picture about trends in general that can be used for comparative analysis. Therefore, these trends are used in investor relations as they have the required characteristics to portray the business deliverables to the investors of the respective company. The important parameters from the information perspective are the textual context or passage, the exact phrasing of the printed trend, and the individual form of presentation that might play a role in emphasizing the relevance of a trend to the corporation. Furthermore, the utilization of these trends in the context of management and business planning further motivates the idea of researching the topic of GETs, and leads to the question of which scientific practices integrate the concept of trends into their conceptual thoughts and practical methodologies.

Slaughter (1995) claims that a broad array of methods and concepts are already available to draw an overview of our context in time (past, present, and near-term future). Literature portrays these methods in the context of foresight. The term is used as an umbrella term that integrates the prospective vision into management science and has several branches, like technology, corporate/organization, or strategic foresight. In the business context, foresight utilizes trends in the context of innovation and extends existing concepts of strategic management to include GETs into business planning, and to foster innovation based on current or future trends. Existing methods stem from qualitative, quantitative, and semi-qualitative tools, such as panel research with experts, scenario analysis, trend extrapolation, Delphi or real-time Delphi studies. The latter have reached a state of maturity and are accepted in research and business practice (Popper, 2008a). However, foresight lacks a standard vocabulary, due to different methods and practices, which provides room for the development or the refinement of existing ones (Magruk, 2011). The literature shows that foresight in the context of geographical and regional development with a focus on technology and innovation seems as a great companion for foresighting practice (Georghiou et al., 2008).

Rohrbeck (2014) points out that corporations face a high level of uncertainty in the context of innovation, as they use traditional techniques like discounted cash-flow analysis to decide on innovation efforts, which results in improvements in existing fields, rather than in new fields of innovation. On the contrary, business practitioners depend on standardized financial tools for cash flow analysis and prognosis. This dilemma might be resolved if financial insights are aligned with directed innovation efforts that found on strategic analysis of the current as-is situation. This idea was also supported by a recent survey of 202 finance executives in medium-sized and large businesses in the U.K., conducted by Robert Half Management (2015). Interestingly, 49% of all respondents of the study believe that financial insight can improve business strategy. At the same time, 37% complained about not having the right tools and methodologies for analyzing big data. The development and implementation of innovative data models that incorporate “megatrends” therefore involves a high level of uncertainty, and require investments into technology and into qualified service personnel. Recent work on foresight support systems (FSSs) seems to fit perfectly into this context. In recent literature on foresight and forecasting, the so-called FSSs get strong attention (von der Gracht et al., 2014). Rohrbeck et al. (2013) point out that the developments in FSSs lead to even more complex and mature software solutions. In particular, the integration of big data provides room for the improvement of existing models and for the development of new econometric models. Varian (2014, p. 5) points out that data analysis and econometrics are used for prediction, summarization, estimation, and hypothesis testing. In the field of finance, Researchers such as Preis et al. (2013) or Kristoufek (2013) utilize the data of Google Trends for optimal investment strategies. Preis et al. (2013, p. 1) have analyzed the behavior of market participants, and their results indicate that "Google Trends data did not only reflect the current state of the stock markets but may have also been able to anticipate certain future trends." It must be stated here that this assumption will be investigated in the empirical part of the analysis. Kristoufek (2013) used Google Trends for portfolio strategies and risk diversification. Another example is Shimshoni (2013, p. 25) who claims that web search trends are a decent foundation for business intelligence, especially for practical applications such as competitive analysis, econometric modelling, detection of market changes, prediction of demand and nowcasting and macroeconomic monitoring, to name a few. The integration of this data into the analysis of trends was the foundation for the empirical research of this thesis. The motivation was to develop a conceptual trend model that incorporates the complete perspective from trend to impact. The goal was to develop a model that grants a holistic view of the use of trends that was founded on economic and web search data.

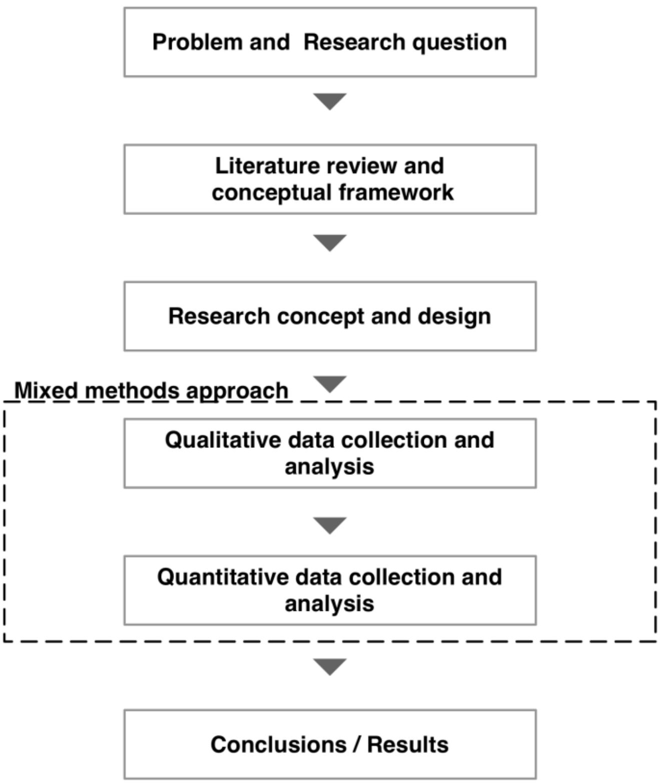
1.2 RESEARCH METHODOLOGY

The first part of the research was founded on an explanatory approach that established the foundation for the development of the quantitative analysis later in the analysis. The explanatory part was founded on a pilot study that researched the impact of global economic trends in the context of regional development and strategic management theory, published as "Global Economic Trends and Regional Development" (Bezjak, 2015). The outcome of the pilot study was translated into a model that was used to conduct empirical research to deliver quantitative results based on the analysis of Google Trends. Data that was used in the analysis is available upon request from the author.[1] In addition, the source code in this thesis was developed under the general public licensing (GPL) model.

[1] Also refer to http://www.globaleconomictrends.com

To operationalize the model, two indices were created in the context of trends: the confidence ranking index (CRI) and the regional information index (RI), built on annual mean values of google trend data. Both were ratio scaled variables used (a) to emphasize behavioral aspects for how confident corporations are that a trend has a direct or an indirect impact on the business operations of the company, and (b) to represent societal web search activity within a certain region or city. The chosen approach of the empirical study w called mixed-method research. Creswell and Plano Clark (2011, p. 5) point out that the mixed-method approach "focuses on collecting, analyzing, and mixing both quantitative and qualitative data in a single study or series of studies." This study integrates qualitative and quantitative approaches to research on global economic trends (GETs). This approach is called exploratory design (Creswell and Plano Clark, 2011) and was the foundation for the empirical research, as depicted in Figure 1.

Figure 1: Research process
(Based on Creswell and Plano Clark (2011, p. 69))



The exploratory sequential design comprised two phases: qualitative data collection and analysis followed by quantitative data collection and analysis. The mix of qualitative data and quantitative data provided a holistic understanding of the research problem (Creswell and Plano Clark, 2011). Annual reports in the period from 2004 until 2014 were collected and analyzed based on the technique of qualitative content analysis.

The population of reports (n=330) was prepared to be analyzed from a cross-sectional and a longitudinal perspective. Qualitative content analysis (QCA) is a data driven and iterative process that involves the interpretation of symbolic material and the assignment of units of meaning based on categories specified in a coding frame (Flick, 2014, p. 173). In this context, the following steps of analysis were conducted:

1. Trend passages utilized in annual reports were extracted, identified, and analyzed according to their use in industries and according to their occurrence in regions and cities.

2. An existing categorization system called STEEPV, which stands for "social, technological, economic, environmental, political, and value" was applied deductively to the data. The STEEPV systems segregated the trend passages into different categories.

3. An inductive categorization system was developed and applied to the trend passages, which were then compared in terms of effectiveness and efficiency to the STEEPV system.

4. The emphasis of the individual trend passages was assessed. The criteria were whether a GET is mentioned directly or indirectly, and if the passage represents a risk or an opportunity.

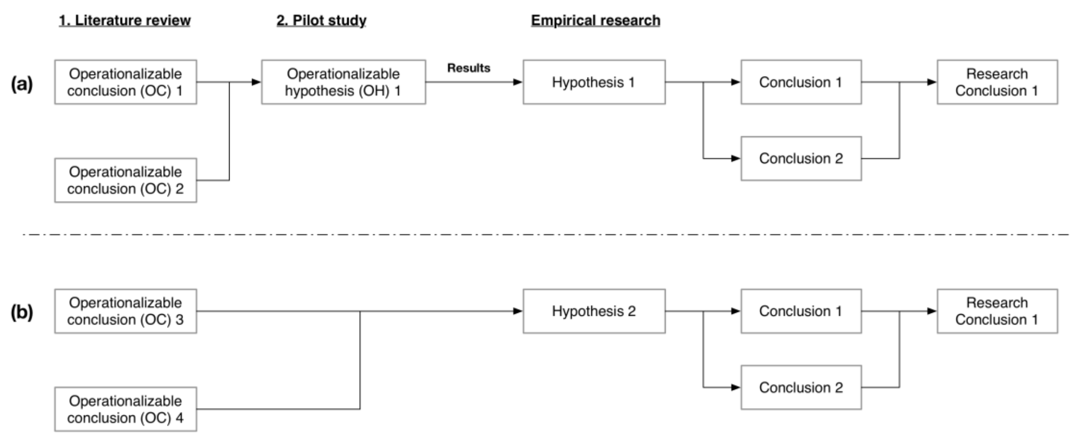
5. Based upon the assessment in step (4), a CRI was prepared to build the foundation for the quantitative analysis. Furthermore, the obtained trends were prepared for the analysis with Google Trends.

The qualitative analysis was designed to deliver the data foundation for the quantitative analysis, which can be interpreted as a panel data model. In this phase, economic indicators from data sources like the World Bank, the Federal Statistical Office in Germany, and Google Trends were added to the analysis. In detail, the analysis focused on the influence of financial KPIs and web search data obtained from Google Trends, on the utilization of trends codified in the indicator CRI. Frees (2004, p. 4) states that panel data models are often described as cross-sectional time series, or longitudinal data. From the point of correlation and causation, LTA (longitudinal analysis) can have further benefit in contrast to cross-sectional design. Kumar (2011, p. 110) points out that LTA allows a researcher to measure “pattern of change, and obtain factual information, requiring collection on a regular or continuing basis." Furthermore, this setup enables the interpretation of the quantitative data from two perspectives. The analysis of the acquired data from the longitudinal analysis or panel perspective motivates a change of the statistical model towards generalized estimating equations (GEEs) (Chiou and Muller, 2005). The research used the GEE model that was introduced by Liang and Zeger (Feddag et al., 2003; Zorn, 2001; Ballinger, 2004; Fitzmaurice, 2009). Fitzmaurice (2009) provides an overview of the historical of longitudinal data models and points out that (maximum) likelihood-based approaches have been abandoned altogether in favor of semi-parametric methods (e.g. GEE approaches).

Important to the quantitative analysis were how the financial performance of corporations and how web search activity influence the confidence of corporations in GETs implemented in annual reports. In addition, the analysis demonstrated the regional level of interest codified in web searches. The latter was realized with the indicator regional index (RI). This indicator was used to visualize geographical information about trends used in annual reports by German stock index (DAX) corporations. The indicator RI was used to create geographic maps with source code realized in the statistical software package R. This step builds on the concepts of foresight information systems and geographical information systems (GISs), and it provides a standardized interface in the form of a database and in the form of geographic visualization. The source code is printed in the appendix of this thesis.

To keep track of the argumentation process, a system for cross-referencing the different phases in research such as literature review, pilot study, and empirical research was implemented. This system is depicted in Figure 2, and contains two lanes that are explained in the following.

Figure 2: Argumentation process and cross-referencing



At the core of the argumentation are the hypotheses of the empirical research, which can have two origins. First, literature review produced premises, which are referred to as operationalizable conclusions (OC). These are the foundation for the operationalizable hypotheses (OH) for the pilot study, which were then modified and transformed into hypotheses for the empirical research. This process is depicted as (a) in Figure 2. Second, some hypotheses were directly derived from the literature review and implemented into the empirical research. This process is depicted as (b) in Figure 2. The developed hypotheses were researched in the empirical research, and let to one or many conclusions. Each of the individual conclusions was later summarized into a research conclusion (RC) that addresses the initial hypothesis. This approach was conducted to provide transparency in the chain of argumentation from literature review to empirical analysis. In addition, the approach allowed drawing conclusions to specific parts of the literature.

1.3 SUMMARY OF RESULTS

Different results arose from the conducted research. The qualitative analysis of trend passages (TP) included in the annual reports of corporations from 2004 to 2014 revealed that:

- In total, 5,920 passages that contained the term "trends" were identified in the population (n=330) of annual reports. Integrated automatically via the software package were 4,770 passages, and 1,150 were implemented by manual inquiry. Included in the empirical research were 2,012 trend passages, of which 392 trends were categorized as direct trend passages, and 1,620 were classified as indirect TPs.

- Global economic trends (GETs) were used sparsely in the early years of the longitudinal analysis. The term "megatrends" was first introduced in 2005 by Siemens AG, and gained popularity over the years. However, only few DAX (German Stock Index) listed corporations used this term in their annual reports, even though the described effects of megatrends are included indirectly in a large sum of the researched reports. Industries like the chemical, engineering, and the automobile industries are predominantly addressing GETs in their investor relations. These industries are energy-intensive industries. Directly mentioned TPs are more likely to be depicted as a (business) opportunity, rather than a risk in annual reports.

- The STEEPV (Social, technological, economic, environmental, political, and values) categorization system is capable of categorizing trend passages from an ex-post perspective. The final distribution of categories has a strong qualitative appeal, and depends much on the expert who applies the system to the data. The STEEPV categorization system shows low emphasis on "Political" and "Value" trends. In most cases, the STEEPV category "Economic" matches the TP best. However, the use of the category "Economic" is too intense in comparison to the other categories. 70% of all direct TPs were identified as economic, and 75% of all indirect TPs were identified as economic.

- The inductive category system (ICS) for trends used in annual reports is providing better options for the classification of trends reported in annual reports, and outperformed the comparable systematic of the STEEPV categorization system. Notably, the developed categories of "business" and "human resource" trends provide good options for the classification of trend passages. With this categorization, the overall use of the category "economic" was reduced to 45% for direct and indirect TPs. Furthermore, this systematic is applicable for research of annual reports provided by international stock market listed corporations.

The quantitative research comprises three parts, which are the (1) regional analysis of web searches, (2) the development of a linear regression model and a general estimated equation model based and (3) the optimization of the models developed by implementing data from Google Trends. In detail, part 1 focused on the geographical correlation between Google Trends data and macroeconomic indicators like gross domestic product (GDP) and GDPpc. This approach founded on the results of the pilot study. The results could be summarized as follows:

- The visualization module developed with R provides visual and geographical maps of web trend searches. The module visualizes that trends used in German annual reports are also searched for outside of Germany. The developed source code can be implemented into other software solutions like foresight support systems (FSSs) or geographical information systems (GISs), and can be used for the geographical analysis of web searches.

- An indicator called regional indicator (RI) was developed that aggregates the absolute values of regional information of web searches. Two individual indicators for regions and cities were created based on two datasets. The first one contained web searches with global information, and the other dataset only contains web search information from Germany. This quantitative indicator was used for correlation analysis of web searches.

- Local Google Trends indices on the city level and on the regional level based on global data are not able to explain the development of GDP. This seems to be a rather spurious correlation. This was shown by utilizing the population rate as an explanatory variable for GDP, and by comparing these results to the results gained from the previous analysis. Calculated regression models for GDPpc that eliminated the effect of population lacked quality. Only the model based local data (Germany) for regions was able to deliver explanatory results. However, the developed regression model is of low quality and does not qualify for practical purpose.

- The global RI indicator was not able to explain the development of GDPpc on the level of regions and cities. The regression models that were developed for the local RI (for regions) indicator and GDP indicated an overall R^2 of .248 (adjusted R^2 of .195), which means that 24.8% of the variance could be explained by the model. The analysis with local RI for cities showed different results. The regression model showed an even lower quality with R^2 of .104.

- Google Trends data are not provided globally. Data from countries like China and Russia should be handled carefully because the use of Google is restricted in these countries. Future research should consider this, by restricting regional analysis to countries were the use of Google is not restricted.

In the second part of the empirical analysis, a linear regression model for the confidence ranking index based on the financial KPIs net income, operating income, shareholders' equity, and total assets was developed. The purpose was to find out if the financial KPIs are able to explain the use of direct TPs in annual reports for the overall population of reports research (n=330). In addition, the same premise was researched from a longitudinal point of view, which treats the individual years separately. The results are as follows:

- From the cross-sectional perspective, the financial KPIs net income, operating profit, or earnings before interest and tax (EBIT), shareholders' equity, and total assets correlate weakly with the indicator CRI. A linear regression model with CRI as the dependent variable, and shareholders' equity and net income was developed and tested (R Square: .103 and adjusted R-Square of .097). Due to the rather low quality of the model, these results were perceived as an intermediate result.

- From the panel or longitudinal analysis (LTA) point of view, a generalized estimated equation model based on the same parameters was developed, analogous to the cross-sectional model. This model included only net income as an explanatory variable. As an outcome, the model delivered better results compared to the linear regression model with only one explanatory variable.

The rather weak correlation of the financial KPI data and the CRI index motivated further steps of inquiry. At this phase, the research integrated Google Trend data into the developed equations to identify whether the web search data provided improvement potential for the developed regression. For this purpose, an automated correlation analysis was developed in R with the intention to identify the Google Trend time series with the highest correlation to the CRI index. This approach resulted in the following findings:

- Nine hundred forty-one trends were found in the annual reports that were the foundation for querying Google Trends data from 2004 to 2014. On the global level, 315 trends were returned, of which 87 trend series had a high significance ($p < 0.01$) to the CRI index. One hundred twenty-two (39%) series correlated significantly with CRI ($p < 0.05$), and 106 (34%) showed no correlation. Thirty-six trends were returned on the local level, whereof six were highly significant (17%), 19 were significant (53%), and 11 (31%) had no significance.

- On the global level, time series based on the keywords ″innovation,″ "corporate responsibility," "internationalization," "oil market trends," and "strategic trends" shows the highest correlation. On the local level, the keywords "social media," "RFID," "information technology," "outsourcing," and "environment" had the highest correlation. The results of these trends (local and global) were included in the developed regression model for comparative analysis. The comparative analysis of the refined model, in comparison to the standard model, shows that Google Trends data as an independent variable is able to improve the earlier developed regression model by 15%.

- Based on the GEE model developed in the previous analysis, Google Trends was tested for its ability able to improve the overall results of the model. For this purpose, two individual indices were created. Furthermore, each index has local and global characteristics. With an R^2 of .426 and an adjusted R^2 of .379, the new configuration looks promising in comparison to the model developed in section 4.2.1.3. The newly introduced global Google Trends index also demonstrated better explanatory capacity in comparison to the initial model (Partial Eta Squared of .234). On the contrary, the local Google Trends index performance was worse in comparison to the global index. This index was not even significant within the model.

- The GEE model for panel analysis utilized different so-called working correlation structures to model the interdependencies of the individual groups, which comprised all annual reports for a dedicated year. A comparison of the different working correlation structures based on the Akaike's information criterion showed that one-period autoregressive correlation or AR(1) had the best model fit.

2 LITERATURE REVIEW

2.1 COMPARATIVE ANALYSIS ON GETS

2.1.1 Arbitrariness and interchangeability of the concept of trends

2.1.1.1 Definition and differentiation of GETs

A considerable amount of published literature uses terms like "global economic trends (GETs)," "global megatrends," or in short "global trends," to describe global change processes or long-lasting developments in market economies (Economy Watch, 2010; Bezjak, 2010; Dicken, 2007; Zahariadis, 2008; Burmeister et al., 2005; Pillkahn, 2008; Naisbitt, 1982; Müller and Müller-Stewens, 2009). However, the literature lacks a distinct definition of the term "GETs." In a search of a definition, internet sources reveal that "[…] global economic trends mean the way most of the world economy is behaving in a recent period of time within a set of well-defined parameters" (Economy Watch, 2010). According to Bezjak (2010), "an economic trend can be defined as the direction how the economy will change. Therefore, a global economic trend, further called GET, is the dynamic force that is changing the global economy" (Bezjak, 2010, p. 5). Recent books on economic studies foster a sustainable and robust model of development emphasizing the complex structure and behavior of globalized markets (Capello and Tomaz, 2012; Arpe et al., 2012; Jiatao Li, 2011). Haijkowicz (2010) claims that the predictability of market development seems to lack quality as markets have changed. The author claims that GETs require that all sectors of an economy increase efficiency to cope with the implication of these GETs (Haijkowicz, 2010). The term "GET" itself is a composition of the words "global", "economic," and trend" and approaches in this form or in the form of "economic trend" or "global trend" in the context of economic theory. Studies consider the term "global trends" to seek for driving forces behind market transformations, or to develop business models that are resilient to the anticipated changes, such as "demographic change in industrialized economies, and the urbanization movement in developing nations" (Müller-Stewens and Brauer, 2009, p. 464).

Other research examines the drivers of global growth based on the analysis of trends "to meet the challenges of the globalized world" (Jiatao Li, 2011, p. 277). In this context, terms like "global shifts," "global forces, "globalization trends," or "megatrends" represent a vehicle that materializes the changes in the global economy (Dicken, 2007; Zahariadis, 2008; Burmeister et al., 2005). No mutually agreed definition of these types of changes is available. This study uses the term GET as a platform to investigate trends and to propose to use this terminology in future research. Harrison (1994) outlines that GETs are changes in the global economy that can be perceived as globalization of economic relations and transactions, technological change, shifts in the organization of production, change in the role and organization of labor, and change in the nature of competition. These changes lead to new knowledge and often-new paradigms in scientific theory. Singh utilizes this term to analyze development issues and economic prospects for developing countries (Singh, 2000). He addresses problems of developing countries like unemployment, and income inequality and its negative impact to economic growth. Economic growth is measured in gross domestic product (GDP) derived from on statistical data gained from World Bank Report (1965-1996). Clark (1996, p. 448) draws the argument that GETs are technological advances in communications and transportation that reduce the effective economic distances between countries. So why are GETs crucial for understanding markets and their trajectory? Outside of academic sources, reports created by governmental agencies, multinational corporations, or consulting companies deploy these terms to refer to shifts in demand and supply, and the results for economic growth (National Intelligence Council, 2008; Bisson et al., 2010). Capello and Tomaz (2012) point out that foreign direct investments (FDIs) have grown twice as much as international trade, which results in an increase in the mobility and the volatility of capital:

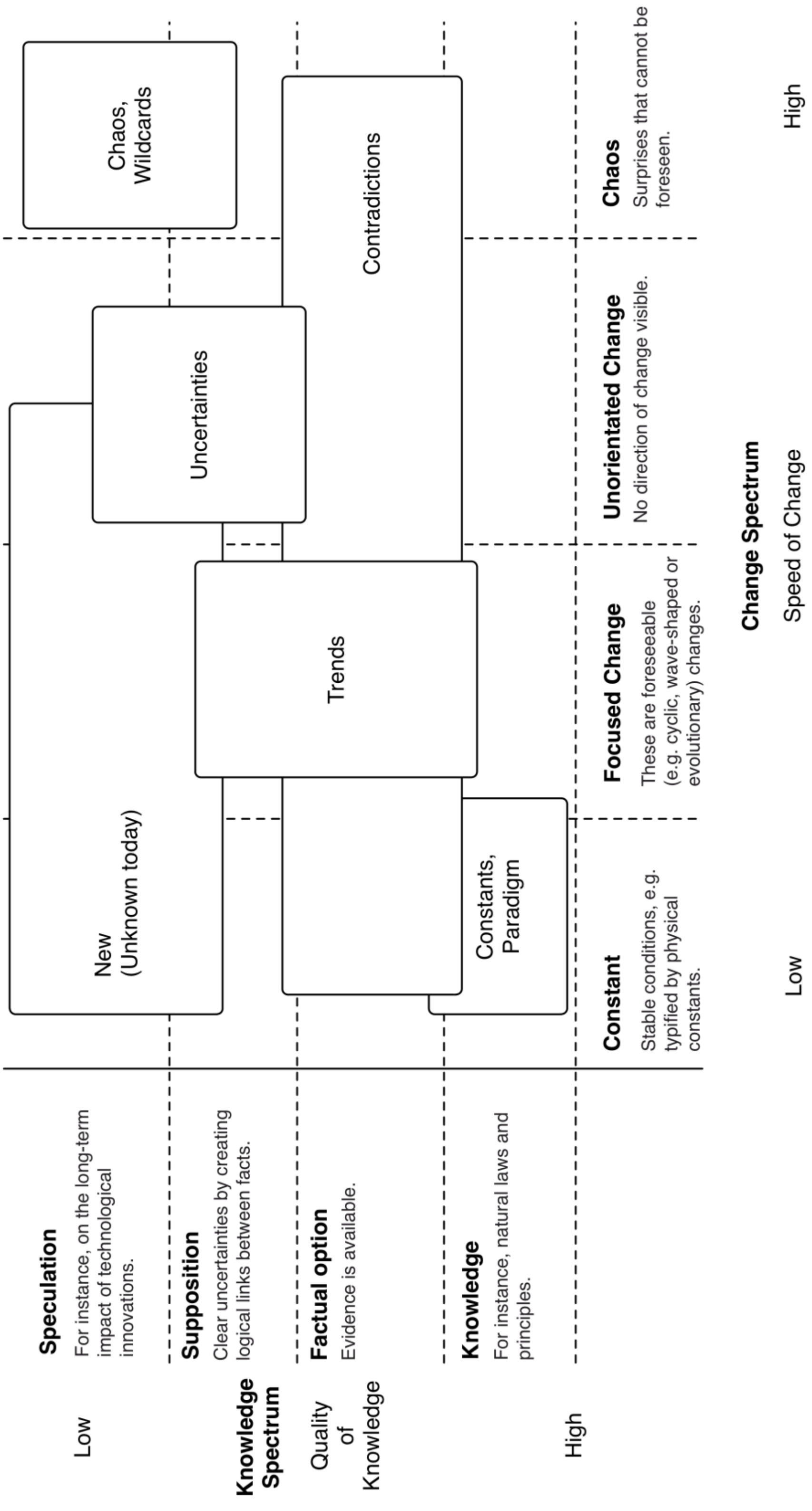
> International trade has been steadily growing for almost thirty years at a rate which is twice that of world GDP. Foreign direct investments, in turn have grown at a rate that is twice that of international trade, and four times that of world GDP. Most of these investments are directed towards developed countries and seem to be particularly attracted by situations of acceleration in economic integration processes[…] (Capello and Tomaz, 2012, p. 2).

Consequently, this increase has a qualitative and a quantitative influence on the economic trajectory, which may result in a modification of markets, or in an extreme case, to an economic crisis. El-Erian claims that the outcome of underlying global transformations plays a major role in the investment and policy landscape that involves actors, instruments, products, and institutions (El-Erian, 2008, p. 5). Several researchers point out that the term “trend” itself has many faces in literature, but lacks a clear and distinct definition (Franses, 2005; Millard, 2010; Chandler and Concannon, 2011; Pillkahn, 2008). Pillkahn claims that it may represent changes in “the moral and behavioral fabric of society” (Pillkahn, 2008, p. 123), in the field of economics and socials science, or “changes and developments in consumer and user behavior” (Pillkahn) in the area of marketing. Genov (2012) describes trends as “orientations, actions, and structural effects in all areas and at all levels of social interaction” (Genov, 2012, p. 4). The author applies this definition to describe economic development based on quantitative data on FDI and gross domestic product. Researchers like Holzinger (2011) or O'Hara (1999) imply that trends are changes over a longer period of time that have a repeating or cyclic character. Holzinger (2011) views trends as “cultural, societal and technological changes over longer periods of time (years)” (Holzinger, 2011, p. 55). O'Hara (1999, p. 178) views trends as cycles that “repeat themselves in some way.” He further emphasizes that trends influence the trajectory of international trade, which is measurable in terms of cross-border flows of finances, products, and services (O'Hara, 1999, p. 261). Capello and Dentinho (2012) agree to this perspective and refer to GETs as development in globalization and internationalization, and its influence to local businesses. Pillkahn and El-Erian consider trends as changes or transformations in business processes and value-creation chains. Pillkahn (2008) depicts GETs as a matter of “new business models or changed perspectives with regard to enterprise processes or goals” (Pillkahn, 2008, p. 125). El-Erian (2008, p. 1) draws the conclusion that trends are an invisible force changing social, political, financial, environmental, and technological configurations, and that they “feed a dynamic that is inevitably uneven and, at times, unpredictable”. Trends have quantitative and qualitative characteristics. From the quantitative perspective Chandler and Concannon (2011) suggest that trends are changes of a condition or that they are "long-term temporal variations in statistical configurations, depending on the application" (Chandler and Concannon, 2011, p. 10). This perspective refers to the mathematical forecasting of further data points based upon past data. The qualitative view of trends is more complex and comes with a major drawback, as there are several studies in place that are not founded on profound scientific methodologies. As Buchen (2002) explains, futurologists are especially interested in the topic to deliver assumptions and scenarios based upon trend analysis:

> Every major forecasting effort of the last 25 years has always exhibited an intellectual core –a global concept of transformation to the traditional history of ideas. Indeed, it is the task of futurist, acknowledged or not, to preside at historical branch points, and to identify the future implications, directions and choices provided by and compelled by the emergence of powerful megatrends (Buchen, 2002, p. 36).

The social and economic perspective on trends is not founded on distinct data series, which leads to the fact that assumptions based on future development come with a high degree of uncertainty. Knowledge about trends is rather of medium quality, as no scientific proof for the development of a trend is available. Aoki (2007) describes the qualitative aspects of trends by describing trends as changes in the economic conditions of markets, the variation in behavior, and the change of parametrical configuration or markets, also labeled institutional changes or paradigm shifts (Aoki, 2007). The term “factual option” fits well to describe this circumstance. Trend changes are rather foreseeable, leading to the speed of change being low to moderate. Change tends toward a certain direction, rather than being non-orientated. Figure 3 shows a typical matrix that is used to categorize future elements (Pillkahn, 2008). The matrix provides the dimensions “knowledge spectrum” and “change spectrum” and illustrates the differences and commonalities between trends and paradigms, or other terms used in context of future studies. The future elements in the Knowledge and Change spectrum of foresight studies are the elements “uncertainties,” “contradictions,” and “wildcards,” which represent the chaotic and orientated type of change.

Figure 3: Elements in the knowledge and change spectrum
(Own Creation, based on Pillkahn, 2008, p. 119)



Futurologists apply the term wildcard to disruptive types of change that alter existing concepts and trends radically (Steinmüller and Steinmüller, 2004, p. 14). Taleb (2008, p. 22) coined the term Black Swan, which refers to an event that is outside of regular expectations, carries an extreme impact, and "makes us concoct explanations for its occurrence after the fact, making it explainable and predictable". Based on the analysis above, unknown knowledge illustrated as speculation or supposition will become disruptive, if this knowledge is utilized and materialized in innovation. Other events, such as stock market crashes, terrorist attacks, or natural disasters are also of great impact and fall in the same category.

Researchers agree that knowledge about change related to trends is highly stabile, which leads to high predictability of the character of change (Müller and Müller-Stewens, 2009, p. 242). Paradigms represent stable knowledge, which have a low speed of change. Kuhn (1962, p. 23) point out that in scientific research, a paradigm is "an accepted model or pattern" that serves as a foundation for articulation rather than it is recipe for repetitive usage like grammar rules. Other sources, such as O'Hara and Aoki, refer to a paradigm as a set of rational behavior, tacit or explicit knowledge, which influences people's decision-making processes for existing problems (O'Hara, 1999, p. 261; Aoki, 2007). Mackenzie and House observe that research about paradigms is founded on "integrating data into a common theoretical framework, inducing general laws to explain the data, deducing hypotheses from the general laws, and subjecting these hypotheses to empirical test" (Mackenzie and House, 1978, p. 8). Changes in paradigms or paradigm shifts are also referred to as "secular transformations". El-Erian (2008, p. 8) describes these transformations as "fundamental, sustainable, and long-term". In the context of trends, Pillkahn (2008, p. 122) argues that a paradigm change "amounts to a radical change in a personal belief, in complex systems or in organizations". Skyrme (2000) argues that the impact of a paradigm shift effects not only businesses, but also society as a whole. The borders between paradigms and trends overlap. Processes of change in the field of technology can lead to a paradigm shift when new technological innovations replace existing ones.

According to Baldwin and von Hippel (2009), innovation processes in advanced market economies change from so-called single-user innovation to open innovation models, which also represent a new paradigm in innovation. Several authors agree on the mutual relationship between trends and paradigm shifts (Naisbitt, 1982; Done, 2012; Bezjak, 2010). Naisbitt (1982) defines megatrends as paradigm shifts in political, social, financial, environmental, technical, or macro-economic conditions with long-lasting impacts that “last between seven and ten years, or longer.” In contrast to Naisbitt authors like Done (2012) use the term ″global trends″ instead of “megatrends” in the same context. The author assumes that paradigm changes are driven by “global trends” (Done, 2012, p. 257).

This is a textbook example for conflict of terminology in the literature. Various authors use the terms “global trends” and “global megatrends” to describe fundamental trends in society. To conclude with the example of global trends that was utilized by Done , trends “have emerged as being considerable hurdles to be overcome in the continuing survival and progress of humans as a species […]”(Done, 2012, p. 8). This study plays with the versatility and interchangeability of the terms ″global “economic ″trends″ and ″megatrends″ to reveal fields where a more distinct definition of trends with a focus on economics makes sense, such as topics like economic crisis, geopolitical power shifts, technological changes, climate change, or the scarcity of resources. This variation in terminology seems promising for deeper literature review. As the literature does not provide clear terminology for trends, the question arises whether the context of trends in literature or the application determines the real meaning of “trend.” Consequently, the commonalities and differences between the terms deserve more attention.

Operationalizable Conclusion 1: The literature does not distinguish between the terms ″global economic trends″ and ″megatrends.″ The terms have similar meanings in the context of globalization, changes in technology and innovation, and they both reflect a current (subjective) state of mind.

2.1.1.2 Terminologies in the context of trends

Recent literature lacks clear distinction between the different terms that relate to trends and uses these type of terms arbitrarily. For example Singh et al. (2009, p. 14) define Megatrends as “overarching global forces that stem from the past, are shaped in present and will transform the future”. Singh et al. (2009) explain that megatrends could be labelled as “globalization”, “rise of networks”, and “open innovation”, and employ partially the definition of “Global Megatrends” for additional emphasis. In the literature, Globalization is portrayed as “Global Megatrend”, “Metatrend”, and “Global Economic Trend” depending on the author (cf. e.g.Buchen, 2002; Singh et al., 2009; Bezjak, 2010; Genov, 2012). In general, literature reveals that globalization or globalization trends describe fundamental shifts in demand and supply (cf. e.g. Dicken, 2007). As defined by the National Intelligence Council (2008, p. 7) globalization is “a meta-trend transforming historic patterns of economic flows and underlying stocks, creating pressures for rebalancing that are painful for both rich and poor countries”. This gives the impression that terminologies for globalization like “Megatrend”, “Global Megatrend”, or “Global Economic Trend” and the term globalization itself are vehicles to transport subjective assumptions and to communicate individual interests, as explained by Dicken (2004, p. 5):

> 'Globalization’ has evolved into a catch-all term, used by many to bundle together virtually all the ‘goods’ and ‘bads’ of contemporary society. Such sloppy usage has rendered the term almost meaningless. But if we are stuck with it – as I am sure we are – then we need to be far more precise in how we use it (Dicken, 2004, p. 5).

This perspective is partially shared by Groddeck and Schwarz (2013) who illustrate that trends and megatrends can be perceived as empty signifiers, that have an information content that is rather useless for effective business planning. Groddeck and Schwarz (2013, p. 33) define megatrends as follows: “Megatrends are only abstract semantics that hold together heterogeneous and complex identities and therefore not suitable for in-depth trend research.” This supports the argument of Dicken and leads to the question if a clear segregation between the terminologies is possible. Table 1 shows a comparative overview of terminologies found in the literature research on trends.

Table 1: Different terminologies in the context of trend research

(Based upon Pillkahn, 2008, p. 125; O'Hara, 1999, p. 261; Bezjak, 2010, p. 5; Kreibich et al., 2011, p. 11; Singh et al., 2009, p. 14; Saritas and Smith, 2011)

Terminology	Explanation	Example
Signal or weak signal	Weak signals are the first important indications of a change. Often referred to as noise or raw information (Kreibich et al., 2011, p. 11)	Growing importance of globalization apparent in the early eighties (Kreibich et al., 2011, p. 11)
Discontinuities	Discontinuities refer to rapid and significant shifts - impacts where over time and extending beyond single events, change is rapid and fundamentally alters the previous pathways or expected direction of policies, events and planning regimes (Saritas and Smith, 2011, p. 295)	Internet (Saritas and Smith, 2011, p. 295)
Wild cards and shocks	Surprise events and situations, which can happen but usually have a low probability of doing so, although if they do happen their impact is very high (Kreibich et al., 2011, p. 11)	Crash of global financial markets (Kreibich et al., 2011, p. 11)
Trend	Change that can be observed and that permits one to suppose its continuation over time (Pillkahn, 2008, p. 125)	Fewer children among the college-educated (Pillkahn, 2008, p. 125)
Emerging trend	Emerging trend whose further course is difficult to foresee (Pillkahn, 2008, p. 125)	Men accept more responsibility in matters of family planning (Pillkahn, 2008, p. 125)
Microtrend	Small changes seen in specific regions, or hardly noticeable changes (Pillkahn, 2008, p. 125)	Increase in the number of one-child families leads to behavioral changes at a societal level (Pillkahn, 2008, p. 125)
Megatrend	Large, profound and sustained changes (Pillkahn, 2008, p. 125)	Aging populations (Pillkahn, 2008, p. 125).
Metatrend	Compilation of trends and/or megatrends (Pillkahn, 2008, p. 125)	E.g. Demographic change, globalization (Pillkahn, 2008, p. 125)

Terminology	Explanation	Example
Pseudotrend	A phenomenon is described as a trend although it is not a trend (Pillkahn, 2008, p. 125)	Companies increases their commitment to families (where as a matter of fact, we face a lack of daycare options in many countries) (Pillkahn, 2008, p. 125)
Trend breach	A development that has been characterized as a trend is suddenly interrupted(Pillkahn, 2008, p. 125)	Slump in the birth rate caused by the pill (Pillkahn, 2008, p. 125)
Key trend	Trends that are judged to be especially important (Pillkahn, 2008, p. 125)	Marketing focus shifts to more mature consumers (Pillkahn, 2008, p. 125)
Paradigm	A paradigm is a worldview of belief system; an ideological framework (O'Hara, 1999, p. 261)	Scientific law, such as Newton's law (O'Hara, 1999, p. 261)
Global economic trend	Dynamic force that is changing the global economy (Bezjak, 2010, p. 5)	Collapsing birthrate in the developed world, shift of power from developed economies to emerging economies, technology and innovation, and globalization (Bezjak, 2010, p. 5)
Global mega-trend	Overarching global forces that stem from the past, are shaped in the present and will transform the future (Singh et al., 2009, p. 14)	Globalization(Singh et al., 2009, p. 14)
Countertrend/ Antitrend	Exact opposite of a trend, and mostly generated by a trend (Pillkahn, 2008, p. 129)	Regionalization vs. Globalization (Pillkahn, 2008, p. 129)

Based on the preceding analysis, it should be evident that there are significant similarities between the different explanations of the term "trend." In order to separate this analysis clearly into practices in the field of futurology, it is important to discuss the most prominent terminology in the literature, which is the term "megatrend.", which was originally introduced by Naisbitt (1982). According to the Googlescholar-Citing Index, Naisbitt's (1982) work *Megatrends* has been cited more than 4754 times (Data Collected on 2013-04-13). Naisbitt (1982) presents megatrends as (a) the transformation from an industrial society to an information society, (b) from centralization to decentralization, (c) from a representative to a participative democracy, (d) from north to south, (e) from short to long-term, (f) from either/or to multiple options, (g) from an institutional organization to self-organization. Strong supporters of this approach are researchers like Aburdene and Horx. Horx (2011) states that the trends, as defined by Naisbitt, are not trends such as marketing trends, but are more properly considered paradigm changes within social systems. The borders between trends and paradigm shifts overlap. There is strong consensus in the field of futurology and trend research about the trends and examples that Naisbitt has delivered, as they are stringent and provide enough foundation for hypothetical assumptions (Horx, 2011; Steinmüller and Steinmüller, 2006, p. 12).

Perhaps one of the most serious disadvantages is that only futurologists strongly believe that trends alone provide enough scientific foundation. Rust (2008, p. 85) concludes that Naisbitt uses trivial argumentation that does not satisfy scientific criteria. Another example of the influence of Naisbitt's work is Aburdene (2005) who defines a megatrends as a "large, over-arching direction that shapes our lives for a decade or more" (Aburdene, 2005). Hiltunen claims that the strong influence comes from the mutual co-authoring relationship between Naisbitt and Aburdene (Hiltunen, 2013, p. 43). In contrast to the examples from the field of futurology, strategic management literature and practical work from industries provide more practical and fruitful definitions for "megatrends (Bisson et al., 2010; Singh, 2012; Steinmüller and Steinmüller, 2004; Steria Mummert, 2012; Horx, 2011; Müller-Stewens and Brauer, 2009). Singh (2012, p. 4) defines megatrends as "global, sustained and macroeconomic driving forces that impact business, economy, society, cultures and personal lives, thereby defining our future world and its increasing pace of change." For Singh (2012, p. 4), megatrends are (1) global, (2) sustained macroeconomic forces of development, and (3) transformational. Within a survey that has been published in *McKinsey Quarterly*, a magazine by the consulting company McKinsey, it was reported that more than 1,400 executives view trends, labelled as global forces, as either important to business, as having a positive effect on profits, or as being addressed by their company (Bisson et al., 2010, pp. 2–3). The following forces, in particular, have received strong attention: (1) The great rebalancing, (2) the productivity imperative, (3) the global grid, (4) pricing the planet, and (5) the market state (Bisson et al., 2010, pp. 2–3).

The assumptions and visions imposed upon the term "megatrend" are not only of economic nature. It is especially Drucker (2007, p. 37) who has stated, "above all, they are not, essentially, economic. They are primarily social and political". Although Drucker has not used the term "megatrends," he has exactly pinpointed the complexity and the social and political aspects involved in the discussion of trends. In the context of business, there has been an unambiguous relationship between "corporate strategy" and "megatrends."

In the beginning of the year 2000, the term gained strong popularity among corporations, which has since become even stronger. In 2006, Larsen described that companies already include megatrends in to their strategic planning process (Larsen, 2006, p. 8). For example, Müller-Stewens and Brauer (2009, p. 535) explain that Germany's top multinational enterprises (MNEs), for example, Siemens, founded corporate business models on megatrends like demographic change in industrialized economies, or the urbanization movement in developing nations. Interesting in this context is the regional emphasis drawn by terms like "industrialized economies" and "developing nations." This emphasis indicates that trends have a regional or geographical component. Foresighting companies like Z Punkt (2012), who are at the forefront of state-of-the-art trend research approaches, point out that the regional aspect is crucial to understanding the real impact of trends, because trends vary according to their region in question (Z Punkt, 2012).

Operationalizable Conclusion 2: Phenomenon like "global economic trends" and "megatrend" work over an extended period (10 years and longer) and have a strong impact on the society. They refer to institutional changes of markets and affect all entities within local communities, clusters, and vice versa. The transformation is ongoing, fundamental, sustainable, and long-term. Since 2000, the term has gained popularity among corporations that lead to the implementation of trends in corporate strategy.

2.1.1.3 Categorization of environmental trends

Strategic management has standardized methodologies for environmental assessment and horizon scanning. Among the most prominent example are the concepts called PEST(LE) and STEEPV. PEST(LE) stands for "political, economic, social, technological, and legal" and STEEPV stands for "social, technological, economic, environmental, political, values". PEST(LE) facilitates scanning the existing environment to identify potential impacts to the corporation at the time of observation (Murray-Webster, 2010, p. 88). Murray-Webster (2010) explain that other variations of PEST analysis emerged besides PEST and PESTLE:

> Originally referred to as PEST analysis, the legal and environment prompts were added in more recent times. Some favour adding other factors, e.g. industry analysis, changing the acronym to PESTELO, or ethics and scientific, changing the acronym to PESTLEES. Yet other variants exist. In order for such an analysis to be effective, the subject must be clearly defined before the participants commence the analysis, to ensure that they fully understand the goals (Murray-Webster, 2010, p. 88).

In the context of trend research and foresight, STEEPV is a comparable approach to the PEST methodology (Pillkahn, 2008, p. 419). Meissner et al. (2013, p. 47) describe the technique as "structured brainstorming that focuses on initial assessment of key issues." The methodology aims to provide a structural approach to identify possible future impacts on a corporation from environmental trends. STEEPV examples are illustrated in Table 2.

Table 2: STEEPV examples

Category	Examples
Social	Quality of living, population
Technological	Innovation, process optimizations
Economic	Macroeconomic trends, development in the global financial market
Environmental	Natural catastrophes, climate and weather, population
Political	Political stability, geographical distributions of resources
Values	Cultural topics, institutional developments, governance

In the context of foresight, STEEPV can be applied to develop scenarios. Trends are critical elements in horizon scanning, such as wild cards/shocks, weak signals and discontinuities (Saritas and Nugroho, 2012, p. 510). The effectiveness of STEEPV is pointed out by Marx (2006, p. 89): "Perhaps no other approach to environmental scanning so directly connects the present with potential futures as far analysis." The STEEPV approach is also valuable in the analysis of GETs, as it provides the potential to assess opportunities and threats that stem from trends.

Saritas and Nugroho (2012, p. 526) support the idea of utilizing STEEPV to categorize the external context of an environment, and they use this concept to further assess the subjective environmental perception of foresight practitioners at a future-oriented technology analysis conference. They utilized the STEEPV systematic to implement a model called systematic foresight methodology. The model connects the external environment to the internal processes of a company, which "includes political, structural and behavioral elements within organizations where Foresight activities take place." (Saritas and Nugroho, 2012, p. 511)

Operationalizable Conclusion 3: The STEEPV approach provides the capability to categorize trends along the dimensions social, technological, economic, environmental, political, and value dimensions from an ex-post perspective.

This view is partially supported by Wippel (2014, p. 152), who points out that environmental trends lead to risks and opportunities in the sense of governmental and market regulations and business opportunities. From the marketing point of view, the author points out that an environmental trend has a pull or a push effect on the corporation. That effect means that corporations and regions face a risk and have the necessity to react or to provide counterstrategies. In contrast, corporations and regions can also benefit from a certain trend. Therefore, trends have a push or a pull effect on the corporation, which then determines the possible scope of action. Another implication that arises out of this discussion is that the STEEPV analysis could be upgraded by the dimensions of push or pull to determine whether a trend has a push or a pull effect for a certain corporation.

Operationalizable Conclusion 4: The environmental impact of a trend can have a push or a pull effect on corporations. Corporations or regions benefit from a trend or need to provide counterstrategies to cope with the impact of a trend.

2.1.1.4 Critical appraisal of trend research

The controversy over whether trend research is more of an ideological than a theoretical practice has been present in discussion of the subject for many years, especially due to the opportunistic character of trend research studies (Morris, 2000, p. 247; Pillkahn, 2008, p. 124; Rust, 2008, p. 85). Pauldans (2006, p. 14) claims that forecasting megatrends may not require any expert knowledge, but exploiting megatrends to create awareness about possible future scenarios for decision-making is the crucial part. In this context, it is important that Pauldans chooses the verb "forecast" in combination with megatrends, clearly referring to time-series analysis. As Liebl and Schwarz (2010, p. 314) point out, "The term is very precisely defined in the context of statistics, particularly in time-series analysis. [...] However, this quantitative approach to the future is not appropriate for strategic issue management based on weak signals." Liebl and Schwarz (2010) argue that the literature lacks a clear perspective on trends in the context of strategic management. Liebl and Schwarz (2010, p. 314) point out that the usage of term "trend" ranges from statistics models employed in marketing, public media, strategic management, and economics to organizations that actively scan the environment for strategic trends. The involvement of public media into research studies is notably rated as very critical (Rohrbeck, 2011; Rust, 2008; Pauldans, 2006; Morris, 2000; Pillkahn, 2008; Liebl and Schwarz, 2010). The intuitive characters of several megatrend examples show that the assumptions created by trend research involve a state of mind or the interest of a certain group, or person. As pointed out by Pillkahn (2008, p. 124), "Trends are constructions that are based on the assumptions held by those announcing them and those hearing them." Larsen (2006, p. 8) states that "future researchers always work with the three types of futures: the predictable, the possible, and the preferred." The preferred future reflects the role of emotions in deciding what type of future might be beneficial in the eye of the beholder. As Barrett (2007, p. 937) points out, "functional and dysfunctional affects of feelings are equally acknowledged and simultaneously managed to maximize their positive effects and minimize their negative effects."

Operationalizable Conclusion 5: Trend research studies provide various terms and rather arbitrary explanations for trends. This inconsistent use of "trends" observed in literature may also occur in business.

Rust (2008, p. 85) provides criticism by concluding that the trends delivered by trend studies and content analysis are trivial and are already defined in scientific foresight studies. He further argues that trend research produces too many findings, which makes it hard to identify profound results. Naisbitt's book "Megatrends" contained trends that seem to be trivial from a current point of research (Rust, 2008, p. 33). Goel et al. (2010) explain that managers and entrepreneurs see trend research as imprecise, non-committal and unreliable, because "they lack of systems, and processes" (Gold et al., 2010, p. 548). Slaughter (1996) provides an even harsher critique:

> There is no single, fully developed theory of social change and the future on which futurists have agreed. One reason is that many futurists work for clients who are mostly interested in practical results, not abstract theories. Thus, the driving force for futurists' work tends not to be the test of theory or the creation of knowledge for its own sake. Rather, it tends to be the search for solutions to recognized problems (Slaughter, 1996, p. 18).

However, the process of scanning and interpreting changes to the environment of a corporation is critical to “organizational performance and viability” (Lenenkov, 1997, p. 287). Lenenkov (1997) perceives the environment of a corporation as a layered model that involves elements where the company has direct and indirect contact with its surroundings (Lenenkov, 1997, p. 287). Competitors, suppliers, customers, and regulatory bodies are elements that are directly connected to a company. Conversely, the elements that indirectly affect the company are of macroeconomic, political, and social nature. The topic of environmental scanning and organizational strategy is important in research, as demonstrated by Hambrick (1982, p. 159). From the viewpoint of Daft and Weick (1984, p. 287), scanning and interpreting these environmental changes is a process of learning. Rohrbeck and Schwarz (2013, p. 1596) conclude based on the work of Daft and Weick (1984) that “organizations perceive their environment (step 1: ‘scanning - data collection’), translate what the find into organizational implications (step 2: ‘interpretation - data giving meaning’), and develop responses based on their insights into their environment (step 3: ‘learning - action taken’).” In their original work Daft and Weick (1984, p. 287) developed a model to illustrate the ways that organizations take to learn about their environment and illustrate the following two forms of organizational interpretation:

> They are: (1) management's belief about the analyzability of the external environment and (2) the extent to which the organization intrudes into the environment to understand it (Daft and Weick, 1984, p. 287).

Godet (2011) shows that due to the constantly changing environment, environmental scanning is crucial for a company, especially the anticipation of “shifts in technological, competitive, and regulatory environments” (Godet, 2011, p. 16). Hence, constantly scanning the environment and translating the signals into business strategy is crucial to success, a central axiom in trend research that is founded on the work of “weak signals” from Ansoff (1975). Modern approaches in trend research still rely on this type of work, as confirmed by various authors (cf. e.g. Schwarz, 2008a; Singh et al., 2009). Singh et al. point out (2009, p. 24), “The winners will be those companies that can not only see these trends in isolation but study them holistically so as to map their interactions and take advantage of the multiple configurations that they will create.”

Literature in the field of global economic trends research, as well as online trend databases and projects such as iKnow (Innovation, Foresight & Horizon Scanning Community)[2] reveal that modern approaches to trend research still refer to the concepts of the weak signals implemented by Ansoff. Weak signals are the early warning signs of an upcoming change.

Such approaches motivate several researchers to take a critical position on the amount of trends and weak signals discovered through the research activities (Rohrbeck, 2014; Groddeck and Schwarz, 2013). Groddeck and Schwarz (2013) point out that megatrends have a low level of information quality in describing the complexity of transformation processes. The authors claims that the true information content of a megatrend is close to zero and is "analogous to the notion of empty signifiers." (Groddeck and Schwarz, 2013, pp. 32–33)

The complexity that stems out of the analysis of GETs is often underrated, and the literature provides only few approaches for how to integrate trend analysis into change management and value-creating processes (Bezjak, 2010). The critique of the information quality of trend research deserves further attention, and the following section provides further analysis to this issue. To conclude the discussion in this context, Rohrbeck (2014) outlines that including GETs into business strategy comes with the downside that competitors may also base their corporate strategy on identical trends. On the other hand, the analysis of these trends can produce misleading information and corporations "can easily end up innovating in an area where uncertainty, and therefore the number and size of business opportunities are low." (Rohrbeck, 2014, p. 14)

Operationalizable Conclusion 6: Environmental scanning is crucial for the future orientation and the success of a business strategy. However, GET research lacks on information quality, and does not lead directly to in-depth knowledge or competitive advantage.

[2] See http://community.iknowfutures.eu

2.1.1.5 *Comparative Analysis on trend research studies*

There is a large number of published studies available describing various global economic trends (GETs) or megatrends. Governmental agencies, consulting companies, think tanks, or individual researchers deliver trend studies that usually present trends and their environmental, social, or economic impacts. The following comparative study draws a sample of various studies to demonstrate the repeating characteristic of megatrends, and to demonstrate the pitfalls that come with the nature of these studies. One the one hand the repetitive nature of trends mentioned has a negative impact on the competitive market positioning of corporations (Rohrbeck, 2014, p. 60). If corporations rely on the same types of trends, then there is a high probability that these corporations orient themselves in the same direction when they "consider such megatrends sufficient for guiding innovation efforts towards promising future markets" (Rohrbeck, 2014, p. 60). That common focus results in equal products, and same market positioning. On the other hand, trend studies have no credence in the identification of a trend. Especially in terms of governmental research, Slaughter has some serious doubt, as he formulates it in his article "Time to Get Real: A Critique of Global Trends 2030" (2014, p. 358).

As Slaughter (2014, p. 356) describes it "one could not credibly claim to have detected a 'megatrend' without giving some account, however brief, of the framing capacities, perceptual 'filters' and cultural sources of the modes of valuation employed." Slaughter criticizes that ensuring proper public interest is a difficult task, due to competing goals. Notably, governments and the private sector hold unique interests, which might interfere with the quality of foresight work (Slaughter, 2014, p. 358). A major drawback of the literature on trend research is that no author has provided a comparative analysis of trends. Table 3 provides information about different trend studies, and illustrates their main characteristics, which are the publication date and the trends derived from the analysis. The illustrated studies agree on the similar impact of trends, and the existence of some key trends like "globalization," which play an important role in all studies revealed. The impact of the observed trends varies from economic, social, and political to environmental impacts. The results of this analysis raise further questions.

Table 3: Comparison of different trend studies

Name of study Researcher / institute	Year	Trends
Trendcompendium 2030 (Roland Berger, 2012, p. 2)	2012	Changing demographics Globalization and future markets Scarcity of resources The challenge of climate change Dynamic technology and innovation Global knowledge society Sharing global responsibility
Global forces: An introduction (Bisson et al., 2010, pp. 2–3)	2010	The great rebalancing The productivity imperative The global grid Pricing the planet The market state
Management Challenges for the 21st Century (Drucker, 2007, p. 37)	2007	The collapsing birthrate in the developed world Shifts in the distribution of disposable income Defining performance Global competitiveness The growing incongruence between economic globalization and political splintering
Global Economic Trends and Their Impact to Corporate Development (Bezjak, 2010, p. 10)	2010	Collapsing birthrate in the developed world Climate change Shift of power from developed economies to emerging economies Changing financial landscape Globalization of regulatory environment Technology and innovation Scarcity of resources
Global Trends 2015 (National Intelligence Council, 2000)	2000	Population Natural resources and the environment Science and technology The global economy and globalization National and international governance The nature of conflict The role of the United States
Global Trends 2025 (National Intelligence Council, 2008, p. 7)	2008	The globalizing economy The demographics of discord The new players Scarcity in the midst of plenty Growing potential for conflict Challenges for international systems Power-sharing in a multipolar world

Name of study Researcher / institute	Year	Trends
Global Trends 2030 (National Intelligence Council, 2012)	2012	Individual empowerment Diffusion of power Demographic patterns Food, water, energy nexus Crisis-prone global economy Governance gap Potential for increased conflict Wider scope of regional instability Impact of new technologies Role of the United States Stalled engines Fusion Gini-out-of-the-bottle Nonstate world
Global Trends Survey (IMD, 2009)	2009	Changing labor landscape Changing economic of information and knowledge Changing industry landscape Growing pressure on natural resources Growing stakeholder demands on business Economic power shifting Market landscape shifting
Megatrends Update (Z Punkt, 2012)	2012	Demographic Change Individualisation reaches A new stage social and cultural disparities Reorganisation of healthcare systems changes to gender roles New patterns of mobility Digital culture Learning from nature Ubiquitous intelligence Technology convergence Globalisation 2.0 Knowledge-based economy Business ecosystems Changes In The work world New consumption patterns Upheavals In energy And resources Climate change and environmental impacts Urbanisation New political world order Global risk society

On the one hand, the question arises why studies depict trends with similar or identical impacts differently. Specifically, the use of the term “globalization” deserves further attention. On the other hand, this study asks whether other concepts or research studies can be identified that employ a similar approach as GET studies. Based upon the identified impacts of trends, the concept in the field of social studies may provide similar concepts. From the table above, it is obvious that there is no common agreement on the labelling of the trends. For example, some researchers, such as Larsen, depict “globalization” as an individual trend (Larsen, 2006, p. 8). Within the analysis above, various terms for globalization are used, such as “Globalization and future markets” (Roland Berger, 2012), “The great rebalancing” (Bisson et al., 2010), “Global competitiveness” (Drucker, 2007), “Globalization of regulatory environment” (Bezjak, 2010), “The global economy and globalization” (National Intelligence Council, 2000), or “The Globalizing Economy” (National Intelligence Council, 2008). The different terms represent globalization directly, or they illustrate certain facets of a globalizing economy. Furthermore, the research reports provided by the National Intelligence Council demonstrate that globalization is labeled as “the global economy and globalization” in the report “Global Trends 2015” (National Intelligence Council, 2000), then labeled as “The globalizing economy” in the report called “Global Trends 2025” (National Intelligence Council, 2008, p. 7).

Based on the assumption that GETs are trends with a long-term impact, it is not obvious why the labelling should change. Furthermore, the latest report (Global Trends 2030) delivered by this agency does not list this trend anymore.[3] By comparing the studies of the “Global Trends 2015” (National Intelligence Council, 2000) with “Global Trends 2025” (National Intelligence Council, 2008, p. 7) it could be supposed that the manager’s attention changed after the peak of the financial crisis. It is notable that the trends reported by managers before the subprime crisis show significant differences from the trends reported in 2009. Researchers at the institute IMD (2009, p. 4) agree on this phenomenon, as they report that “managers flipped their opinion on trends, as well as, their priorities” due to lessons learned. As depicted in section 2.1.1.2, the literature on GETs or

[3] See “Global Trends 2030” National Intelligence Council (2012)

megatrends also uses the term "weak signal" to emphasize early warnings to big change processes. Kreibich et al. (2011, p. 11) illustrates the example of the growing importance of globalization to bridge the gap between trends and weak signals. In the paper "Strategic Issue Management," Ansoff (1980, p. 138) presents a list of environmental trends that represent opportunities and threats to an organization and are at the heart of the strategic issue management. However, the observed environmental trends have strong similarities to GETs or megatrends, as demonstrated below.

Table 4: List of environmental trends
(Source: Ansoff 1980, p. 138)

No.	Environmental trend
1	Trends in the global market place (protectionism vs free trade)
2	Growth of government as a customer
3	Development of the Common Market
4	Business with socialist countries
5	Economic and political trends in developing countries
6	Monetary trends
7	Inflationary trends
8	Emergence of the multinational firm
9	Technology as a competitive tool
10	Bigness as a competitive tool
11	Saturation of growth
12	Emergence of new industries
13	Technological breakthroughs
14	Growth of the service sector
15	Affluent consumers
16	Changes in age distribution of customers
17	Selling to reluctant consumers
18	Social attitudes toward business
19	Government controls
20	Consumer pressures
21	Union pressures

No.	Environmental trend
22	Impact of society's concern with ecology
23	Impact of 'zero-growth advocates
24	Shrinking product life-cycles
25	Intra-European nationalism
26	Conflict between multinational firms and national interests
27	Public distrust of business
28	Shrinking of forecasting horizons
29	Strategic surprises
30	Competition from developing countries
31	Strategic resource shortages
32	Redistribution of power within the firm
33	Changing work attitudes
34	Pressures for employment maintenance

An implication that stems out of the listed trends called "environmental trends" is more evidence for the fact that economic literature misses a unique and coherent definition of trends. Furthermore, trends as drivers for social, technological, political, and economic change processes are complex, have multiple facets, and vary in their impact. Based upon the analysis of Ansoff, the detection of weak signals is important to the strategy of corporations and can as well be important to the assessment of regional strategies when it comes to investment decision-making and regional development. Therefore, until enough knowledge about a certain trend is available, labelling or categorizing a trend into a megatrend may lead to the wrong strategic decision. The numerous terminologies used in trend studies, such as the term megatrend, do not emphasize the importance and impact of a certain trend to a corporation, an institution, a nation, or a geographical region.

They try only to catch the attention of the reader by combing the prefix "mega" with the word "trend." However, little to no research is available that closely examines the arbitrariness of terminology used in trend research. Only Groddeck and Schwarz (2013, p. 33) call megatrends empty signifiers or "abstract semantics that hold together heterogeneous and complex identities and therefore not suitable for in-depth trend research." The implication is therefore that the impact of a trend needs to be put in the context of analysis. Ansoff's example of environmental trends is a textbook example in which environmental trends represent the impact on a corporation.

The same can be valid for GETs that define the economic influence of corporations and regions. Another implication is that when emphasis has to be put on the discussion of trends analysis, the use of a compound term like "environmental trend" or "economic trend" gives orientation, emphasizes the context, and qualifies meaning. As demonstrated above, the term megatrend is not capable of doing so, and can be misleading.

Operationalizable Conclusion 7: Trend research studies draw a wide variety of trends and agree on the description and impact of these trends, but differ in the labelling of the trends. In comparison, a compound term like "environmental trend" has a higher information value then the term "megatrend," and provides a better ground for interpretation and categorization of the trend.

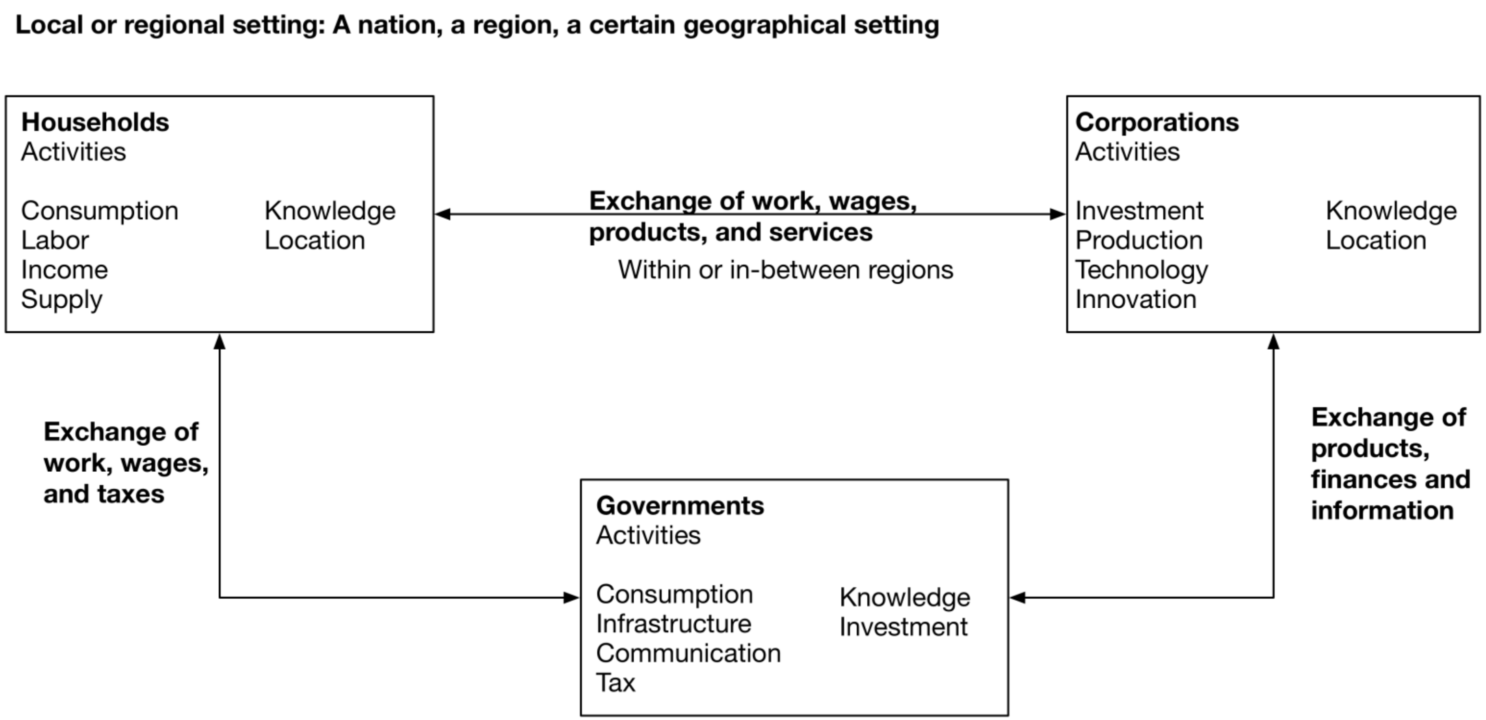
2.1.2 GETs in light of theory

2.1.2.1 Macroeconomic cycles and GETs

Several researchers claim that there is an unambiguous relationship between global economic trends (GETs) and macroeconomic theory, as GETs have an institutional effect that needs further attention (e.g. Geenhuizen et al., 2009; El-Erian, 2008; Voigt, 2002). This section reviews literature in the context of macroeconomic theory regarding the influence and utilization of trends. Within the macroeconomic environment companies, both households and governments (public sector) behave independently to reach a certain state of well-being (cf. e.g. Maier and Tödtling, 2006; Boyes and Melvin, 2009; Mankiw, 2012). Figure 4 depicts these objects and their interaction, and is the essential model in macroeconomic theory. The emphasis on this model relies on the relation of consumption and investment within a nation, a region, or a certain geographical setting. However, the exchange of work, wages, products, finances, information and services also happen across borders. To measure the influence of GETs on these processes, key performance indicators are required that deliver robust quantitative data. A further requirement to profound econometric analysis of GETs is that the indicators draw a picture of the overall market development, especially the development of economic growth.

Mankiw (2012, p. 29) illustrates that these indicators are (1) changes over time in unemployment rate, (2) effects of borrowing by federal government, and (3) economic growth measured by key performance indicators such as gross domestic product (GDP) and gross domestic product per capita (GDPpc) . GDP analysis is a core disciple of economic growth theory. Foreign direct investments (FDI) play also a crucial role in economic growth. Various studies use historical GDP data to gain knowledge about the current as-is global economic situation and economic crises, to anticipate the actual as-is situation and/or upcoming economic progress (cf. e.g.Haas et al., 2009; Capello and Tomaz, 2012; Ghemawat, 2011; Neves, 2012). Statistical and econometric models require sophisticated data (Costanzo and MacKay, 2008, p. 2). The timing of events like economic shocks or special events or their impact is hard to estimate, and forecasting models require continuous optimization (Dinopoulos, 2009, p. 947).

Figure 4: Macroeconomic circulation among regions
(Own creation based on Maier et. al. 2006, p.10–10, Boyes et. al. 2009, p.198–198)



Operationalizable Conclusion 8: GETs affect all participants (households, governments, and corporations) within a macroeconomic environment, such as a nation, a region, or a certain geographical setting. This effect is measurable quantitatively by macroeconomic indicators.

Researchers such as Neves (2012) and Haas et al. (2009) put the analysis of the global economy in the context of globalization. Neves (2012, p. 15) explains that globalization is a process that is "far from fully integrated and interdependent, and large regions and sectors remain outside the main dynamic pattern of the moment." Consequently, the author points out that globalization is not a global phenomenon (Neves, 2012).

Haas et al. (2009, p. 2) claim that the characteristics of the global economy are spatially distributed in terms of economic activity and economic indicators, and economic activity has a cross-border in terms of foreign trade, FDI, and transportation. These indicators are the foundation for quantitative analysis of GETs, especially in the context of forecasting, such as time-series analysis. Schaefer (1995) emphasizes in his book *International Economic Trend Analysis* that the term "global economy" is itself ambiguous and provides chances and risks, depending on the point of view, which perfectly represent the importance of trade and in this case cross-border trade activities (Schaefer, 1995, p. 2). Schaefer (1995) explains that business cycles are the driving force in international economic trends. The theory of business cycles is an obvious reference to the work of Schumpeter (1939), which closes the gap to the process of internationalization and globalization, innovation discussed in economic growth theory.

Schumpeter's theory of business cycles "Business Cycles: A Theoretical, Historical, and Statistical Analysis of the Capitalist Process" is among the earliest works in the field of trend analysis. In his work, Schumpeter (1939) illustrated that business cycles vary in length, and created four classes of cycles, named after their innovators Juglar, Kuznets, Kinchin, or Kondratieff, as depicted in Table 5.

Table 5: Cycles and related timespans

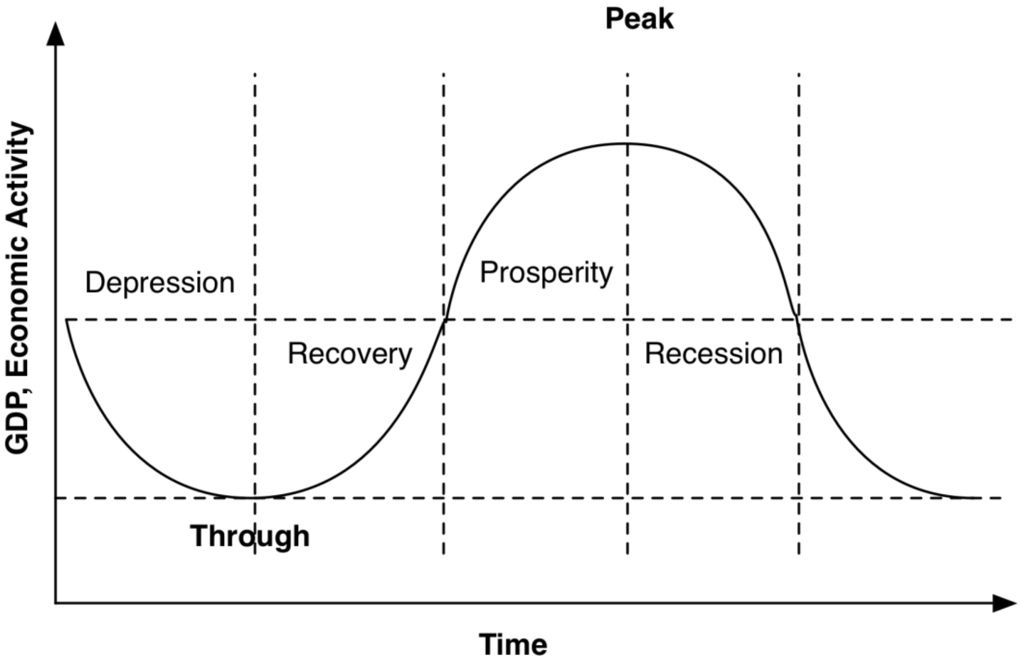
Cycle	Timespan
Kondratieff	60 years
Kuznets	15-20 year
Juglar	10 years
Kinchin	40 month

Driving economic growth through innovation is one of the core concepts in social sciences (Dawkins, 2003, p. 132). Based upon the theory of cycles, a GET seems to obtain the characteristics of a macroeconomic cycle, which are labelled either in macroeconomic theory (e.g. Schumpeter, 1939; O'Hara, 1999).

Schumpeter (1939, p. 170) points out that “all cycles have four phases of equal length, amplitudes of plus and minus excursions are equal and constant, periods are also constant, and each of the two higher cycles consists of an integral and constant number of units of the next lower movement.” The time span of the business cycles theory is also reflected in the conceptual idea behind GETs and megatrends, which play a key role in corporate strategy due to their impact and a longtime horizon (Rohrbeck, 2014). Within the theory of business cycles, each cycle follows a certain process that consists of the following stages: prosperity, revival, recession and depression, as depicted in Figure 5 (below). Cooley (1995) points out that economic growth and business cycle theory goes hand in hand, and much empirical research has been conducted in this field of science that has proven a regular occurrence of the cyclic movement.

Current literature mentions a relation between trends and Kondratieff cycles (cf. e.g. Jänig, 2004, p. 5; Nefiodow, 2006; Pillkahn, 2008, p. 44; Kohlöffel and August, 2012, p. 12). Schumpeter (1961) has stated that data on GDP and interest rates are not alone able to explain the causal relations.

Figure 5: The anatomy of an idealized business cycle
(Own creation, based on Schumpeter 1939)



Early work on GETs provided by Harrison (1994) has emphasized the concept of Schumpeter in the context of GETs. He has stated that the economy develops in cycles or is repeating in circles, driven by (1) the globalization of economic relations and transactions, (2) technological change, (3) shifts in the organization of production, (4) change in the role and organization of labor, and (5) change in the nature of competition (Harrison, 1994). Even earlier, Kahn (1967) delivered a work called *Year 2000*, which is a book about future analysis. This work is an early form of scenario planning that shows many similarities to modern approaches of future analysis, which will be discussed further in the later sections. Important in this case is to point out that trend analysis is not a new topic and has a long history in economic theory. This observation is also confirmed by Jänig (2004, p. 5), who points to the economists Adam Smith, David Ricardo, John Maynard Keynes, and Joseph Schumpeter as the earliest references that established profound discussion of economic trends and macroeconomic driving forces.

During and after the economic crisis in 2008 that has become famous under the name "subprime crisis," macroeconomic theory gained much attention that still drives recent discussion about reshaping and refining existing economic theories. Researchers such as Malik claim that the methods of the 20th century are not able to manage the complex systems of today (Malik, 2008, p. 52). The high level of complexity implies that recent economic theory needs refinement to established the forecast models of GETs used in decision-making processes in the public and private sector (El-Erian, 2008; Malik, 2008). This discussion is driven by unexpected events, which are referred to as shocks that are hard to forecast (Nikolopoulos, 2010, p. 947). El-Erian (2008) claims that when market changes occur unanticipated and evolve rapidly, conventional wisdom is not able to predict the changes, especially as changes are not easy to detect and come with a high level of noise. In this context, Uhlig (2012, p. 38) demonstrates that the real business cycle theory that was at the heart of dynamic macroeconomic theory in the 1980s and 1990s was the main influence of "empirics and economic thinking and theory."

Based on the discussion of business cycle theory, Uhlig (2012, p. 39) concludes that "Reality, i.e. empirical evidence influences economic thinking and theory and vice versa — but it does not do so in textbook fashion. Practical economics and economic policy follows, with considerable distance." Within economic theory, researchers see changes in the organization of production, as well as in localization and internationalization strategies as a driver for the reconfiguration of markets. Furthermore, this new idea fuels new conceptual thoughts on theory, opening new fields of economic theory and in the design of new managerial frameworks (Carballo-Cruz, 2012; Capello and Dentinho, 2012; Segrestin and Hatchuel, 2011; Taleb et al., 2009, p. 78; Stiglitz, 2011, p. 595; Mathur, 2007; Nodeau, 2000).

Capello and Tomaz (2012) point out the influence on economic theory is the rising influence of developing countries in terms of economic contribution to the global economy, which is an outcome of the globalization progress. Mathur (2007) used the term "GET" to describe the growing contribution of developing economies (2007, p. 2). His analysis examines the economic position of the South

Asian countries and its growing contribution to the world economy. His emphasis is on the rise of the GDP of developing countries, and the challenges that lie as Mathur (2007, p. 2) points out in the "systemic weakness entailed in huge and still-growing global finance imbalances and rising public debt in high-income countries." The literature widely agrees on the rising influence of developing economies and the development in urbanization.[4] Of special interest in this regard should be the work of Nodeau (Nodeau, 2000, p. 1), who asserts that GETs emphasize (a) globalization and (b) the importance of knowledge as a key factor of production. Taleb et al. (2009) explains that no forecasting model has been able to predict the impact of the subprime crisis, especially because risk-management models themselves "increased their exposure to risk instead of limiting it and rendered the global economic system more fragile than ever" (Taleb et al., 2009, p. 78). The author delivers further criticism based on Ricardo's theory of comparative advantage by claiming that specialization in production leads to inflexible configuration in markets that are not able to deal with changes (Taleb et al., 2009, p. 81). Stiglitz claims that information asymmetries and market imperfections lead to market noise that "entails random behavior (mixed strategies) on the part of market participants" (Stiglitz, 2011, p. 610). Holopainen and Toivonen (2012, p. 200) claim that the probability and information quality of possible phenomena distinguish signals from noise: "Phenomena with major impacts are either weak signals or megatrends; weak signals have a low probability and megatrends have a high probability of realization." However, such an explanation leads to the question of what the prediction of future events is, as well as demonstrating that market noise should not be ignored, as it might provide further information. Practitioners like El-Erian (2008, p. 68) point out that identifying and distinguishing signals from noise involves quantitative and qualitative aspects that might open up new findings on market behavior, and might reveal the true driving force behind market noise.

[4] Of special interest should be the urbanization movement in developing nations. Today, for example, China holds 18 tier-1 cities that have an urban population greater than 200 Million, and account for a GDP of 26bn USD in total.

Behavioral finance agrees on this perspective, as misconceptions in theory have their roots in increasing evidence of anomalies in financial markets and the irrational behavior of investors due to a lack of available information (e.g. Dargham, 2009).

As an outcome, economic theory has not only once failed to predict crisis, as economic crisis are not a new phenomenon.[5] In 2010, Joseph E. Stiglitz used the term GETs to describe how established markets collapse due to wrong investment decision-making, and he criticizes that macroeconomic theory needs refinement because standard models are not able to cope with large variations of economic configuration (Stiglitz, 2010, p. 251). According to Kuhn (1962), "crisis are a necessary precondition for the emergence of novel theories" (Kuhn, 1962, p. 77). Modern societies are able to take advantage of new data sources with better information that will lead to better knowledge about markets (Done, 2012, p. 257). Preis et al. (2012) deliver a promising approach. Their analysis based on webtrend data stresses correlation between a country's GDP and the "predisposition of its inhabitants to look forward" (Preis et al., 2012, p. 1). The analyses of webtrend data are an option to gain deeper understanding of GETs (cf. e.g. Moat et al., 2013). Uhlig (2012) concludes that empirical evidence is the foundation for economics and vice versa and leads to new methodologies that raise the quality of science and practical economics and economic policy in the long run.

Operationalizable Conclusion 9: Knowledge about GETs is perceived as a strategic lever that fosters the quality of investment decision-making. Methods in the field of economic theory need refinement to cope with the complexity of markets. Data sources (big data) from social media like web trends provide new possibilities to raise the quality of economic models.

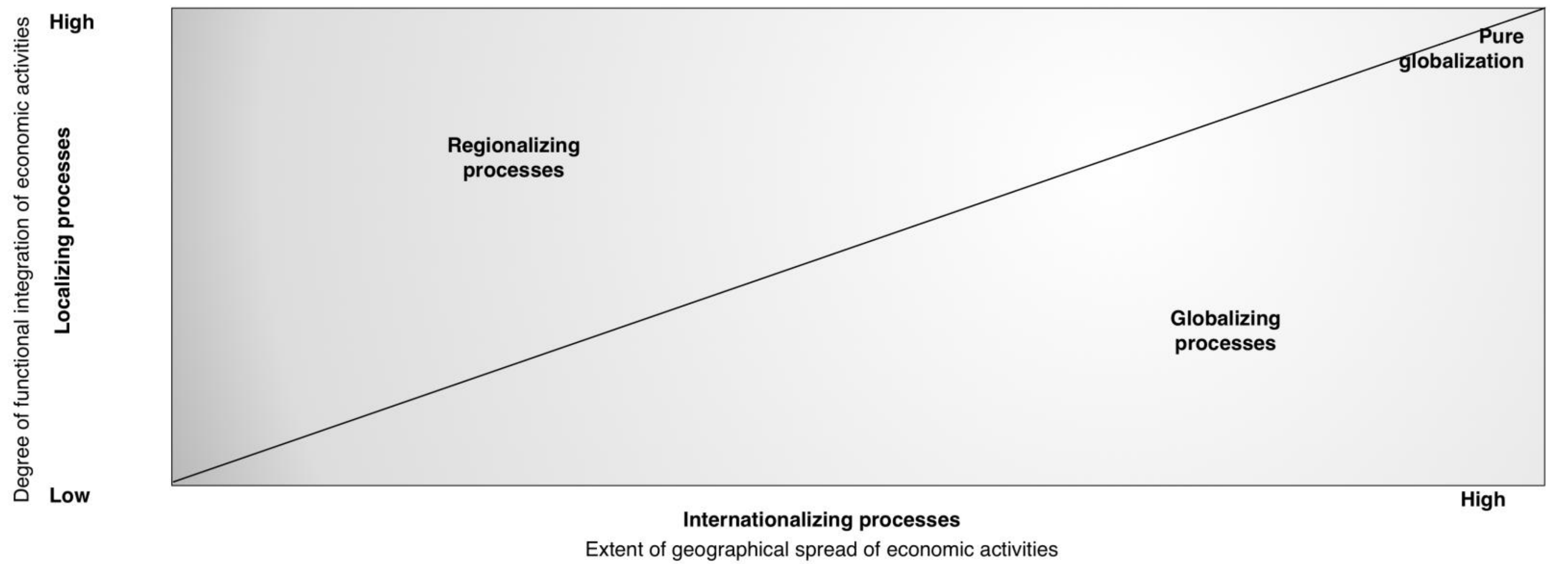
[5] As Stiglitz points out, besides the subprime crisis more than 392 examples can be identified as economic crises, since economic records began (Stiglitz 2010).

2.1.2.2 The trend of globalization

As demonstrated in the previous analysis, a considerable amount of literature labels “globalization” as a global economic trend (GET) or a megatrend (e.g. Dombrowski et al., 2014, p. 101). The discussion of globalization started in the 1980s and gained momentum the 1990s and the 2000s. In 2011, Ghemawat (2011, p. 4) revealed, “the U.S. Library of Congress catalog listed fewer than fifty publications per year on globalization; since 2000, the number has averaged more than a thousand per year.” Capello and Tomaz (2012, p. 1) provide a practical definition and define globalization as the “process of internationalization of production and markets, which can take various forms — such as increasing international trade or increasing foreign direct investments.” Hence, globalization, or global transformation, is an outcome of the process of internationalization. The question in this regard is of how far the process realized this expected result. This question is crucial to many researchers, and various sources criticize the view of globalization as globalization hard to classify, because most business activity takes place within regional blocks and is more a form of regionalization (cf. e.g. Rugman, 2005, pp. 2–3; Hirst et al., 2009; Carballo-Cruz, 2012; Neves, 2012, p. 15).

In 1983, Theodore Levitt presented an analysis called *The Globalization of Markets* in which he questioned the development of global markets by giving a clear distinction between internationalization and globalization (Levitt, 1983). In 2004, two decades later, Quelch and Deshpande (2004, pp. 24–25) concluded that Levitt used the word ”globalization” “to indicate a qualitative change in the character of the world's markets, not a quantitative change.” Levitt claims that globalization has two sides, the process side, and more importantly the heuristic side, which has many characteristics. Quelch and Deshpande (2004, p. 26) pinpoint that globalization is a new form of “density of economic interactions among societies”. Dicken (2007) portrays the processes of economic transformations by the degree of functional integration of activities, which refers to the interconnection of supply and value chains across borders, and by the extent of their geographical spread, as depicted in Figure 6.

Figure 6: Processes and scales of global economic transformation
(Own creation, based on Dicken, 2007, p. 8)



Localizing processes
Geographically concentrated economic activities with varying degrees of functional integration

Internationalizing processes
Simple geographical spread of economic activities across national boundaries with low levels of functional integration

Globalizing processes
Both extensive geographical spread and also a high degree of functional integration

Regionalizing processes
The operation of "globalizing" processes at a more geographically limited (but supranational) scale. Ranging from highly integrated and expanding, European Union to much smaller regional economic segments

Dicken (2007) shows that economic transformation is determined by localizing, internationalizing, regionalizing, or even globalizing processes. Localizing processes are geographically and functionally concentrated, whereas internationalizing processes spread across national borders with a level of functional integration. Regionalizing processes have a geographical spread and are integrated functionally, but are limited on a supranational scale. Globalizing processes have a strong geographical spread, and a high degree of integration. These examples demonstrate that from the process perspective, localizing and internationalization processes play a key role in understanding the concepts of globalization, which is important to understanding of GETs. Specifically, the understanding of current developments in the internationalization processes of multinational enterprises (MNEs) and national governments play a key role in understanding the role of GETs.

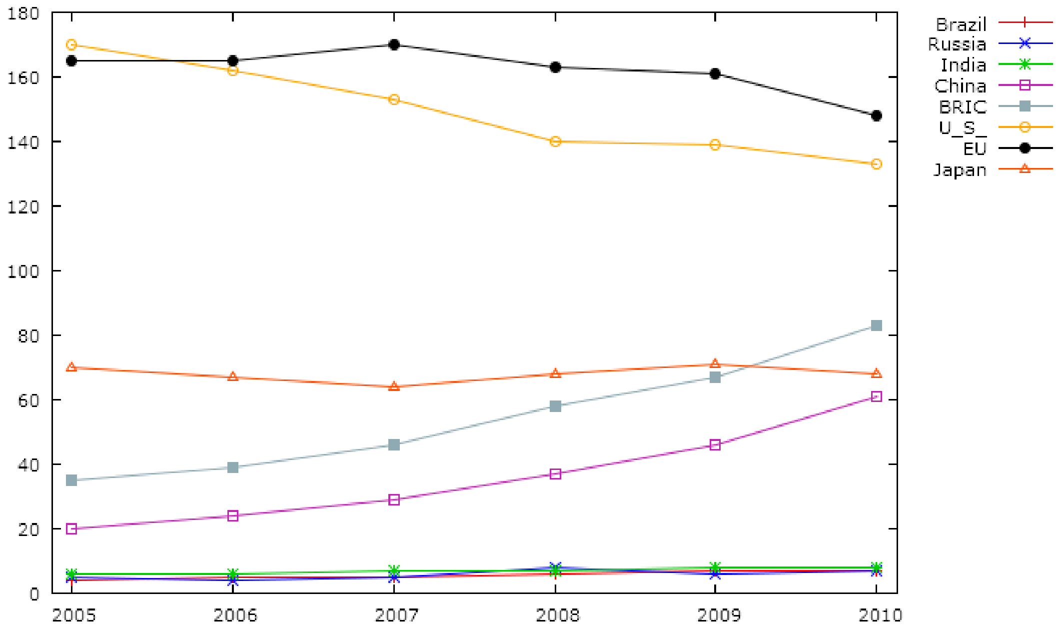
It is evident that globalization is an ongoing process that interconnects or integrates different regional functions, which are services, production, and finance. Several researchers claim that the integration process is ongoing and that globalization is far from being global (cf. e.g. Ghemawat, 2011; Neves, 2012). Neves (2012, p. 15) addresses this claim very directly: "The global economy is far from fully integrated and interdependent, and large regions and sectors remain outside the main dynamic patterns of the moment. Globalization is not global." Ghemawat (2010, p. 1) said that "If one has to guess the level of internationalization of some kind of economic activity, it is safer to assume it to be much closer to 10% than 100%." Authors like Hiltunen (2013) point out that even if megatrends are present in numerous geographical locations, they are not always global. This shows that globalization in particular can be questioned concerning its global appeal (Ghemawat, 2011).

As Dinopoulos (2009, p. 575) concludes, "Schumpeterian growth models predict that globalization will increase the relative demand for skilled labor and accelerate the rate of technological progress." This discussion of economic growth models in relation to the process of globalization and the analysis of business cycles based on secondary data fits well to the discussion of the recent conclusions on GETs. Even more, according to Dicken, the term "globalization" "has evolved into a catch-all term, used by many to bundle together virtually all the 'goods' and 'bads' of contemporary society" (Dicken, 2004, p. 5).

Research has visualized these dynamic processes of globalization on wage-income inequalities, shifts in demand and supply, gross domestic product (GDP) distribution, and labor market development between developed and developing economies (cf. e.g. Krugman and Venables, 1995, p. 858; OECD, 2009, p. 73; Dinopoulos, 2009, p. 575). In fact, this is a perfect breeding ground for political discussions. A textbook example of political investigation based on GETs and globalization delivers the U.S. National Intelligence Council (2008, p. 7), which claims that global economic trends are the driving force behind globalization that transform the patterns of economic flows.

As Rugman reveals, the world's 500 largest multinational enterprises (MNEs) (320 of the 380 for which data are available) account for over 90% of the world's stock of FDI and over half of world trade, the latter usually in the form of intra-firm sales (Rugman, 2008, p. 100). In comparison to the ratio delivered by Ghemawat, this value demonstrates that only MNEs truly contribute to the process of internationalization due to their financial resources and capabilities in cross border transactions. Furthermore, Neves' insights about the growth of developing economies, driven by India and China, lead to the assumption that MNEs from those regions contribute most to the overall process (Neves, 2012, p. 33). This fact was also affirmed by Peng (Peng, 2012, p. 98). Peng based on data from the Fortune 500 Global, Chinese MNEs grow much stronger than their peer group, MNEs from BRIC (Brazil, Russia, India, and China) countries, as well as MNEs from developed economies like US, Europe and Japan. Figure 7 shows the importance of MNEs to the contribution of internationalization or globalization. The common average growth rate (CAGR) of MNEs in absolute numbers in BRIC countries overall is 48%.

Figure 7: Quantitative development of MNEs
Based on Peng, 2012, p. 98 and data from fortune 500 list



China alone contributes 80% to that growth. This development is particularly interesting because regions of the so-called broad triad (European Union, North America, and Asia-Pacific) deliver an average of 80% of sales of multinational corporations in total (Peng, 2012, p. 98). Hence, GETs impact all entities of an economy, but they mostly impact the business of MNEs, and the decision-making processes on the political level in economically developed countries (Stiglitz, 2002, p. 11). As a concluding remark, this is the biggest critique of the discussion of globalization, as emphasized by many authors (Ervin and Smith, 2008, p. 82; Stiglitz, 2002, p. 11; Hirst et al., 2009).

Operationalizable Conclusion 10: GETs effect all entities of an economy, but the impact is mainly important to the business of MNEs due to their degree of international business activity, and the decision-making processes on the political level in economically developed countries. To gain knowledge about GETs, it is crucial to analyze the regional influence of a certain trend.

2.1.2.3 GETs and economic geography

It is important to point out that global economic trends (GET) can be found in the context of economic geography, which is concerned with the concepts of space, territory, place, and scale (cf. e.g.Higgins and Savoie, 1997, p. 4; Pike et al., 2011, p. 35). Higgins and Savoie (1997, p. 11) consider that economic geography "is already accepted as a compound of other scientific elements and disciplines, such as economics, social, technological, and politics that address differences among regions, and the interplay of actors." If considered as an individual discipline, economic geography, also referred to as regional science, regional analysis or regional development is relatively young.

Since the 1950's, researchers have examined why regions differ in terms of social welfare, political stability, or innovation based on the principles of economics and geography (cf. e.g. Dawkins, 2003; Isard, 2003). Isard (1956) introduced the term "regional science" to establish a new scientific discipline. Since the founding days of the theory, various theories have emerged. Capello (2011, p. 6) claimed that August Lösch and Walter Christaller have developed the "central place theory" that uses the model of the urban systems built as a network of different cities instead of resource locations. Hoover and Giarratani (1999) propose that especially Lösch argued that economies of spatial concentration and transport costs are the dominant factors that add up to regional configuration.[6] These two findings are at the heart of regional science.

Pike et al. (2011) confirm that regional science has emerged into a very broad topic, with numerous publications providing similar references, and many terms have a similar meaning as regional science: local and regional development, regional economics, regional innovation systems, regional economic development, regional science, urban economics, economic growth theory, or regional planning (Pike et al., 2011, p. 2). Researchers such as Dawkins (2003) show that region itself is viewed and discussed with controversy and little

[6] As Hoover and Giarratani (1999) describe it, "What the Christaller-Lösch theoretical exercises demonstrated was that factors other than natural-resource location play an important part in explaining the spatial pattern of activities."

agreement among researchers. A core problem is the definition of region itself (Dawkins, 2003, p. 133). Cooke and Leydesdorff (2006, p. 2) point out that the term region originally stems from the Latin word *regrere*, which represents governance, and can be "any large, indefinite and continuous part of a surface or space, or a unit for geographical, functional, social or cultural reasons, or in military usage […]"(Cooke and Leydesdorff, 2006, p. 2).[7] Porter (1998, p. 236) puts clusters into the focus and claims that even with the rapid technological development of information and communication technology (ICT), the fall of transportation costs, or easier access to resources, capital, or other inputs, location remains fundamental to competition. Especially in economic clusters that hold a high "concentration of skills and knowledge, institutions, rivals, related businesses, and sophisticated customers in a particular nation or region" (Porter, 2000, p. 32). Porter (1998, p. 237) points out that the region or the location plays a central role in the discussion of competitiveness and regional growth, as knowledge and the availability of resources are geographically bounded and "difficult to tap from a distance."[8]

Capello (2011, p. 1) points out that the geographic distribution of resources and potential is determined mainly by human capital, social fixed capital, the fertility of the land, and accessibility, rather than exogenous factors such as raw material and exogenous factors. In this context, space and territory are the central components in location theories. Capello (2011, p. 5) provides a comparison of location and regional growth theories based on space, aim and nature of conception, as well as most important authors.

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[7] As Cooke and Leydesdorff (2006, p. 2) further illustrate, "Regional is nested territorially beneath the level of the country, but above the local or municipal level. In objective terms, this is generally how the conceptual level can be aligned with the geographical one. However, some countries only have national states and local administrations, but no regions."

[8] Porter (1998, p. 237) explains, "The relaxation of barriers to trade and investment, still comparatively recent in many countries, is incomplete. The fall of transportation and communication costs has been rapid, while investments in plant and equipment often last for many decades. As a result, many overly broad national and subnational economies persist, as do many clusters in countries and regions that lack a real competitive advantage."

The central research object of modern economic theory is the world economy. Theories like new economic geography and endogenous growth seek to identify the potential of local growth. The global economy has two dimensions: (1) the spatial distribution of economic activity (creation of value, location) plus its economic indicators (GDP, sovereign risk, factor costs, etc.), and (2) cross-border economic activity (foreign trade, FDIs, transport activity) (e.g. Haas et al., 2009, p. 2). Stimson et al. (2011) provide an interesting approach by illustrating the two main trends that have emerged in the field of regional science, which are regional growth theories and regional development theories. Maier et al. (2006, p. 9) observes two dimensions, which are development, in the sense of location theory and spatial structures, and economic growth, which is at the heart of regional development and political decision-making.

The processes driving innovation and economic growth are especially interesting to other researchers from the field of social science, like sociologists or political scientists; there is a growing interest in this field of science (e.g.Dawkins, 2003, p. 132; Stimson et al., 2006). In general, this field centers on an understanding the creation of economic value within a coherent economic region by factors or processes, which can be measured by common economic, geographical, social, cultural and political indicators (McCall, 2012). Geographical distance and proximity are key in understanding the complexity of economics (Dicken, 2007; Ghemawat, 2011). This insight also has implications for a successful development of regions, as knowledge about GETs is crucial for efficient foresight processes, which is also confirmed by Gertler and Wolfe (2004):

> As a result, successful regions must be able to engage in regional foresight exercises that identify and cultivate their assets, undertake collaborative processes to plan and implement change, and encourage a regional mindset that fosters growth (Gertler and Wolfe, 2004, p. 46).

Operationalizable Conclusion 11: The practices of foresight help to estimate the impact of GETs to the competitive advantage of clusters and regions. Geographical data provide insights for localizing the impact of GETs.

2.1.2.4 Trends from the perspective of management theory

Numerous definitions and concepts in the management literature, like forecasting or foresight, refer to or utilize trends like global economic trends (GETs). A significant problem in the literature is that trends and concepts to trend assessment lack clear concepts. From today's perspective, trend diagnosis in the context of strategic management still has a relatively short history. Since the 1950s, concepts like "long range planning," "strategic planning," "environmental scanning," "strategic issues management," "trend monitoring," and "early warning systems" have been introduced by scientific writers to include a prospective vision into managerial thinking (Ansoff, 1975, p. 132; Schwarz, 2008a; Liebl and Schwarz, 2010, p. 314; Godet, 2010). Trends play a key role in these concepts, and as Liebl and Schwarz (2010, p. 134) explain, authors in the Anglo-American literature like Aguilar and Keegan, Bright, Ansoff and Dutton provided the managerial concept that incorporates trends into strategic management. Another important aspect is that modern literature uses the term "foresight" as an umbrella term that integrates the prospective vision into management science and has several branches like technology, corporate/organization, and strategic foresight. Godet (2011, p. 26) proposes a modern concept named "Strategic Prospective" that is a textbook model for integrating trends into a process of anticipation the objective of which is to "study scenarios and propose various strategic orientations and subsequent actions which correspond to the competencies of the organization." Godet (2010, p. 1457) points out that since 1960 the terms "la prospective" or "prospective" in the Romance-language countries use concepts similar to strategic foresight. Godet and Roubelat (1996, p. 164) refer to Gaston Berger who proposed that 'la prospective' has a preactive or proactive attitude. It seeks to find the trends that are important to scenario planning and induces scenarios to be prepared for the anticipated changes.

The concept of "signals" is closest to the discussion of GETs. As Liebl and Schwarz (2010, p. 314) point out based on the analysis of Ansoff (1980, p. 136), "'a Conceptualization of trends is not given. [...] Three sources of information about impeding issues are illustrated: trends in the external environment, trends within the enterprise, and trends and its performance'." Ansoff, who claims that trends are weak signals, is the most prominent resource in this field of research. Ansoff

(1975, p. 134) invented the strategic issue management system (SIM) that is a procedure for early identification and fast response to important trends and events both inside and outside an enterprise (Ansoff, 1975, p. 134). The vision of Ansoff has been that a SIM detects strategic surprises and provides a methodological approach to respond to threats and opportunities. In his concept, future trends are in the focus of the senior management that has the authority to react in case of urgency, and to foster sustainable change in the corporation (Ansoff, 1975). It is therefore important to diagnose warning signs early to be able to react in time (Drucker, 1998, p. 14).

Ansoff (1975, p. 134) points out that the SIM is an action-based and not a planning-based approach. Its strength is that its enables a corporation to continuously monitor for trends and events. Furthermore, it provides the capabilities to react quickly to a trend, ideally in real time, when a dedicated staff is employed that scans and classifies the observed trends. In this regard, modern literature refers to the development of management systems, as depicted in Figure 8.

Figure 8: Ansoff's classification of management systems

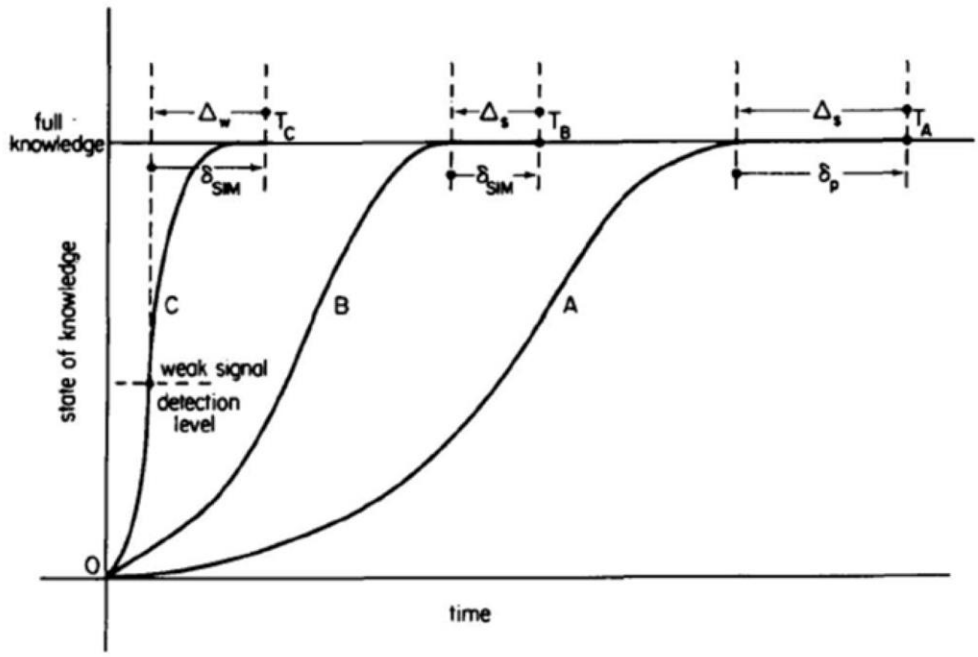
(Source: Ansoff, 1975, p. 132)

	Control	Long range planning	Strategic planning	Strategic management	Strategic issue management	Surprise management
Purpose	Control deviations and manage complexity	Anticipate growth and manage complexity	Change strategic thrusts	Change strategic thrusts and change strategic capability	Prevent strategic surprises and respond to threats/opportunities	Minimize surprise damage
Basic assumption	The past repeats	Past trends continue into future	New trends and discontinuities	Expect resistance. New thrusts demand new capabilities	Discontinuities faster than response	Strategic surprises will occur
Limiting assumption	Change is slower than response	The future will be 'like' the past	Past strengths apply to future thrusts. Strategic change is welcome	Future is predictable	Future trends are OK	Future trends are OK
	← Periodic			→	← Real time	→

Researchers such as Rohrbeck (2011) also base their conceptual work on corporate foresight on Ansoff's approach of early detection of environmental changes. Furthermore, Groddeck and Schwarz (2013, p. 28) point out that the concept is so important that it had the power to create its own unique stream of trend research. In his doctoral thesis, Rohrbeck (2011, p. 15) claims that corporate change and ambidexterity, environmental scanning, and decision making are the core of corporate foresight research.

A gap in the modern literature is that a key concept of Ansoff is not followed up in the modern literature. The concept of the maturity of corporate knowledge in relation to the forecasting horizon and the response time of the corporation is the key to assess the strategic capability and changeability of business processes. Figure 9 illustrates this concept.

Figure 9: Interaction between forecasting horizon and response time
(Source: Ansoff 1980, p. 144)



Interaction between forecasting horizon and response time. Δ_s = strong signal forecasting horizon, Δ_w = weak signal forecasting horizon; δ_p = periodic system response time, δ_{SIM} = SIM response time

It depicts three curves that represent the learning or response time of a corporation from the detection time of a weak signal to the point where the corresponding management system, or the methodological approach to environmental scanning, has generated enough knowledge about the possible impact to the corporation. At the stage represented as full knowledge, Ansoff (1980, p. 144) points out that the impact to the corporation is fully understood and response strategies to the economic, political, social, or technological issue can be selected and implemented in a timely manner.

Important to the concept is that the planning horizon represented by Δ is limited by availability of information, which leads to the result of the response time represented by δ in the figure above. Depending on the slope of the learning curve of the corporation, the choice of the preferred environmental scanning and management system differs. The depicted Curve C represents a corporation that reacts to the information of a weak signal. As a prerequisite, management has to respond or to learn about the impact to be able to react in a timely manner. Hence, Δ has to be longer than the time δ required for the response. That relation requires that corporations identify the important signals based upon a high level of uncertainty. Ansoff (1980, p. 145) claims that when the planning horizon is shorter than periodic response, a system for coping with weak signals has to be established. As pointed out by Rohrbeck (2011, p. 15), this system is a tool for upper management in order to be able to assign resources to dedicated and urgent tasks. Weak signal detection is the foundation for understanding strategic surprises or discontinuities. Modern concepts that refer to “weak signals” refer to these phenomena as “wild cards.” Groddeck and Schwarz (2013, p. 29) point out that the concept of weak signals has been transferred to trends by authors such as Liebl (2000). In contrast to the weak signal, Curve A is a strong signal, whereas Curve B is a signal with a medium range. However, all types of signals belong to the discussion of trends.

Operationalizable Conclusion 12: Detecting the weak signals that are sent by GETs requires an optimal configuration of the forecast horizon and response time in order to gain enough knowledge about the possible impact of trends. This is true for all members of a macroeconomic environment.

2.2 GETs IN THE SCOPE OF FORESIGHT

2.2.1 The discipline of foresight

2.2.1.1 Foresight in light of academic literature

Costanzo and MacKay (2008, p. 2) explain that the Oxford English Dictionary defines foresight as "the ability to predict and prepare for future events and needs." Piirainen (2014) states that foresight "is a purposeful process of developing knowledge about the future of a given unit of analysis or a system of actors, which is aimed at action in the form of public or private policy making, strategizing and planning." Martin (2010) reports that on April 16, 2010, Google Scholar has referenced more than 5,000 academic articles that contain the term "foresight." However, the author leaves open whether the article or the title contains the term. A recent query on Google Scholar on article titles that contain the term "foresight" delivered over 5,500 results, which amounts to an increase of 10% since 2010. A query on articles that contain the word "foresight" amounts to 295,000, which leads to the assumption that the author has performed the query regarding to articles that contain the term 'foresight" within the title.[9] The increase demonstrates the growing interest in the field of research.

Recent studies on foresight reveal that foresight is a professional discipline practiced in various professional and academic domains, and is about to emerge as an individual scientific discipline (Georghiou et al., 2008; Giaoutzi and Sapio, 2013; Andersen and Andersen, 2014; Gavigan et al., 2001). Academic peer-reviewed journals like *Technological Forecast and Social Change*, *Foresight: The Journal of Future Studies, Strategic Thinking and Policy*, *Foresight: The International Journal of Applied Forecasting*, *Journal of Future Studies*, *Futures*, and *European Journal of Futures Research* emphasize the scientific progress of foresight. However, foresight lacks a clear theoretical fundament (Hideg, 2007; Miller et al., 2010; Piirainen, 2014). Piirainen (2014) provides an approach to theory development and claims that research should elaborate more on the epistemology, which is also codified in a later article:

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[9] Google Scholar accessed on February 2, 2015

> Finally, theorizing in foresight contributes to better, more valid, reliable, and unbiased (or recognizably biased), foresight, and may also contribute to the surrounding disciplines through refinement of the theories. As theories are essentially empirically tested codifications of generalizable knowledge, and thus contribute to building a discipline and in the field, we argue that more rigorous theory development would both improve the quality and impact of foresight as well as legitimacy of the field (Piirainen and Gonzalez, 2015, p. 199).

Foresight applies existing models of management science and future research in the context of environmental analysis and long-term planning, to conquer the risk and the chances that stem out of global economic trends (GETs). There are different types of foresight, such as strategic foresight, corporate foresight, regional foresight, innovation foresight, technology foresight, as well as future-oriented technology analysis that focus on technological innovation (Georghiou, 2008). Dufva and Koivisto (2014, p. 3) explain that foresight explores the future with the aim not to "know what will happen but rather to know what needs to be done in the present." Each discipline of foresight follows this aim, but differs in its application. Furthermore, Dufva and Koivisto (2014) point out that foresight comprises three different facets, which are depicted in Table 6.

Table 6: Three facets of foresight
(Source: Dufva and Koivisto 2014, p. 3)

Facet	Definition	Examples of effect
Knowledge	The production of new knowledge and insights about possible future developments and the consequences of present actions that help stakeholders to (re-)position themselves in the innovation system	Foresight practices as illustrated in Section 2.2.1.1
Relations	The creation of new connections between different stakeholders and across sectors, and the restructuring and enhancing of existing networks	Bringing together stakeholders (e.g. from industry, research and public sector) into joint envisioning, new contacts, enhanced networks
Capabilities	The learning of new capabilities that contribute to the future-orientation of an organization and the system at large	Learning new skills, habits, mind-sets and methods, which strengthen foresight and innovation capabilities

2.2.1.2 Classification of foresight

A keyword search on "foresight" in the EBSCO database delivers an early work on foresighting, the article "Harrod on the Trade Cycle" (Hansen, 1937). Hansen (1937) has used the term "perfect foresight" in the context of perfectly foreseeing a future event, which was the cyclic movement of business (1937). Turnovsky (2000, pp. 288–289) defines the perfect foresight equilibrium (PFE) as a situation in which the "planned demands for output, labor, and the various securities in the economy all equal corresponding real supplies, and in addition, all anticipated variables are correctly forecast." The concept of rational expectations is still present in modern economic theory, but it is portrayed critically due to its idealized form of presentation. Christiaans (2013) presents a critical account on perfect foresight based on the rational expectations model of the housing market.

According to Miles et al. (2008), Irvine and Martin (1984) introduced the term "foresight" as a counterpart to hindsight and used the term to portray foresight as a methodological approach in various contexts. Foresight, however, has many facets and different terminologies, such as strategic foresight, corporate foresight, national and regional foresight, technological foresight. Gavigan et al. (2001, p. 3) provide a common definition to foresight, by stating that foresight is "a systematic, participatory, future intelligence gathering and medium-to-long term vision building process aimed at present-day decisions and mobilising joint actions." Gavigan et al. (2001, p. 12) define five criteria to foresight, which are also referred to by Georghiou et al. (2008, p. 12):

- It involves structured anticipation and projections of long-term social, economic, and technological developments and needs;
- Interactive and participative methods of exploratory debate, analysis and study, involving a wide variety of stakeholders, are also characteristic of foresight (as opposed to many traditional futures studies that tend to be the preserve of experts);
- These interactive approaches involve forging new social networks. Emphasis on the networking role varies across Foresight programmes. It is often taken to be

equally, if not more, important than the more formal products such as reports and lists of action points;

- The formal products of Foresight go beyond the presentation of scenarios (however stimulating these may be) and beyond the preparation of plans. What is crucial is the elaboration of a guiding strategic vision, to which there can be a shared sense of commitment (achieved in part, through the networking processes);

- This shared vision is not a utopia. There has to be explicit recognition and explication of the implications for present day decisions and actions.

The above definition was part of a paper of research project FOREN (Foresight for Regional Development Network) from the European Commission Research Directorate General STRATA Programme. Gavigan et al. (2001, p. III) explain that the study that concentrates on the area of the European Union "sets out to explain how Foresight (also known as *prospective* or *prospective territoriale*) can be implemented so as to provide valuable inputs to strategy and policy planning in regions, municipalities or localities, as well as to mobilise collective strategic actions."

Godet (2011, p. XVI) deploys the terms "prospective" or "*prospective territoriale*" in the context of foresighting to and characterizes it as "a multidisciplinary intellectual approach characterized by an all-encompassing and systemic vision in which various actors and variables may play a determining role in the outcome of any given future." The term "*prospective territoriale*" refers to regional foresight (Miles and Keenan, 2002, p. VII). The terms "foresight" and "*la prospective*" have commonalities. Godet (2011, p. XIV) refers to Martin (2010), who claims that foresight and *la prospective* in France indicate belief in the existence of many possible futures. Furthermore, Godet (2011) provides a perfect reference to GETs in the context of foresighting:

> That which will happen tomorrow depends less on prevailing trends or any sort of fatalistic determinism, and more on the actions of groups and individuals in the face of these trends (Godet, 2011, p. 19).

Since the mid-1940s, studies like FOREN have been the breeding ground for future-oriented analysis in the private and public sectors (Andersen and

Andersen, 2014, p. 278). Before foresight, no science-based approach for future studies or environmental analysis that transforms into strategies was been available (Kreibich et al., 2011, p. 3). Kreibich et al. (2011) claim that prior to foresighting exercises in philosophy, theology, and the social sciences had been driven by speculation, as demonstrated by future and historico-philosophical models of society of Hegel, Marx and Engels, Henry Adams, and Oswald Spengler. However, the lack of science in the field of future studies, which is still present, provides researchers in this field the chance to establish a scientific foundation to reach a higher degree of acceptance. As neither trend research nor existing scientific models have been capable to provide a foundation for future studies, foresighting is the new ground for future studies (Pillkahn, 2008, p. 34).

A recent example is the book *Technology Foresight* by Georghiou et al. (2008). In the chapter, "The Many Faces of Foresight," Miles et al. (2008, p. 8) reveal that there are very few uses of the term "foresight" until the 1990s when there was a dramatic increase that materialized to "forecasting, scanning, strategy analysis, or prospective[, which] are now relabeled foresight." Pillkahn concludes that the popularity of foresight studies has dramatically increased in recent years (2008, p. 162). Kreibich et al. (2011, p. 4) claim that modern future studies come from the U.S. academic environment where the acceptance of crossing traditional disciplines and the multidisciplinary cooperation between science, business, politics and economics is high. This view is also supported by Rohrbeck (2011, p. 35), who points out that foresight has a lack of clear terminology, of interchange, and of "cross-referencing between research streams." As depicted in Table 7, the literature provides various terminologies for foresighting.

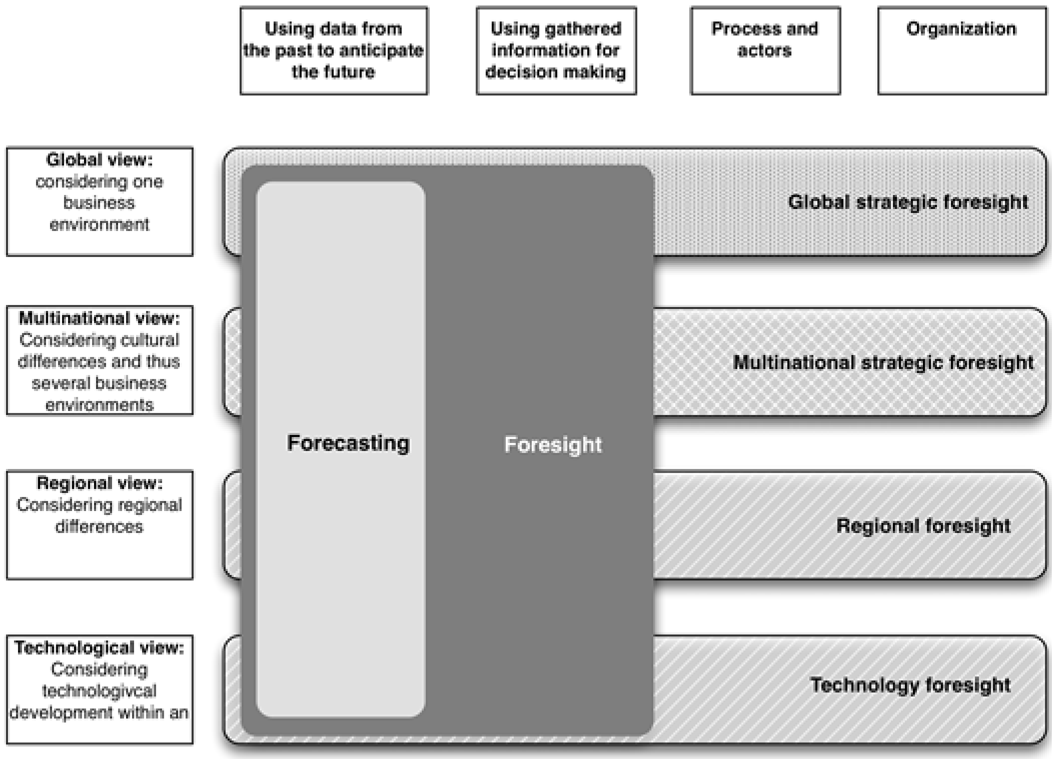
Wippel (2014) provides a classification of recent future studies, based upon the work of Rohrbeck et al. (2007), which distinguishes forecasting from foresighting activities. Rohrbeck et al. (2007) claim that forecasting and foresighting have been investigated on various areas on the regional, national, or supranational level. However, forecasting concentrates merely on methods like trend exploration, s-curves, patent and publication analysis, whereas foresighting takes the corporate capacity to deal with the future into account (Rohrbeck et al., 2007, p. 3).

Table 7: Foresight terminologies and characteristics

Terminology	Definition	Author
Regional foresight	Regional foresight is the implementation of anticipation, participation, networking, vision and action at a reduced territorial scale..	Gavigan et al. (2001, p. 3)
Corporate foresight	Corporate foresight is an ability that includes any structural or cultural element that enables the company to detect discontinuous change early, interpret the consequences for the company, and formulate effective responses to ensure the long-term survival and success of the company.	Rohrbeck (2011, p. 11)
Strategic foresight	Strategic foresight, which is also known as managerial foresight, is distinguished not just by its time frame and field but also by its wider perspective, as it not only includes tools for analyzing past data but also those for predicting the future, such as scenario planning. Strategic foresight also considers corporate foresight activities in terms of facing higher uncertainty due to their long product life cycles and high investments.	Wippel (2014, p. 21); Müller and Müller-Stewens (2009, p. 8)
Industry foresight	Industry foresight helps managers to identify possible customers in the short-term (5 years), the mid-term (10 years), and the long-term (15 years). It identifies the important competencies for the corporation and the customers (discontinuities and innovation), and it reconfigures the interface between customers and corporations.	Hamel and Prahalad (1994, p. 79)
Technology foresight	Technology foresight is about scanning the macroeconomic environment to foresee technological changes. The timeframe of scanning is mid- to long-term time.	Wippel, 2014, p. 26

The classification of Wippel (2014) divides the initial view on the corporate level into the global view and into the multinational view to distinguish the cultural aspects important to foresighting. The initial presentation of Rohrbeck et al. (2007) contains the regional, national, and supranational view. However, both demonstrations come with certain benefits and disadvantages. The conclusion drawn in this context takes the regional and the technological component of foresighting into account. Hence, an overall academic classification of future studies incorporates regional and technological foresight as an individual strain of research, as depicted in Figure 10.

Figure 10: Academic classification of forecasting and foresight studies
(Own creation, based on Wippel, 2014, p. 28; Rohrbeck et al., 2007)



As depicted above, each strain of foresighting includes practices from the field of forecasting and foresight, has an individual view, and involves different processes and actors as well as different organizations. This classification is ideal to the GETs, because the outcome of foresight can have social, economic, political, and cultural characteristics (Gavigan et al., 2001). For Gavigan and Scapolo (2001) foresighting is a highly participatory approach to seek for network opportunities and to stimulate policy-makers, researchers, enterprises to translate scenario analysis into strategic planning and decision-making (represented on the horizontal axis in Figure 10). Furthermore, foresight activities combine and utilize tacit knowledge from its actors to identify the valuable inputs. Gavigan and Scapolo (2001, p. 2) emphasize that foresight is especially important for "public and/or private initiatives, vision building, network formation, education and knowledge dissemination among relevant actors, especially among policy decision-makers".

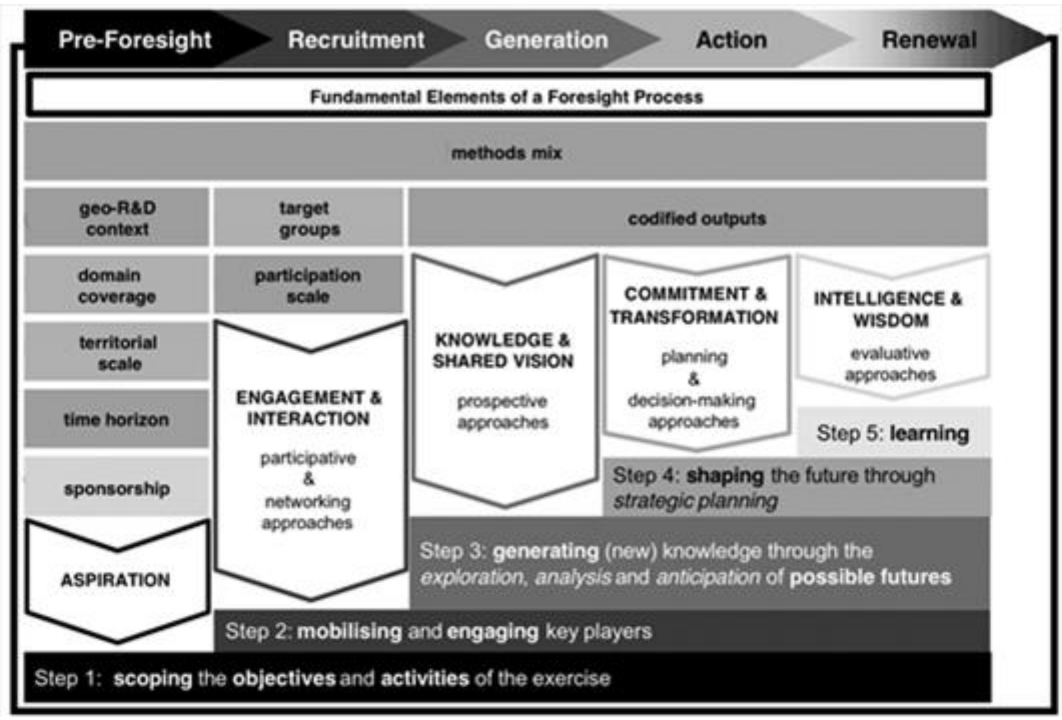
Operationalizable Conclusion 13: Forecasting and foresighting are either independent or mutual activities that foster the creation of a completely exhaustive view in the field of future studies with global, multinational, regional, or technological focus.

2.2.1.3 Foresighting processes

Researchers and practitioners see processes of foresighting as the practical application of qualitative and quantitative methodologies in the context of future research (Cuhls, 2003b; Popper, 2008a; Rohrbeck, 2011; Wippel, 2014). Cuhls (2003b, p. 96) agrees with the definition from Coates et al. (1994, p. 30), who define foresight as a process that includes qualitative and quantitative aspects "for monitoring clues and indicators of evolving trends and development and is best and most useful when directly linked to the analysis of policy implications." Hanssen et al. (2009, p. 1735) underline the benefit of the foresight process, as it is a "technique for combining relevant information on current trends and future developments with actor-based information and attitudes, which is obtained through participatory measures." In recent years, various models of foresighting processes emerged, corresponding to the type of foresight. Literature on the profession of foresighting shows various processes applied in research studies

(Slaughter, 1995; cf. e.g. Miles and Keenan, 2002; Popper, 2008a; Georghiou et al., 2008; Miles, 2010; Liebl and Schwarz, 2010; Magruk, 2011; Wippel, 2014; Rohrbeck, 2011; Godet, 2011). Magruk (2011, p. 701) cites a popular definition of foresighting by Ben Martin and John Irvine: "Foresight is the process involved in systematically attempting to look into the long-term future of science, technology, economy and society with the aim of identifying the areas of strategic research and the emerging generic technologies likely to yield the greatest economic and social benefits." (Martin 2010, adopted in Magruk 2011, p.701). Schwarz (2008b, p. 85) explains that foresight processes are learning efforts made by organizations to foster the robustness of business, and help organization to be better prepared for "surprises, new and emerging weak signals, or trends." Popper (2008a, p. 45) depicts foresight as a general process with five phases, based on Miles (1981), which are pre-foresighting, recruitment, generation, action, and renewal, as demonstrated in Figure 11.

Figure 11: Foresight process
(Source: Popper (2008a, p. 45; 2008b, p. 68))



These steps also relate to the classical approach of strategic or business planning, which emphasize the participatory approach of foresight as well as the resource-driven approach that stems from the nature of strategic planning. Slaughter (1995, p. 2) explains that foresight is a "process of expanding awareness and understanding through futures scanning and the clarification of emerging situations." Slaughter (1995) refers to the importance of creating awareness for possible scenarios to create a common understanding, and to leave aside the absurd conceit of predicting social futures. Based upon his analysis (Slaughter, 1995, p. 52), an efficient and effective foresight process avoids an "overemphasis on empiricist and fixed space-time thinking, personal disempowerment and fear […].". To reach effectiveness and efficiency, it is required that foresighting interlinks with existing value-creating processes. For example, in the context of innovation, it is crucial that research and development processes incorporate future changes in economy and/or society to technology development (van der Duin and den Hartigh, 2011, p. 48). Rohrbeck (2011) claims that the discipline of foresight, especially corporate foresight, qualifies itself as a resource that provides a competitive advantage for corporations. Reflecting on the argument that foresight is a competitive resource, Barney (1991, p. 106) assumes that a resource is valuable and creates a competitive advantage that meets the following four key principles:

- It is valuable;
- It is rare among a firm's current and potential competition;
- It is imperfectly imitable;
- It cannot be strategically substituted for an equivalent.

Therefore, foresight provides further ground for researchers that analyze the processes of foresight from the resource-based perspective. Another point that is important in this context is that corporate foresight process itself might include perspectives on resources and their ties to the corporation, the region, or the society.

Furthermore, a foresight process is a valuable skill or a key competence to the corporation that enables a corporation to derive innovative options for product improvement or product creation that creates a customer benefit (Prahalad and Hamel, 1990). Besides products, the same applies to services. Major et al. (2001, p. 105) argue that a corporate strategy benefits from the connection between the core competence-based view and foresight. Even more, the authors point out that interdisciplinary research that includes strategy perspectives as well as foresight perspectives fosters the effectiveness of foresight (Major et al., 2001, p. 105). Empirical results from a Delphi study conducted by Schwarz (2008a, p. 244) with 84 members maintain the importance of foresight processes. The study shows that German corporations rate future studies as potentially valuable. However, the application of available methodologies lacks effectiveness because foresight processes are either not mature enough, or the corporate culture cannot adapt to the results of the studies (Schwarz, 2008a, p. 244).

Operationalizable Conclusion 14: Corporate and technology foresighting processes are a key competency for corporations to foster innovative development for products (and services) and to create a customer benefit.

The outcome of the mentioned Delphi study leads to the question of what criteria define an effective foresighting process. Based upon Slaughter (2004), Magruk (2011, p. 702) concludes that an effective foresight process requires "identification, profiling and indication of all factors influencing the technology foresight research process." In detail, Magruk (2011) refers to the effectiveness of technology foresighting:

> For the design process, and the correct choice of suitable research methods, to be an effective process, indispensable are identification, profiling and indication of all factors influencing the technology foresight research process (Magruk, 2011, p. 702).

Based upon past studies, Magruk (2011, p. 702) provides a set of factors that influence a technology foresight process, and this set is adapted and extended in this research to emphasize the complexity that stems out from the design of a foresight process. Table 8 illustrates these factors.

Table 8: Factors influencing a foresight research process
(Source: Magruk, 2011, p. 701)

Category	Factors
Institutions realizing foresight	public institutions; government; the academies of sciences; industrial associations; corporations (SME and MNE)
Range of area studied	global strategy, regions, clusters, individual technology; individual discipline; wide fields; whole areas of science and technique
Aims, tasks, the functions of foresight	determination economic priorities; building social consensus over some issues; delimination strategic economic directions
Levels	supranational; subnational; national; regional; local level; business
Meaning orientation	foresight as a competency, resource, or process; formal or informal orientation on need; orientation to problem
Approach to object of investigation	professional analytical model; model of social changes
Aspects	technological; strategic; social; cultural; political; economic; scientific; consumer; etc.
Kind of possessed data	quantitative; qualitative; digital; printed
Data source	literature; experts; own research, universities; press; media ; scientific publications; internal and external databases
Kind of stakeholders	scientists; businessman; politicians; society
Work environment	scientific-business; virtual-real
Time	horizon; project period
Objectives	policy development; networking; shared visions; public discussion; future thinking
Budget of project	publicly or privately funded
Access to data	quantitative and qualitative; low and wide
Legitimacy of a combination of foresight methods	Low, medium, high, or very high

From the perspective of Magruk (2011, p. 701), it is essential to include these factors in the foresight design process; otherwise it "becomes a process which is non-systematic and incoherent, and is based solely on intuition and sometimes the inexperience and irresponsibility of practitioners and organizers." (Magruk, 2011, p. 701) Anticipating the discussion in the next section, information and communication technology (ICT) helps to reduce process inefficiencies, as pointed out by Keller and von der Gracht (2014):

> Forsight processes are already supported by a large diversity of software applications. This includes trend databased, analytical software for trend extrapolation and scenario software packages (Keller and von der Gracht, 2014, p. 81).

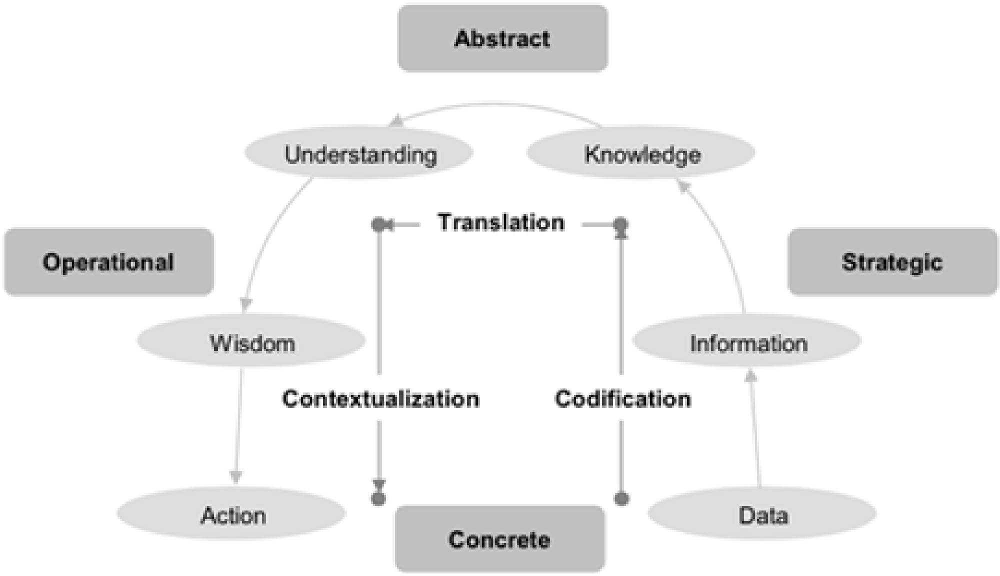
Operationalizable Conclusion 15: An effective and efficient foresight exercise requires careful planning and extensive practical preparation to foster the development of a common vision and a high integration of the foresight stakeholders.

2.2.1.4 Knowledge in the context of foresight and regions

The importance of knowledge in the context of foresight has been pointed out by several authors in the field of corporate, technological, and regional foresight (cf. e.g. Major and Cordey-Hayes, 2000; Müller, 2008; Alsan and Oner, 2004). Acquiring knowledge about future settings and scenarios is at the heart of foresight. Müller (2008, p. 46) refers to the work of Major and Cordey-Hayes (2000), who present an integrated knowledge transfer process in the concept of foresight. Major and Cordey-Hayes (2000, p. 412) derive their concept of knowledge transfer from the field of innovation state that knowledge transfer might occur "from one place, person, ownership etc. to another."

A central argument presented by the authors is that approaches in the field of foresight do not encourage forward thinking effectively enough in the industry. They used the example of the U.K. foresight program to illustrate the knowledge gap between foresight and knowledge, and to demonstrate how data is codified into knowledge, and translated into action. Figure 12 shows the model presented by the authors.

Figure 12: Knowledge translation in the field of foresight
(Source: Major and Cordey-Hayes, 2000, p. 420)



The transformation of data into corporate action require mature knowledge management processes that are capable to transform external into internal knowledge (cf. e.g. Major and Cordey-Hayes, 2000; Müller and Müller-Stewens, 2009, p. 23; Müller, 2008, p. 46). On the one hand, knowledge is either present or absent within a corporation, a region, or a cultural environment, which demonstrates the affiliation of knowledge. This type of knowledge can be either, on the one hand, explicit or codified in files, books, protocols, files, or (expert-) databases, or on the other hand, a hidden or tacit type of knowledge related to unwritten laws, undocumented knowledge, or simply knowledge affiliated with certain experts (Pillkahn, 2008). As demonstrated by future studies, foresight activities aim beyond the knowledge that is available to humankind from today's point in time.

Within a corporate environment, Nonaka and Takeuchi (1995, p. 14) underline that the process of knowledge creation involves ambiguity and redundancies because knowledge is often created out of chaos and sharing of explicit knowledge leads to internalizing processes. In this context, (Nonaka and Takeuchi, 1995, p. 15) point out that the overall process requires control to "direct the confusion towards purposeful knowledge creation." Slaughter (1995) claims that a broad array of methods and concepts is already available to draw an overview of our context in time (past, present, and near-term future), and to overcome uncertainties about our futures. In this regard, uncertainties mean the absence of knowledge about the future, or the unknowable (Taleb, 2008; Pillkahn, 2008, p. 36).

Within regions or in-between regions on the national or supranational level, the process of knowledge creation, learning and sharing refer to the terminology of "knowledge-spillover." This term is deployed by various authors in the field of economic geography and regional innovation systems (e.g. Groot et al., 2001; Acs et al., 2002; Cooke, 2003; Cooke and Leydesdorff, 2006). Regional foresight studies also apply the concepts of knowledge-spillovers and knowledge creation, as demonstrated in the preceding analysis. As Alsan and Oner (2004, p. 890) point out, even though national foresight studies have become more popular in the last decade of the 20th century, most of the foresight studies failed to capture all the dimensions and elements of foresight. They point out that the above-mentioned UK foresight program lacks maturity, as it is still on a more operative level than to foresight programs of Japan or Germany (Alsan and Oner, 2004, p. 899).

Outlining in greater detail, further analysis shows the role of knowledge in the context of regions. As Bastian's (2006) analysis suggests, regional knowledge of culture depicted as explicit and tacit (collective) knowledge is the key to understand the socio-economic interaction within a regional setting, and to get behind economic indicators like growth rates, levels of income or employment, which obfuscate real knowledge development. Bastian (2006, p. 612) points out that "tacit knowledge points to fundamental regional disparities that decide over the prospects for an assimilation of new knowledge." In this case, tacit knowledge is required to understand regional growth process and their quantitative effects (Bastian, 2006).

Furthermore, he concludes that political decision-makers should concentrate on (a) tacit (collective) knowledge to create or to enhance a fruitful knowledge culture, or on (b) the fostering of knowledge management that enables the interchange of knowledge across regions. As the analysis of Nonaka and Takeuchi suggest, establishing a knowledge culture requires that public institutions that accompany the process.

Operationalizable Conclusion 16: Successful foresighting founds on the collaboration of stakeholders. Political institutions should concentrate on (a) tacit (collective) knowledge to create or to enhance a fruitful knowledge culture or on (b) fostering of knowledge management, which enables the interchange of knowledge across regions.

In this context, the concept of collaboration has several aspects, such as developing a common understanding and creating a strong vision. Collaboration has also an economic impact in the form of operational expenses or capital investments that need to be included in the development of the vision. In the regard to the optimization context of capital investments, Hanssen et al. (2009, p. 1735) outline that the rationale of foresight has two aspects:

- Prediction is combined with the development of common visions and shared goals;

- Regional integration and development of networks are as important as the end product.

Collaboration between stakeholders and the involvement of public institutions are requirements to successful foresighting and knowledge creation. Godet (2011, p. 112) emphasizes that regional foresighting has to incorporate a cooperative approach between public and private institutions to raise acceptance in public. Godet (2011, p. 100) explains that the normative goal of foresight raises many concerns about what is “considered desired by society.”

The explorative side of foresight aims to identify the best possible scenarios for public projects and scenarios used within decision making. Godet (2011, p. 103) further points out that the implementation of a regional approach requires three component approaches: “a prospective approach, a strategic approach, and a collective process approach.” Hence, Godet’s approach aims at maximizing the success of public projects in the field of environmental development by (1) creating a mutual vision (anticipation), (2) developing a common strategic plan and mission to achieve the vision (action) and ensure appropriation of the plan by all participating stakeholders (appropriation). However, in terms of decision-making based on strategic knowledge, only few (local) executives in a region are involved in the decision-making process. Godet (2011) explains that the approach of a prospective study overcomes this problem by implementing an open approach for the gathering of information and creating knowledge, and a restricted approach for the decision-making:

> The highly sensitive nature of strategic information often dictates that strategy decisions be made exclusively by local officials without the explicit knowledge of those who are expected to implement the strategy at the tactical level. Any *prospective* study may be structured in such a way as to respect the sensitivity and confidentiality of strategic information. That is to say that *prospective* may involve a large number of participants in order to understand the major stakes concerning the future but that the strategic decisions which ensue are often guarded secrets among regional administrators and elected officials. In some cases, divulging strategic information would undermine an organization’s ability to implement a strategy effectively because it would signal an organization’s strategic orientation vis-à-vis its competitors. Therefore, when strategic information is sensitive, the process includes a pilot group composed of senior regional officials who are guided by both method and domain experts, and the flexible utilization of the tools of *prospective* is recommended (Godet, 2011, p. 110).

Operationalizable Conclusion 17: Developing a mutual vision that results in a strategic plan that is followed by all participating stakeholders is a key requirement to raise the effectiveness and efficiency of capital investments.

2.2.2 General view on the practical application of foresight

2.2.2.1 Method toolkit for foresight practices

Foresight studies apply different types of qualitative, quantitative, and semi-quantitative methods, depending on the context that can range from expert-based to context-based foresight methods. The usual practice is that several methods are combined to achieve the most effective results (Miles et al., 2008). Yet, researchers have not asked what methods belong to a method toolkit for foresight practices. Traditional models in strategic planning, forecasting, and technological development have a narrow focus and do not provide predictive, statistical, economic, or technological approaches that open the view to a broader perspective (Magruk, 2011, p. 701). Karlsen and Karlsen (2013) claim that due to the inherent ontological and epistemological characteristics of foresight studies:

> It is evident that there is a gap between the complexity of future options and pathways which is addressed in foresight studies and the analytical tools applied to map this complexity. And there is no consensus on an appropriate methodology balance between the qualitative and quantitative approaches (Karlsen and Karlsen, 2013, p. 28).

Choosing distinct methods that fit the relevant aspects of the research task is crucial, as foresight methods have a long tradition (Schatzmann et al., 2013, p. 2). In this regard, Karlsen (2014, p. 4) claims that quantitative approaches contribute most to the long history of foresight methods, but qualitative approaches are on the rise. Magruk (2011, p. 701) claims that using multiple foresight methods in a study enhances the quality and delivers a better view on the future (anticipation). Furthermore, Magruk (2011, p. 703) claims that choosing the most effective method for foresight could only be verified from the hindsight, which raises the level of uncertainty in foresight research. Lüdecke (2013) explains that the various approaches and methods used in foresight refute the idea of a nomologico-deductive conception, as the quality of information is too low to apply a formal falsification procedure, due to the predictive character of foresight. Lüdecke (2013) explains that this predictive character is one reason that combining several methods in foresight studies is reasonable, and it opens up new chances for research:

> One way to integrate the different methodological traditions is on the level of the organization of foresight projects, which allows the results of different quantitative and qualitative methods to be integrated. This is certainly a step forward, but does not guarantee the mutual understanding of the reasoning behind these results – which is a severe shortcoming in the communication process. Therefore, it seems to be valuable to look for existing methods at the interface between the qualitative and the quantitative tradition (Lüdecke, 2013, p. 62).

The literature discusses whether qualitative or quantitative methods should shape the characteristic and direction of foresight. Therefore, there is a large variety of methods in between these two categories. Qualitative methods are the domain of expert opinions, whereas quantitative methods belong to the field of mathematical and econometrical analysis (Magruk, 2011). Magruk (2011) notes that the choice of methods should depend on the complexity of the issue:

> Qualitative methods should be used with very complex phenomena, trends which are difficult to numerically visualize unambiguously. Quantitative methods are mainly based on numerical representation of simple phenomena using mathematical models for this purpose. It is possible to distinguish so called indirect methods (Magruk, 2011, p. 706).

However, the literature does not provide a coherent view on which methods are appropriate and which may belong in a toolkit for foresight. Magruk (2011, p. 704) identifies over 108 different methods and techniques that might belong into a method toolkit of foresight. Porter (2010, p. 40) has identified over 51 different methodologies that could be applied in the context of foresight, whereas Popper (2008a) suggests 33 methods that differ in complexity. The methodology of Popper has a number of advantages, as the classification of the methods is clearly aligned along three criteria. Popper (2008a, p. 54) classifies the methods according to criteria such as qualitative, quantitative, or semi-quantitative. This approach is utilized in this thesis to serve as a toolkit for foresight, allowing discussion of the advantages of methods in the selection process and of where refinements to methods could be applied. Furthermore, the approach is widely accepted in other literature on foresight (cf. e.g. Wippel, (2014)). Therefore, this approach adds new findings to the stock of knowledge in this field of research. Table 9 illustrates common methodologies in foresight.

Table 9: Draft of a method toolkit for foresight analysis
(Source: Popper, 2008a, p. 54)

Qualitative (QU)	Quantitative (QA)	Semi-quantitative (SQ)
1 Backcasting	1 Benchmarking	1 Cross-impact / structural analysis (SA)
2 Brainstorming	2 Bibliometrics	2 Delphi
3 Citizens panels	3 Indicators/time series analysis (TSA)	3 Key / critical technologies
4 Conferences / workshops	4 Modelling	4 Multi-criteria analysis
5 Essays / scenario writing	5 Patent Analysis	5 Polling / voting
6 Expert panels	6 Trend extrapolation / impact analysis	6 Quantitative scenarios / SMIC
7 Genius forecasting		7 Roadmapping
8 Interviews		8 Stakeholder analysis / MACTOR
9 Literature reviews (LR)		
10 Morphological analysis		
11 Relevance trees / logic charts		
12 Role play / acting		
13 Scanning		
14 Scenario / scenario workshops		
15 Science fictioning		
16 Simulation gaming		
17 Surveys		
18 SWOT analysis		
19 Weak signals /wildcards		

Qualitative: Methodologies that provide meaning to events and perceptions. Such interpretations tend to be based on subjectivity or creativity that is often difficult to corroborate (e.g. opinions brainstorming sessions, interviews)

Quantitative: Methods measuring variables and applying statistical analyses, using or generating (hopefully) reliable and valid data (e.g. socio-economic indicators)

Semi-quantitative: Methods that apply mathematical principles to quantify subjectivity, rational judgments and the viewpoints of experts and commentators (i.e. weighting opinions or probabilities)

The categorization given by Popper (2008a) provides an ideal starting point to develop a toolkit for foresight analysis. Table 10 provides further details to the illustrated methods.

Table 10: Methods for foresight toolkit

(Source: Popper, 2008a, pp. 55–68; Wippel, 2014, pp. 39–70; Rabin and Jackowski, 1988; UNIDO, 2005; Schwarz et al., 2014; Ansoff, 1980; Kreibich et al., 2011; Holopainen and Toivonen, 2012; Godet, 2011)

Technique	Explanation
QA 1 Quantitative benchmarking	Benchmarking is commonly used for marketing and business-strategy planning and has recently become more popular in governmental and inter-governmental strategic decision-making processes. The main question here is what others are doing in comparison to what you are doing (Popper, 2008a).
QA 2 Bibliometrics	Statistical analysis of publications (number of publications emerging in an area, geographical aspects, important authors) (Wippel, 2014). It involves impact analysis based on citation indicators such as SCI, Google Scholar Index, or H-Index to identify the most influential pieces of work and experts.
QA 3 Indicators/ time series analysis	Identification of figures to measure changes over time. Built from statistical data with the purpose of describing, monitoring and measuring the evolution and the current state of relevant issues (Popper, 2008a).
QA 4 Modelling	Computer-based models, such as agent-based modelling systems. Complexity depends on the amount of variables used. Econometric models are routinely used in economic policy-making, for example, and are “calibrated” from economic statistics and statistical analyses of their interrelations (Popper, 2008a).
QA 5 Patent analysis	Based on the concepts of bibliometrics to analyze patents. Quantitative analysis uses statistical methods to look at the number of patent registrations, assuming that increasing or decreasing registrations would (apparently) indicate, for example, low or high potential for technological developments in a specific area (Popper, 2008a).
QA 6 Trend extrapolation / impact analysis	Mature, long history in forecasting (Wippel, 2014). Numerical methods that use quantitative information of an economic, social, environmental, or technological process to project the state into the future (Rabin and Jackowski, 1988). Preferred in the context of megatrends to refer to macro-level phenomena, which include various (sometimes conflicting) sub-phenomena, and to identify potential impacts that major trends or events would have on systems, regions, policies, people, etc. (Popper, 2008a).
QU 1 Backcasting	Considers many alternative outputs dependent on possible impacts to an entity (corporation, region, etc.). Working back from an imagined future to establish what path might take us there from the present (Popper, 2008a). Used in aspirational scenario workshops (Wippel, 2014).
QU 2 Brainstorming	A creative and interactive method used in face-to-face and online group working sessions to generate new ideas around an area of interest (UNIDO, 2005). Techniques like STEEPV allow people to think more freely and move

Technique	Explanation
	into new areas of thought and to propose new solutions to problems (Popper, 2008a).
QU 3 Citizen panels	Groups of citizens (members of a polity or residents of a particular geographic area) dedicated to providing views on relevant issues, often for a regional or national government (Popper, 2008a). More than a conventional opinion survey, since its members are encouraged to deepen their understanding of the issues involved (Popper, 2008a).
QU 4 Conferences / workshops	Conferences/Workshops are events or meetings lasting from a few hours to a few days, in which there is typically a mix of talks, presentations, and discussions and debates on a particular subject (Popper, 2008a). The events may be more or less highly structured and "scripted": participants may be assigned specific detailed tasks, or left very much to their own devices (Popper, 2008a).
QU 5 Essays / scenario writing	Essays on future events based created on a creative combination of data, facts and hypotheses (Popper, 2008a). Requires insightful and intuitive thinking about possible futures, normally based on a systematic analysis of the present (Popper, 2008a). Essays can be used as an input to a Delphi survey or to an expert panel meeting.
QU 6 Expert panels	Local, regional, national or international groups of people combining their knowledge concerning a given area of interest (UNIDO, 2005). Panels are typically organised to bring together "legitimate" expertise, but can also attempt to include creative, imaginative and visionary perspectives (Popper, 2008a).
QU 7 Genius forecasting	Generation of a vision (or several visions) of the future through the insights of a gifted and respected individual or individuals (UNIDO, 2005).
QU 8 Interviews	Fundamental tool of social research (Rabin and Jackowski, 1988). In futures studies they are often used as formal consultation instruments, intended to gather knowledge that is distributed across the range of interviewees (Popper, 2008a).
QU 9 Literature review (LR)	Provides an overview of the recent state of research (Wippel, 2014). Reviews generally use a discursive writing style and are structured around themes and related theories (Popper, 2008a).
QU 10 Morphological analysis	This technique was originally directed at exploring new forms that systems could adopt from a technological point of view (UNIDO, 2005). Aimed at complex problem-solving and management of change, it may be used in planning or scenario development (Popper, 2008a). It maps promising solutions to a given problem and determines possible futures accordingly: the classic applications have involved systematically working through the entire range of conceivable technological solutions for a particular goal (Popper, 2008a).

Technique	Explanation
QU 11 Relevance trees and logic charts	Creates a logical order and map out topics and sub-topics. Helps to organize research activities. Allows control of attainment of a chosen future by defining alternative pathways (Rabin and Jackowski, 1988).
QU 12 Role play / acting	Requires reflection, imaginary interaction and creativity (Popper, 2008a). Used to create a perspective change that is required to gain further insight into a topic.
QU 13 Scanning / environmental scanning	Is a formal or informal process for monitoring change in the technological, political, social, ecological or economic environment (UNIDO, 2005). Can be passive scanning, active scanning, or directed scanning (UNIDO, 2005).
QU 14 Scenarios	Scenarios refer to a wide range of approaches involving the construction and use of scenarios – more or less systematic and internally consistent visions of plausible future states of affairs (Popper, 2008a). They may be produced by means of deskwork, workshops or the use of tools such as computer modelling (Popper, 2008a). Further information can be obtained in section 2.2.2.4.
QU 15 Science fictioning (SF)	Science fiction (SF) prototyping uses fictional stories about the future to investigate the implication of science and technology not just feasible at present (Schwarz et al., 2014). Has the potential to broaden the perspective of managers in responding to technological questions, and the potential to foster the identification of important weak signals (Schwarz et al., 2014).
QU 16 Simulation gaming	One of the oldest forecasting and planning techniques, which is a form of role-playing in which an extensive "script" outlines the context of action and the actors involved (Popper, 2008a). There have long been technological aids used here, such as model battlefields, and now computer simulations (Popper, 2008a).
QU 17 Surveys	The most fundamental tool of social research widely used in many areas of social science. Comprises a questionnaire that is distributed in print or is made available online. Success of the survey analysis is determined by the rate of respondents (Rabin and Jackowski, 1988).
QU 18 SWOT analysis	Analysis applied in different contexts to determine the external opportunities and threats as well as the inner strengths and weaknesses of an entity, which can take various forms (geographical entity such as a cluster or region, a corporation, part of a corporation, etc.). Determines the strategic options that are required to invoke change, or to be prepared for certain events (Ansoff, 1980).
QU 19 Wild cards & weak signals (Wi-We)	Wild cards and shocks are those surprise events and situations which can happen but usually have a low probability of doing so – but if they do their impact is very high (Kreibich et al., 2011). Assessing of weak signals (and wild cards) means focusing on unclear observable warnings. Phenomena with major impacts are either weak signals or megatrends; weak signals have low probability of realization and megatrends have high (Holopainen and Toivonen, 2012).

Technique	Explanation
SQ 1 Cross impact / structural analysis	Cross impact is a method that forces attention to chains of causality: x effects y; y effects z to create a matrix of conditional probabilities (UNIDO, 2005). Requires that a set of key variables is determined in order to understand the system of concern (Popper, 2008a). A weakness of this technique is the wide range of difficult expert judgement, and only a few variables can be considered for practical reasons (Wippel, 2014).
SQ 2 Delphi / real-time delphi	Delphi is a well-established technique that involves repeated polling of the same individuals, feeding back (sometimes) anonymised responses from earlier rounds of polling, with the idea that this will allow for better judgements to be made without undue influence from forceful or high-status advocates (Popper, 2008a). More information and a discussion about the present situation in the literature can be found in section 2.2.2.4.
SQ 3 Key / critical technologies	Key technologies or critical technologies aim to identify the most influential technologies of a certain period of time – technologies with an impact on quality-of-life and competitiveness (Wippel, 2014). However the method is implemented (expert panels or surveys, for instance), it implies some prioritisation process (such as voting, multi-criteria and/or cross-impact analysis) (Popper, 2008a).
SQ 4 Multi-criteria analysis	Multi criteria analysis supports prioritisation and decision making, and is very useful for complex situations and problems because it weights up the effect of multiple criteria with regards to a particular intervention (Wippel, 2014). Participants are confronted with a variety of criteria that need to be evaluated. The outcome can be quantified and determines possibilities rather than probabilities (Wippel, 2014).
SQ 5 Polling / voting	Assessment of the strength of views about a particular topic among members of a workshop to indicate how probable, uncertain, or important they consider events to be, which actions are priorities and how feasible alternatives are (Popper, 2008a).
SQ 6 Quantitative scenarios / SMIC	Take various forms, such as involving quantification of the contingencies that bring about a certain scenario. Sometimes probabilistic analysis is established via expert opinion in order to build a system that evaluates the likelihood of occurrence of certain events (Popper, 2008a).
SQ 7 Roadmapping	A technique for supporting technology management and planning (UNIDO, 2005). It is a technique widely used by high-tech industries, where it serves as a tool for communication, exchange, and development of shared visions (Popper, 2008a).
SQ 8 Stakeholder analysis / MACTOR	A tool for participatory planning, and involves listing stakeholders and attempting to identify their interests, strengths and weaknesses in the activity (UNIDO, 2005). The method to assess interplay of actors (MACTOR) evaluates the important relationships among actors and their respective convergences and divergences regarding several important stakes and objectives related to these stakes (Godet, 2011).

Based on the analysis above, several observations have to be pointed out. A rather obvious observation is that the number of qualitative methods is greater than that of quantitative or semi-quantitative methods. The literature draws an ambivalent picture of the popularity of quantitative methods. On the one hand, Popper (2008a, p. 62) claims that the use of quantitative methods is rising. On the other hand, other authors who have evaluated the usage of quantitative methods have come to different results (cf. e.g. Prokesch et al., 2014). This difference could be a compelling indicator that quantitative methods are not accepted in practical application. Evidence is delivered by Prokesch et al. (2014, p. xlvii) who point out that corporations avoid forecasting due to costs for customer surveys and data providers, which leads to the situation that many organizations rely on internal informants.

Furthermore, Popper (2008a), Porter (2010), and Magruk (2011) reveal that foresight lacks of a standard vocabulary, due to a different labelling of methods and practices. Hence, it has to be considered that foresight lacks of a clear vocabulary. This is also demonstrated in the interviews about the practice of foresight conducted by Hammoud and Nash (2014, p. 2), who found out that participant "routinely interchanged similar constructs using different terms".[10] Interestingly, the above statement complements the analysis in Section 2.2., which focused on GETs and trend studies and pointed out the interchangeability of and practices in the context of trend research. In addition, the lack of quantitative methods has to be mentioned in this context.

Operationalizable Conclusion 18: The domain of foresight lacks a clear methodological toolkit and a common understanding what concepts have to be included into a toolkit, and how these concepts should be labeled. Furthermore, the availability of quantitative methods in the discipline of foresight has to be pointed out.

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[10] The study of Hammoud and Nash (2014) included 14 foresight practitioners of American corporations.

2.2.2.2 *Comparative analysis of foresight methods*

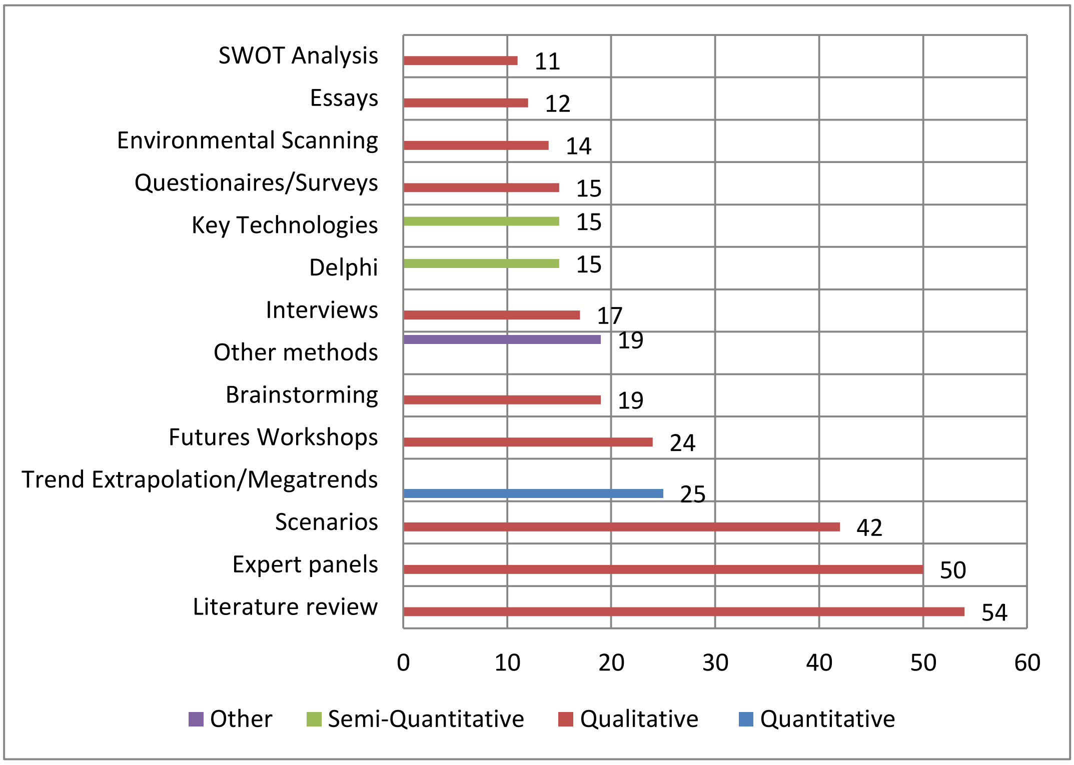
Choosing the correct methods for a foresight approach is based upon the strategic aim of the foresight study or the organizational parameters given (Müller, 2008, p. 52). Therefore, the selection of methods has a huge impact on the practical appeal of the studies. The foregoing discussion showed that foresight implements only few quantitative methods, and relies more on qualitative approaches. This section examines the selection of methodologies. Depending on the methodologies applied, the time from collecting the data, from identifying the signal, or from conducting expert interviews to the processing of the data and information, and to the decision-making varies on the amount of the methodologies applied.

Cuhls (2003b, p. 98) points out that as a prerequisite to the selection of the methods applied in the foresight exercise, specific targets have to be set that are in-line with the scope of the foresight activities. Foresight studies differ on two main approaches, which are that they might be either exploratory or normative. On the one hand, an exploratory approach transfers state-of-the-art knowledge within a certain field of research into a future setting. From that point of view, the studies explore possible future scenarios or establish hypotheses about yet unknown futures. Tools utilized in this context are Delphi studies, scenario workshops, impact analysis, or trend extrapolations. On the other hand, normative approaches ask the question of how a future setting has to look. In this case, the adjective "normative" refers to the model that creates the desired setting explored in the foresight activity. The aim of research is to identify possible paths towards that model. This pursuit involves methodologies like Delphi, scenario techniques, relevance trees, and roadmapping. Researchers such as Nikolova (2014) claim the variety of methods is necessary because no single approach is able to anticipate future events:

> It is clear that there is no single omnipotent foresight method within the myriad of ways to anticipate the future— neither statistically-based, nor intuition-driven. Futurists and foresight practitioners continue, however, to try to elaborate the most adequate tools to acquire knowledge and construct meaningful images of the future (Nikolova, 2014, p. 2).

Popper (2008b) delivers further criteria to the selection of foresight methods, which have been delivered by reviewing of 886 case studies of foresight activities. Qualitative methods like a literature review, expert panels, or scenario studies are more common than quantitative methods, as depicted in Figure 13.

Figure 13: Review of commonly used foresight methodologies
(Popper, 2008b, p. 33)



As demonstrated in the Figure 13, the literature review, expert panels and scenario analysis are the most used methodologies within the sample group of the study. These qualitative methods rely heavily on expert knowledge, and the source of data or information that build the foundation for the application is mostly individual knowledge or codified knowledge within the literature. Popper's findings affirm the qualitative character of future studies. Popper (2008a, p. 70) provides the methodology of the foresight diamond to map methodologies to the source of knowledge that builds the foundation for each of the depicted methodologies, as found in Figure 14.

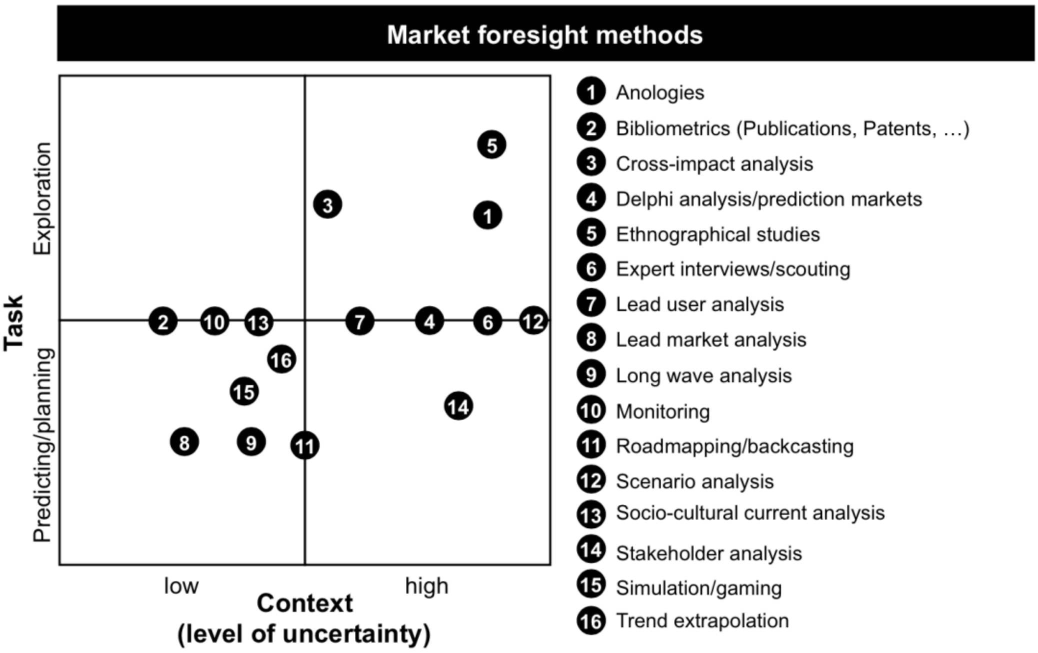
Figure 14: Foresight diamond
(Popper, 2008a, p. 34)

Popper (2008a, p. 34) describes the knowledge domains depicted in Figure 14 as:

> **Creativity**: Methods relying heavily on the inventiveness and ingenuity of very skilled individuals.
>
> **Interaction**: Methods relying heavily on the participation and shared views of experts and non-experts
>
> **Evidence**: Methods relying heavily on codified information, data, indicators, etc.
>
> **Expertise**: Methods relying heavily on the tacit knowledge of people with privileged access to relevant information or with accumulated knowledge.

The choice of foresight methods varies also within the field of foresight as well as the region in which they are applied (Rohrbeck, 2011; Popper, 2008a). Rohrbeck (2014) claims the choice of methods depends much on the purpose of the application and the level of uncertainty. Methods may include methods for exploration and uncertainty, taking account of complexity and volatility of the market environment (Rohrbeck, 2014). According to Rohrbeck, methods that can be employed in low-certainty environments are depicted in Figure 15.

Figure 15: Market foresight methods
(Source: Rohrbeck, 2014, p. 87)



Rohrbeck proposes that scenario analysis (12), expert interviews (6), Delphi analysis (4), stakeholder analysis (14), ethnographical studies (5), and analogies (5) are methods perceived to be able to cope with a high level of uncertainty. On the contrary, methods that are also related to the analysis of trends, like trend extrapolation (16), monitoring (10), or socio-cultural analysis (12), are considered to fit in a context with a low level of uncertainty.

2.2.2.3 *Foresight studies in the context of innovation*

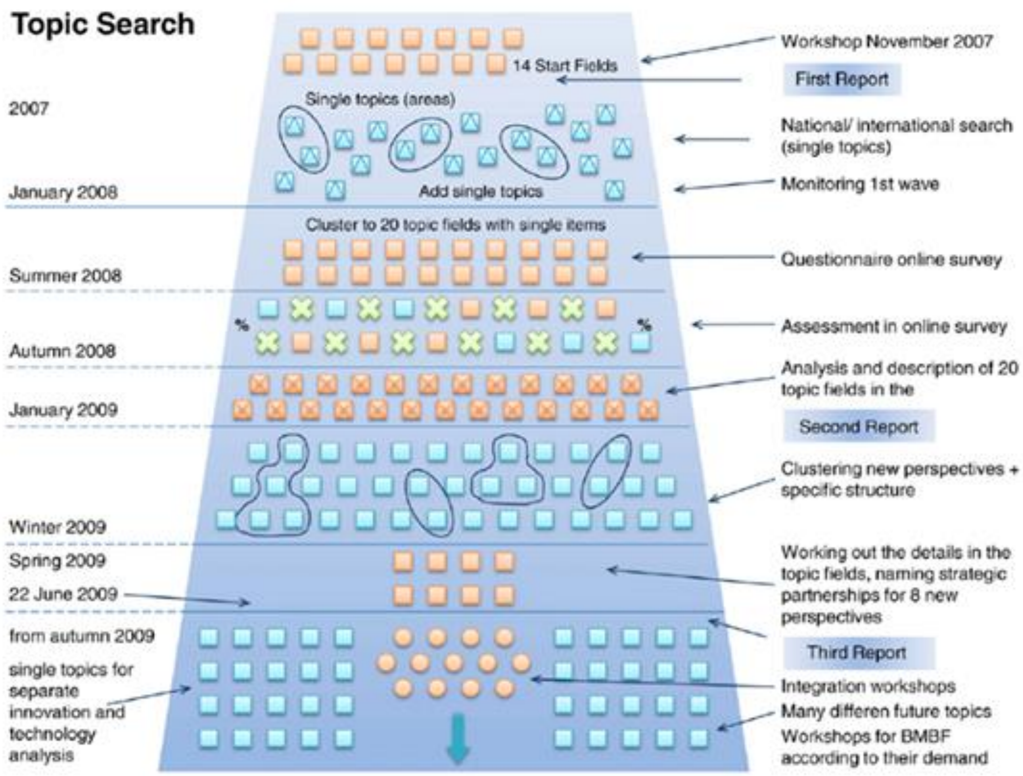
In the field of innovation and corporate strategy, foresight has become an established practice with four major strains that are called "expert-based", "model-based", "trend-based", and "context-based" (Daheim and Uerz, 2008, p. 10; Auernhammer and Rota, 2011, p. 18). The development of these strains started in the beginning of the 1970s with the concepts of the expert-based foresight (von der Gracht et al., 2010, p. 384). Table 11 illustrates the above-mentioned strains, ordered chronologically from left to right.

Table 11: Comparison of different foresight strains
(Source: Daheim and Uerz, 2008, p. 331)

	Expert-based foresight	**Model-based foresight**	**Trend-based foresight**	**Context-based foresight**
Assumption	Known by the means of expertise	Calculated by means of models	Projected by means of developments	Shapes by means of interaction
Key characteristic	Belief in experts	Qualitative and subjective models Exploration Systems Dominated by hard science	Trends Weak signals Early warnings Mix of qualitative and quantitative indicators	Integrating soft and hard approaches Opening up: Participation and interaction More attention to Discontinuities
Perspective	Exploring Change	Calculating change	Reacting to change	Understanding and anticipating Shaping change
Output	Delphi studies Roadmap Scenarios	Models Matrices	Trenddatabases Monitoring Systems Individual studies	Scenarios Wild cards Action plans Innovative ideas

Daheim and Uerz (2008, p. 10) introduced the concept of corporate foresight that founds on "context-based" foresight that aims at the integration of external and internal expertise to foster quality in decision-making processes. This concept is recognized in academia where it is used as a foundation for the development of individual models such as the "Future-Fitness-Portolio" (von der Gracht et al., 2010, p. 384). The concepts of "context-based" foresight are also used in politics to foster the strength of regional or national innovation (Cuhls, 2009). Recently, the Federal Ministry of Education and Research of Germany (BMBF) has conducted a context-based research study in the field of Research and Development with a horizon of ten years to identify a sustainable perspective for research activities, as depicted in Figure 16.

Figure 16: BMBF context-based foresight study
(Source: Cuhls et al. (2009, p. 1190))



The aim of the overall foresight activity has been to point out the significant potential in the research fields of high-tech materials, nanotechnology, manufacturing, water, biotechnology, healthcare, environment, energy, mobility, information and communication technology (ICT), optics, neuroscience, systems research, or service science. As demonstrated in the previous analysis, foresight study is most efficient and effective when it utilizes a set of multiple techniques. Cuhls (2009, p. 11) points out that a combination of the various methodologies has been utilized in the study, which are in detail:

- Structured and focused interaction with experts (workshops and interviews)
- Systematic analysis of strategic processes within the Ministry of Research
- Environmental scanning based on a literature review, analysis of foresight conferences
- Analysis of secondary literature of international foresight studies in research and technology
- Bibliometric analysis
- Two-stage approach of international top experts (panel)
- Scouting of breakthrough innovations based on expert interviews with young researchers

An overview of the methods will be drawn in the next section. In regard to the foresight study of the BMBF, Cuhls et al. (2009, p. 1196) mention that the BMBF Foresight Process in not a fully embedded process, as the approach has been relatively new for German communities and the ministry of BMBF itself.[11] A major implication of the approach is that the interlink between existing processes of innovation and foresight require mindful and well planned integration, which cannot be achieved ad hoc due to the various stakeholders involved in the process. However, the approach of an online survey in the summer of 2008 shows that requesting opinions for new topics breaks the organizational barriers

[11] Cuhls et al. (2009, p. 1196): "In this sense, the BMBF Foresight Process is not an inherent, completely embedded process that are regarded as "neutral" in having no direct thematic stakes in the process."

between ministry departments, in innovation streams in public and private research, and in corporations, and it challenges participants to open their view for new innovation (Cuhls et al., 2009, p. 1196).

Operationalizable Conclusion 19: The combination of foresight methodologies improves the effectiveness of innovation and reduces organizational barriers. This effect is strengthened by online surveys and collaboration platforms.

2.2.2.4 Delphi studies and scenario development

Dalkey and Helmer-Hirschberg (1962) developed the Delphi method at the RAND Corporation (Dalkey and Helmer-Hirschberg, 1962; Sackman, 1974). It was originally designed for scientific and technological forecast by experts (Sackman, 1974, p. 3), but it is applicable for other topics as well (Cuhls, 2003a, p. 93). The qualitative Delphi technique is well researched, and it has reached a state of maturity in the literature (Popper, 2008a). The idea behind Delphi is to extract the most unbiased expert-opinion about topics of interest in a structured process-based approach (Schwarz, 2006). A Delphi process is round-based and involves different roles and responsibilities. In general, a Delphi process consists of two rounds of interaction between expert panels and experts, but the process can be extended, as depicted in Figure 17. As Delbecq et al. (1986, p. 5) point out, Delphi studies "are special-purpose techniques useful for situations where individual judgments must be tapped and combined to arrive at decisions which cannot be calculated by one person." For this reason, expert panels are established that organize the information flow to and from the participating experts in the study, to achieve unbiased results. According to Müller (2008, p. 48) the Delphi process aims to identify possible topics and goals for further analysis and strategic decision making. The approach of Delphi is widely accepted and utilized. E.g. Schwarz (2006) demonstrated in the context of corporate foresight that:

> The Delphi study was able to answer the question about the potential of corporate foresight in German companies. It captured a wide variety of opinions and provided an insight into two essential issues: first, the status-quo and second the future of corporate foresight (Schwarz, 2006, p. 4).

Figure 17: General model of a delphi process
(Own creation, based on Cuhls, 2003a; Hsu and Sandford, 2007; Sackman, 1974; Dalkey and Helmer-Hirschberg, 1962)

Role	Round	Activities / Responsibilities		
Steering Committe	0	Research Design	Panel Selection	
Expert Panels	1	Prepare open-Ended Questionnaires	Send questionaire to [1:n] experts	
Experts		Work on open-ended Questionnaires	Send results back to Expert Panel	
Expert Panels	2	Convert the collected information	Prepare Well-Structured Questionnaires based on collected information	Send questionaire to experts with feedback on results of previous round (or additional information)
Experts		Work on Well-Structured Questionnaires	Send results back to Expert Panel	
* Expert Panels	3 - n	Convert the collected information	Prepare Well-Structured Questionnaires based on collected information	Send questionaire to experts with feedback on results of previous round (or additional information)
Experts		Work on Well-Structured Questionnaires	Send results back to Expert Panel	
Expert Panels		Analysis of results, preparation of reports		
Steering Committe		Communicate results of the Delphi study to the public		

* Depending on the application, further rounds 3-n can be performed to dive deeper into the topic or to fine-tune findings

A Delphi study aims to achieve consensus with the involved experts on certain problems. Karlsen (2014) points out that the Delphi process is a consensus method, such as the Consensus Development Conference, and the Nominal Group Technique. According to Karlsen (2014, p. 4), "The consensus method is a structured method of group decision-making that allows a rich generation of original ideas, balanced participation of all members of the small group, and a rank-ordered set of decisions based on a mathematical voting method." This underlines the expert-based approach of Delphi. Kreibich et al. (2011) and Hsu and Sandford (2007) refer also to Delbecq et al. (1986), who indicated the following objectives of the Delphi method:

> […] to determine or develop a range of possible program alternatives; to explore underlying assumptions or information leading to different judgments; to seek out information which may generate a consensus on the part of the respondent group; to correlate informed judgments on a topic spanning a wide range of disciplines, and; to educate the respondent group as to the diverse and interrelated aspects of the topic (Kreibich et al., 2011, p. 19).

There are several downsides and pitfalls to this approach. A key problem of Delphi is pointed out by Hsu and Sandford (2007, p. 4), who claim that "conducting a Delphi study can be time-consuming. Specifically, when the instrument of a Delphi study consists of a large number of statements, subjects will need to dedicate large blocks of time to complete the questionnaires." Bañuls and Turoff (2011, p. 1579) note that "decision makers have broadly used the Delphi method as a collaborative technique for generating important events and scenarios about what may happen in the future." Wippel (2014, p.49) sums up the strengths and weaknesses based upon review of the literature. Hsu and Sandford (2007, pp. 4–5) point out that the main problems with Delphi are that it has:

- potential of low response rates,
- consumption of large blocks of time,
- potential of molding opinions,
- potential of identifying general vs. specific topic-related information.

Recently, in the literature there has been debate about the further development of Delphi, which can be summarized under the umbrella term "real-time Delphi (RTD)," which is a relatively new method for collecting and synthesizing expert opinions. Glenn and Gordon (2009) points out that:

> The big advantage of the RTD is that it is a "roundless" Delphi. There is no need for an explicit second round. The respondents participate by filling out an online questionnaire, and the results—both numerical and qualitative—are updated as responses are recorded in "real time." Respondents can and are encouraged to revisit the questionnaire as many times as they want. Each time, they are shown their own responses as well as the updated answers of the others, and they can revise and change their own inputs based on this feedback (Glenn and Gordon, 2009, p. 5).

Rabin and Jackowski (1988, p. 146) refer to Linstone and Turoff who explain that real-time Delphi involves a computer to process results and to provide feedback. Recently, real-time Delphi has reached maturity in the scientific community, and has to be a part of the foresight toolkit. Gnatzy et al. (2011, p. 1692) claims that the robustness of online Delphi methods are as valid as regular Delphi surveys, as "the comparison analyses showed no significant differences between conventional and real-time Delphi survey methods." Keller and von der Gracht (2014, p. 83) explain based on the theory of crowds from Surowiecki (2004) that new developments in information and communication technology (ICT) improve the data quality as more experts from diverse background can be integrated into the process. Further information about the methodologies is provided by Linstone and Turoff (2002, pp. 8–9).

For GETs (global economic trends), it is recommended to rely on Delphi studies if needed, as they provide an ideal ground for experts to discuss the influence of trends to corporations in given regions and to refine the opportunities or threats involved with trends. This recommendation is consistent with the findings of Linstone and Turoff (2002). Furthermore, Linstone and Turoff (2002) provide several examples in which Delphi was able to deliver results on the direction of long-range trends (2002, p. 10), deliver environmental trend background material for planners in research at the Bell corporation (2002, p. 72), or deliver information about the development of social, political, and economic trends (2002, p. 99). A Delphi study conducted in German corporations pointed out that the implementation of Delphi, as well as other methods that are also included in the foresight toolkit, lack acceptance by business practitioners (Schwarz, 2008a).[12] Schwarz (2008a, p. 244) points out that especially the acceptance for Delphi is not as firm as for techniques like trend monitoring, environmental scanning, scenario development, strategic early warning, creative methods, or quantitative forecasting. In this regard, it must be assumed that the maturity of foresight in Germany has to be rated as rather low.

[12] The two round Delphi Study consisted of 84 members in the first round and 64 members in the second round.

It seems fair to recommend Delphi techniques as valid options when unbiased expert opinions should be collected. Based on the comparison between Delphi and real-time Delphi, it might be interesting to assess trends with a long-term impact with the classic methods of Delphi demonstrated in the first part of this section, because response time is not crucial. This comparison could be interesting for regional development. Here, the real-time Delphi method provides opportunities to assess trends with a short response time by providing continuous monitoring capabilities. The real-time Delphi tool will deliver the latest view on the impact of trends. However, this requires that practitioners are motivated to participate continuously. If the process is continued by all participants, latest information on trends that affect a corporation can be obtained. Recent developments in IT and foresight drive can help researchers to develop and to enhance the utilization of these methods and to obtain the required information. This information can then be used to optimize existing business models, and might deliver a surplus in safeguarding business operations. In the context of strategic planning and scenario development, the real-time Delphi method can also act as another source for information or even strategic validation. Furthermore, the discussion of methods in foresight is not complete without focusing on the methods of strategic planning and scenario development, which have a long tradition in management science and in foresighting (Postma and Liebl, 2005; Martinet, 2010; Godet and Roubelat, 2000).

Godet and Roubelat (2000) point out that the popularity of scenario planning grew in the mid-eighties with the Harvard Business Review's publication of the success of Shell written by the late Pierre Wack. The literature shows consensus on the success of the Shell approach and the business planners around Pierre Wack (cf. e.g. Postma and Liebl, 2005, p. 162). Postma and Liebl (2005, p. 162) refer to Ringland (1998), who indicates that "most of the organization she surveyed loosely uses what she calls Pierre Wack Intuitive Logics." The origin of modern strategic management can be found in the early work of H. Igor Ansoff and Michael Porter. Martinet (2010, p. 1485) explains that according to citations, H. Igor Ansoff was the leading researcher in the field of strategic planning and scenario development in the 1960s and 1970s, and was replaced in the 1980s by Michael Porter.

There are several approaches to construct scenarios, such as expert panels, formative scenario analysis, la prospective, Delphi analysis, or even combinations of techniques like Delphi and cross-impact analyses (Comes et al., 2014, p. 3). These methods are applicable for the creation of several scenarios in which various requirements such as demographic, economic, technical and social can be specified (Godet and Roubelat, 1996). Godet (2006) notes that "A scenario thus becomes nothing more than a path, a combination bringing together a configuration for each component." GETs are at the heart of scenario development and strategic planning (cf. e.g.Ansoff, 1975; Porter, 1998; Postma and Liebl, 2005).

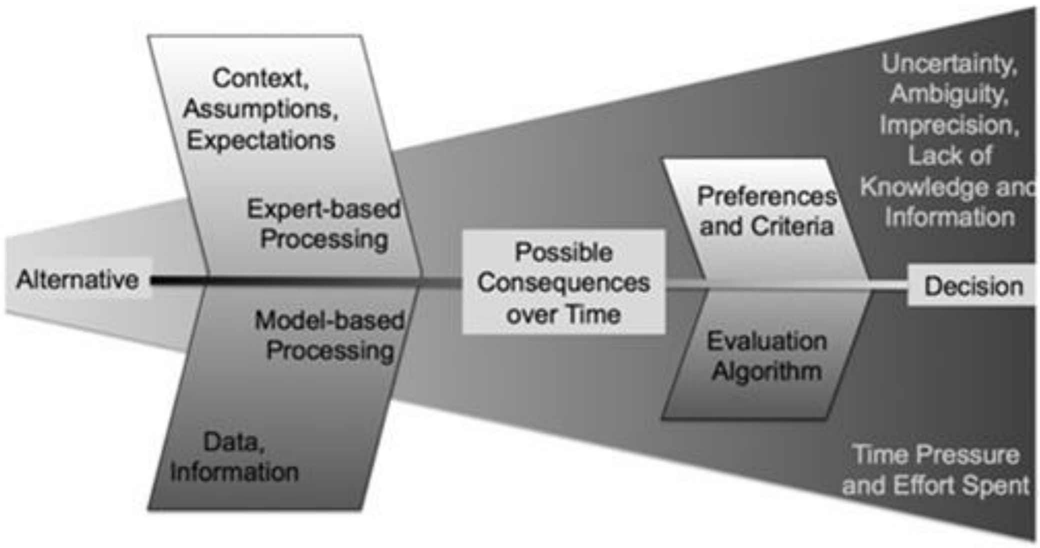
Popper (2008a) points out that scenario development means involvement of several parameters and objects, which stem from other qualitative methods like deskwork, expert workshops, surveys, and Delphi studies. Quantitative data such as forecast or computer models may be added to the development. The volatility of the global economy requires a corporation to make steady changes and adaptions to the parameters to fit the environment and requires a corporation to develop dynamic capabilities (cf. e.g. Godet and Roubelat, 2000; Rhisiart et al., 2014). Rhisiart et al. (2014) points out that "anticipatory activities influence the cognitive capabilities of the organization to sense and make-sense of changes, risks, opportunities and the need for strategic shifts." Furthermore, researchers like Schwarz (2008b) and Rhisiart et al. (2014) explain that in the context of foresight and scenario processes, learning has to be an integral part of the process because the activities might lead to a change of the business model. Schwarz (2008b) claims that:

> A foresight process fosters learning in an organization. By adding to the memory of the future by considering trends, countertrends and alternative pictures of the future, this process adds greatly to an organization's memory of the future, eventually helping an organization to be better prepared for surprises, new and emerging weak signals, or trends (Schwarz, 2008b, p. 85).

Dynamic capabilities require a corporation to be (1) flexible in future planning and decision-making and (2) to provide an optimal breeding ground for management decision-making that reduces the uncertainty induced by the dynamics of the business environment. Rohrbeck (2011, p. 50) proposes that "Corporate foresight systems can be regarded as a dynamic capability that enables a firm to detect a need to renew its portfolio of resources." In this context, Rohrbeck (2011, p. 50) reflects on the work of Danneels (2008, p. 519), who illustrates the concepts of discontinuous change and the requirements of change to resources of corporations in terms of competitive advantage. This illustration is important, because the classical approach to scenario planning is not able to cope with the complexity of modern business settings (Stratigea and Giaoutzi, 2012). This provides as well an ideal breeding ground for academic researchers. Comes et al. (2014) point out that the information overload and time pressure strongly drive the need for computational support for decision-making processes.

A key driver for the use of IT in scenario development is the fact that the level of uncertainty is lowered drastically when the optimal density of information is provided in a timely manner. However, the role of uncertainty in scenario development should be stressed even more in this section. Wright and Goodwin (1999, p. 311) recommend a combination of scenarios with decision-making processes to reduce the perceived level of environmental threat and foster strategic inertia. This recommendation refers to the problem of time-criticality and complexity of decision-making, which increases the degree of uncertainty. It is crucial that scenarios are well thought-through to avoid inconsistency and incompleteness of information (Comes et al., 2014; Godet, 2011). As pointed out by Comes et al. (2014), stable scenarios require three essential steps in the decision process: "(a) choosing feasible alternatives that are relevant and need to be assessed; (b) per such alternative assess the relevant possible consequences and how they evolve over time; (c) evaluate the alternatives, make a decision and implement it." This conception is illustrated in Figure 18.

Figure 18: Uncertainties in strategic decision-making
(Source: Comes et al. (2014, p. 3))



As depicted above, Comes et al. (2014) demonstrate that the degree of uncertainty and ambiguity increases from the stage of collecting expert-based and model-based assumptions, to that of the weighing up of alternatives, and to the final step of decision. In this regard, the effort and uncertainty rises continuously. An additional and unforeseen change, such as new and revised expert-based opinion and information that is added in the process increases the time pressure that forces management to take decisions. Another important aspect that might be integrated into the research is the role of bias and time-pressure on decision-making (Comes et al., 2014; Maule et al., 2000; Kahneman, 2012). Maule et al. (2000) demonstrated in their experiments that time-pressure changed the behavior of participants, especially the aspects of risk-taking and strategic decision-making. Furthermore, the role that the status quo plays is also important (Kahneman, 2012). Kahneman (2012) points out that preventing loss (i.e. loss aversion) is most important in the decision-making processes of humans:

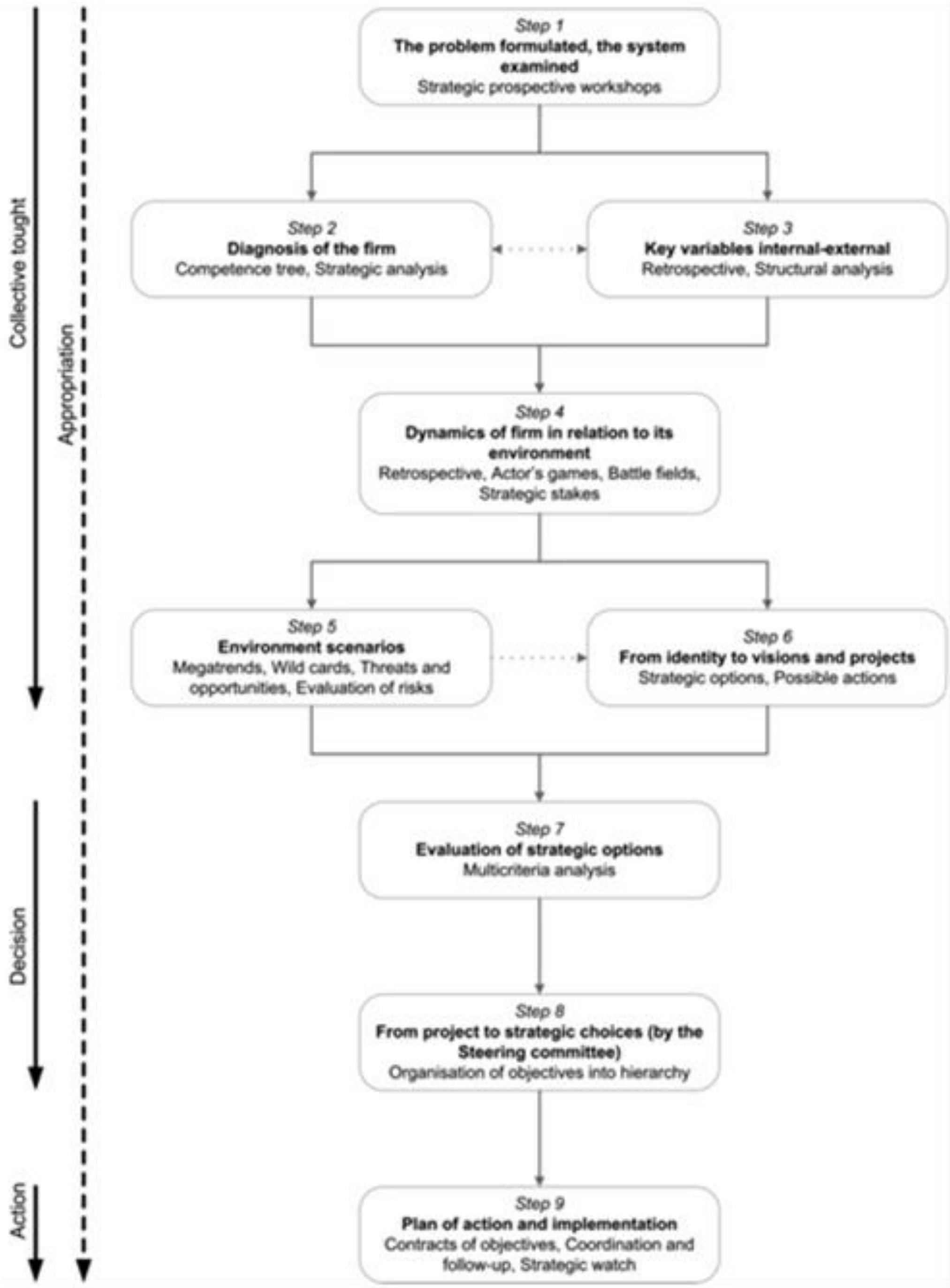
> In human affairs, the same simple rule explains much of what happens when institutions attempt to reform themselves, in "reorganizations" and "restructuring" of companies, and in efforts to rationalize a bureaucracy, simplify the tax code, or reduce medical costs. As initially conceived, plans for reform almost always produce many winners and some losers while achieving an overall improvement (Kahneman, 2012, p. 305).

These dynamics in business decision-making require management of communication and information to ensure the robustness of scenario development. In particular, discussion of trends and unforeseen events may raise the level of uncertainty even more. Again, the behavioral component plays a key role, as pointed out by Kahneman (2012, p. 324): "People overestimate the probabilities of unlikely events," and "People overweight unlikely events in their decisions." Further aspects of information about robustness and decision-making with the involvement of unlikely events (black swans) are illustrated by Taleb (Taleb, 2008, 2012). Taleb (2012) notes:

> Collaboration has explosive upside, what is mathematically called a superadditive function, i.e., one plus one equals more than two, and one plus one plus one equals much, much more than three. That is pure nonlinearity with explosive benefits—we will get into details on how it benefits from the philosopher's stone. Crucially, this is an argument for unpredictability and Black Swan effects: since you cannot forecast collaborations and cannot direct them, you cannot see where the world is going. All you can do is create an environment that facilitates these collaborations, and lay the foundation for prosperity.(Taleb, 2012, pp. 233–234).

The above notes also points at the problematic that comes with collaborative decision-making processes. As outlined by Taleb (2012) and Kahneman (2012), the magnitude of collaboration and the individual focus of participants play a key role in collaboration. Hence, the awareness of each individual about unexpected events and uncertainty that is involved with decision-making about future processes is a crucial success factors. Based upon the previous discussion it should be concluded here that continuous learning and knowledge creation is a key to maximize the effectiveness of decision-making, and to lower uncertainty (Brătianu, 2015, p. 29). These conceptual thoughts are already implemented into strategic decision-making models. Such a model is the strategic prospective model provided by Godet (2011), as depicted in Figure 19.

Figure 19: Strategic prospective (la prospective)
(Source: Godet, 2011, p. 24)



In the model from Godet (2011), collective thought and collaborative decision-making are well defined, which provides researchers of collaborative decisions opportunities for further research. Durance and Godet (2010) explain that anticipation is paradox, and requires special tools to integrate the numerous aspects of scenario development:

> The anticipation phase should be collective and should involve the greatest number of people possible. Indeed, this phase employs tools to organize and structure the collective thinking process according to what is at stake in the future as well as the eventual evaluation of strategic options. On the other hand, for reasons of confidentiality or liability, the phase of strategic choices should involve a limited number of participants, e.g., the elected representatives only or a company's board of directors (Durance and Godet, 2010, p. 1488).

An even more important aspect is that the model integrates trends into the development of environmental scenarios. The process integrates GETs (depicted as megatrends) into process Step 5, also referred to as environmental analysis, and is interconnected to Step 6, which develops scenarios and projects based on the gathered insights. Furthermore, wildcards and environmental threats and opportunities are integrated into the process as well. It could be observed that literature rather provides new approaches to strategy, rather than improving existing approaches. The approach developed by Godet provides potential for strategy improvement, which has not yet been pointed out in the literature. The thoughts and developments on collective intelligence provide an ideal starting point. Collective intelligence requires continuous feedback on a systematic and ongoing basis, which makes scenario development highly dynamic, as changes to existing approaches are frequent. That dynamism means ongoing interaction between the participants, steering committee and external experts (Glenn, 2013). This interaction provides (a) the chance to establish new platforms, also labelled as foresight support system (FSSs), and (b) to integrate external data sources in to process to raise the quality of decisions, as Glenn (2013, p. 2) points out:

> In the past, leaders would often gather wise elders and favorite consultants to discuss a problem until a solution was found. Then along came the Internet and Google, allowing leaders to have staff search through vast sources of information and distill these to provide intelligence for a decision (Glenn, 2013, p. 2).

A rebuttal to the above argument, and as another and final important aspect to the development of scenarios, is the influence of different spatial scales on scenario development, which varies from global to local (Stratigea and Giaoutzi, 2012; Cagnin and Könnölä, 2014). Cagnin and Könnölä (2014, p. 27) explain that foresight "has been applied at global and regional levels to support the design and implementation of policies and strategies."

Cagnin and Könnölä (2014, p. 27) provide examples such as "the European Commission through the Framework Programmes and its Joint Research Centre, the OECD through its International Futures Programme, UNIDO through its Technology Foresight Initiative, the Asian-Pacific Economic Cooperation (APEC) Centre for Technology Foresight, the UK Foresight Horizon Scanning Centre, the Risk Assessment and Horizon Scanning (RAHS) programme in Singapore." On these grounds, the importance of GETs and their regional influence is confirmed. Finally, the aspect of quantitative data in the context of scenario development has to be pointed out. Stratigea and Giaoutzi (2012) explain:

> As empirical work shows, global scenarios are usually long-term exercises that aim at exploring critical future uncertainties and provide plausible future outcomes in support of decision making and policy analysis. So far they tend to be rather science or research-oriented and seem to heavily rely on quantitative methods (e.g. global scenarios for climate change, water resources, etc.) (Stratigea and Giaoutzi, 2012, p. 849).

Operationalizable Conclusion 20: Developing scenarios under the influence of GETs is complex and has a high degree of uncertainty. It requires an environment that provides collaborative thinking and communication among experts, expertise on quantitative data, and the integration of up-to-date information.

2.2.3 Nowcasting with web search data in the context of foresighting

2.2.3.1 Nowcasting based on web search data

Varian (2014, p. 5) points out that data analysis and econometrics are used for prediction, summarization, estimation, and hypothesis testing. The prediction and estimation of data can appeal to multiple approaches, such as (1) quantitative forecasting, (2) flash estimates, or (3) nowcasting, often referred to as "contemptuous forecasting" (Castle et al., 2013, p. 3).[13] The benefits of "contemptuous forecasting" are expressed by Choi and Varian (2012) who also refer to Castle et al. (2009, p. 71):

> As Castle et al. [2009] point out, contemporaneous forecasting is valuable in itself, but it also raises a number of interesting econometric research questions involving topics such as variable selection, mixed frequency estimation, and incorporation of data revisions, to name just a few (Choi and Varian, 2012, p. 2).

Modern approaches like nowcasting use web search data as a foundation for econometric analysis. The tool Google Trends has been used in macroeconomics to microeconomics for a variety of studies. These studies include finance and portfolio strategies; analysis of private consumption, tourist flows, unemployment; and the examination of influenza epidemics (cf. e.g. Askitas and Zimmermann, 2009; Ginsberg et al., 2009; Kristoufek, 2013; Artola and Galán, 2012; Preis et al., 2012; Preis et al., 2013). Other sources like Wikipedia, Twitter, or Facebook have also been used, but are not part of this analysis (cf. e.g. Bollen et al., 2011; Miller, 2011; Moat et al., 2013; Metaxas and Mustafaraj, 2012). In the field of finance, Researchers such as Preis et al. (2013) or Kristoufek (2013) employ data from Google Trends for optimal investment strategies. Preis et al. (2013, p. 1) have analyzed the behavior of market participants, and their results indicate that "Google Trends data did not only reflect the current state of the stock markets but may have also been able to anticipate certain future trends." Kristoufek (2013) used Google Trends for portfolio strategies and risk diversification.

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[13] Castle et al. (2013, p. 3) claim that "Forecasts are defined as made before a period (say a quarter) commences, nowcasts during the relevant period, and flash estimates immediately or shortly after the period ends when disaggregate information remains incomplete."

Vosen and Schmidt (2011) show that the forecasting of private consumption based on Google Trend data is able to outperform survey-based indicators such as the Michigan University's Consumer Sentiment Index (MSCI) and the Conference Board's Consumer Confidence Index (CCI). Koop and Onorante (2013) claim that several research papers have investigated the usefulness of internet search data for contemptuous forecasting, such as Choi and Varian (2012), who demonstrate in their paper "Predicting the present with Google Trends" that the software tool Google Trends provides sufficient data for predicting present economic conditions. In addition, Koop and Onorante (2013) remind of the time lag in the publishing of macroeconomic data:

> Macroeconomic data are typically published with a time lag. This has led to a growing body of research on nowcasting. Nowcasting uses currently available data to provide timely estimates of macroeconomic variables weeks or even months before their initial estimates are produced. The availability of internet search data has provided a new resource for researchers interested in nowcasts or short-term forecasts of macroeconomic variables (Koop and Onorante, 2013, p. 2).

In their paper called "Using Web-based Search Data to Predict Macroeconomic Statistics," Ettredge et al. (2005) investigate how search-term usage and unemployment data are statistically associated. Ettredge et al. (2005, p. 92) observe "a positive, significant association between search-term usage and lagged unemployment data." Preis uses Google Trends to illustrate that well developed countries are more future orientated based on web search data and gross domestic product (GDP) data (Preis et al., 2012, p. 1).[14] Other work, such as of Askitas and Zimmermann (2009), illustrate that search activities for specific keywords or keyword groups correlate with the current unemployment rate in Germany.

[14] "Google Trends demonstrates that Google users from countries with a higher per capita GDP are more likely to search for information about the future than information about the past. The findings suggest there may be a link between online behavior and real-world economic indicators. The authors of the study examined Google query logs made by Google users in 45 different countries in 2010 and calculated the ratio of the volume of searches for the coming year ('2011') to the volume of searches for the previous year ('2009')." (Preis et al. (2012, p. 1).

Furthermore, they (Askitas and Zimmermann, 2009, p. 11) point out that "It is particularly welcome at times of an economic crisis where the traditional flow of information is too slow to provide a proper basis for sound economic decision making." Goel et al. (2010) investigated the box-office revenues of movies, the performance of first month sales of video games, as well as the Billboard 100 charts and pointed out that web search data is able to indicate future development. Artola and Galán (2012) analyze the inflow of British tourists into Spain based upon Google Search activities.

In general, Shimshoni (2013, p. 25) claims that web search trends are a decent foundation for business intelligence, especially for practical application such as competitive analysis, econometric modelling, detection of market changes, prediction of demand and nowcasting and macroeconomic monitoring to name a few. In detail, Shimshoni (2013, p. 18) points out the following steps that are important in the analysis of web search trends:

- Examine the regularity, seasonality and predictability of search trends;
- Conduct correlation analysis, clustering and profiling of the trends space;
- Use time series prediction methodologies to forecast search trends;
- Forecast users interest and analyze business cycles using search trends;
- Examine the dynamics of co-searching of search terms;
- Define relatedness metrics and investigate association between search terms;
- Compare and integrate query data with other online and offline data sources;
- Examine the '"flow" of web phenomena and analyze their geo-propagation.

Operationalizable Conclusion 21: Web search data as provided by Google Trends provide behavioral data of online activity by users and enable researchers to make inferences about the economic decision-making of users (nowcasting). Furthermore, the data are capable of portraying the development of economic growth.

2.2.3.2 *Google as an econometrical data basis for nowcasting*

A growing body of literature that has investigated Google Trends pointed out that the data of search queries provided by Google are an ideal foundation for econometrical analysis (cf. e.g. Askitas and Zimmermann, 2009; Choi and Varian, 2012; Vosen and Schmidt, 2011; Dimche and Davcev, 2014). The search volume index (SVI) provides a measure to show the importance of a certain keyword used in a search (Dimche and Davcev, 2014, p. 34). The SVI is available on a daily basis for ninety days, and on a weekly basis. The weekly SVI reports the data beginning from Sunday of a week to Saturday. This indicator is available beginning from January 1, 2004, and provides data for hypothesis testing as well as for forecasting. Google Trends is updated on a daily basis with a maximum delay of one to two days (Shimshoni, 2013). A drawback of Google Trends is that no absolute data are reported.

So far, there has been little to no work that researches global economic trends (GETs) with Google Trends. Google Trends provides timely data about search entries that users type in into the Google search engine (e.g. Askitas and Zimmermann, 2009; Artola and Galán, 2012; Preis et al., 2012). Google Trends (formally known as *Insights for Search*) presents an aggregated view of user web searches. The software collects and displays web search terms since January 1, 2004 that users have entered into the search engine. It displays how many times users entered a particular term into Google. It also provides further data mining capabilities for the comparison between search terms, which found on time and data series comparison. Furthermore, the spatial filters in the software allow filtering the data according to geographical setting. Choi and Varian (2012) point out that the data are normalized and displayed on a scale of 0 to 100. The tool "analyzes a portion of worldwide Google web searches from all Google domains to compute how many searches have been done for the terms […] entered, relative to the total number of searches done on Google over time."[15]

[15] As stated by Choi and Varian (2012): "The query index is based on query share: the total query volume for the search term in question within a particular geographic region divided by the total number of queries in that region during the time period being examined."

In addition, Google features another tool called Google Correlate that can be used to find and compare time series based on the Approximate Nearest Neighbor (ANN) algorithm. Vanderkam et al. (2013) explains that "Correlate searches across millions of candidate query time series to find the best matches, returning results in less than 200 milliseconds.". The tool was designed to seek for correlations among different time series data by GoogleTrend (Shimshoni, 2013). Nowcasting provides several opportunities for the enhancement of existing techniques used in the field of foresight support systems (FSSs). Recent information and communication technology (ICT) provide new opportunities for corporations to identify patterns in information, enhance macroeconomic statistics and quantitative analysis (cf. e.g. Ettredge et al., 2005). The importance of ICT in context of foresight is also addressed by Keller et al. who conducted a Delphi study using 20 projections about the importance of ICT for foresight in 2020 that were presented to 177 foresight experts (2015).[16] Keller and von der Gracht (2014, p. 87) explain that until 2020 foresight will utilize interactive ICT for proactive strategic decision-making. Ciarli et al. (2013, p. 30) support the integration of tools like Google Trends into the toolset of quantitative foresighting.[17] The main benefit is that web searches may provide add additional insights. Hiltunen (2013, p. 59) points out that Google Trends may be useful to be utilized in the context of trend identification, because it "tells you what people are talking and where". Another interesting aspect that is pointed out by Hammoud and Nash (2014) who have found out that several foresight methodologies are not applied anymore by the foresight practitioners of their assessment. Hammoud and Nash (2014, p. 15) claim that especially methods that rely on historical data

[16] The sample group contained various institutional members: 4% from universities, 30% from foresight consultancies, 15% from applied research institutions, 13% from industrial enterprises and 8% from administration.

[17] Ciarli et al. (2013, p. 30) illustrates that "there are numerous techniques that use historical data […]to infer future trends: Indicators/Time Series Analysis (I/TSA), Long Wave Analysis/Models (LWA), Trend Extrapolation, Trend Impact Analysis (TIA), S-Curves, Technology Substitutions, Megatrends Analysis, and Google tools such as Google Trends and Google Correlate. We are thus moving from data gathering to examine inference oriented techniques, which are more useful for forecasting than for foresight exercises. However, these techniques are still more useful for extrapolative (rather than normative) exercises and are more descriptive than prescriptive. Some of these techniques differ only with respect to the initial assumptions and/or the specific application."

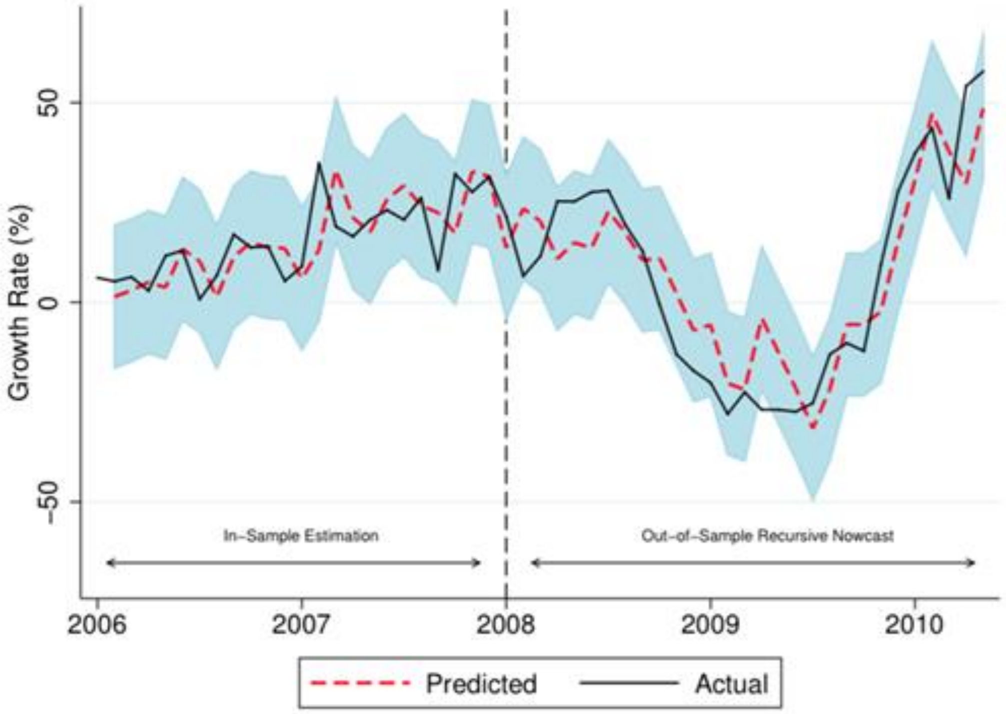
lost popularity, "because consumers rarely know what they will want; they only know what they want at present." This is textbook example where quantitative forecasting based on web data provides new opportunities and chances for foresight practitioners. SVI represents primary data as users actively type their interest into the search engine. Hence, social scientists have a valid point when using this data for hypothesis validation. Another benefit is noted by Vosen and Schmidt (2011):

> The high frequency and the publication lead of these indicators are of particular usefulness to economic forecasters in times of macroeconomic turbulences, great uncertainty or unique shocks when past values of other macroeconomic variables lose predictive power (Vosen and Schmidt, 2011, p. 566).

Consumption indicators demonstrate that nowcasting based on web data is able to outperform survey-based indicators (cf. e.g. Vosen and Schmidt (2011)). Recent work underscores that in all cases of data analytics additional knowledge about the geographic, economic, and cultural aspects is required to fully understand the outcome of out-of-sample predictions (Barreira et al., 2013, pp. 129–130). Barreira et al. (2013) concludes that Google Trends tends to improve the quality of out-of-sample predictions, but not always, for to the following reasons:

> Google Trends data [...] may have a high level of noise due not only to the characteristics of the specific use of the search query and due to the sampling procedure used by Google [...], but also due to possible changes in the total volume of searches[.] This level of noise may be different for different countries and for different periods, leading to different predictive abilities of the Google Trends data. [...] user behaviour is continually changing, and that it is quite different in different countries, leading to changes in the predictive content of Google Trends data across time periods and across geographical locations (Barreira et al., 2013, pp. 152–153).

Figure 20: Nowcast for automobile sales
(Source: Carrière-Swallow and Labbé 2010, p. 8)



A popular type of time series model used in the field of nowcasting is the autoregressive moving average (ARMA), or ARMA(p,q). Several empirical analyses utilize the autoregressive (AR) model, or AR(p) model, and do not use moving average (MA) (c.f. e.g. Barreira et al., 2013). Carrière-Swallow and Labbé (2010) developed a model for in-sample estimation and out-of-sample nowcasts on automobile sales in Chile that was found on a the AR model, as depicted in Figure 20.

Christiaans (2015, p. 30) points out that time series models implement one dependent or observed variable, and time as an explanatory variable to analyze trends in time, seasonal trends, or macroeconomic trends. The focus of time series is to generate a forecast for the dependent variable. A common approach is to create in-sample and out-of-sample forecasts, as demonstrated in Figure 20. The benefit of Google Trends as a foundation for forecasting data has been demonstrated by Carrière-Swallow and Labbé (2010), who showed that turning points in the data could be revealed:

> In fact, the inclusion of Google Trends information already improves nowcasts a full three weeks prior to the close of the month of interest. Using the optimal window of observations, the model correctly identifies turning points in the growth rate in 73% of periods (Carrière-Swallow and Labbé, 2010, p. 9).

If researchers or managers want to apply the data of Google Trends into their market prognosis, then it is important to assume that the search for a specific search term does not mean that the effect occurs directly after a search has been conducted. For example, customers may not directly buy a certain product after they have entered a search term into Google. Hence, a time lag between the compared time series has to be considered in model development. However, Google Trends has not been analyzed in the context of linear regression analysis for annual indicators, such as in the consideration of economic and financial models that use classical indicators like gross domestic product (GDP). Because Google Trend data is provided on only a weekly and daily basis, researchers have not yet used Google Trend data that is aggregated on an annual basis. This research gap provides further room for empirical analysis. However, this requires the transformation of weekly Google Trend values into aggregated annual mean values.

Even though this process reduces the detail of the information, the information is still valuable enough for the analysis of annual indicators such as GDP. In addition, the problem with the time lag between time series is reduced on this abstract level of analysis. In conclusion, this information is considered to add value in the context of behavioral analysis of the use of GETs.

Operationalizable Conclusion 22: Nowcasting based on web data is able to outperform survey-based indicators and provides new approaches for research on economic indicators. The aggregated data of Google Trends on an annual basis provides explanatory capabilities for behavioral research in economics and finance.

2.2.3.3 Online behavior and economic indicators

Recent information and communication technology (ICT) provide new opportunities for corporations to identify patterns in information, enhance macroeconomic statistics, and utilize them for competitive analysis (Ettredge et al., 2005; e.g. Holzinger, 2011, p. 55; Preis et al., 2012; Choi and Varian, 2012). New databases that hold a large amount of behavioral user information allow the acquisition and processing of a large amount of quantitative data that can be manipulated and analyzed.

Ettredge et al. (2005) demonstrate that web search trends reflect the public opinions, the needs, the wants, the interests, and the concerns of a statistical sample group.[18] Ettredge et al. (2005, p. 87) empirically demonstrate that information about user requests with search terms related to job opportunities has enough explanatory power to "anticipate the content of forthcoming federal monthly unemployment reports." They claim that the approach might be useful in other econometrical applications. Preis et al. (2012, p. 1) outline that researchers are able to apply the correlation between "behavior online and real world economic indicators" to analyze the present economic situation. Page and Uncles (2014, p. 2356) point out that online behavior is complex and "growing and transforming as consumers engage in ever more varied practices across digital context, from browsing and search, to shopping and downloading, to social networking and sharing." Goel et al. (2010, p. 17486) point out that "it is a short step to conclude that what people are searching for today is predictive of what they will do in the near future." Papers on consumer behavior in relation to web search data use this relation (cf. e.g. Vosen and Schmidt, 2011; Jun et al., 2014). Jun et al. (2014, p. 238) point out that online search traffic "can serve as a proxy measurement of social phenomena, and can yield analytical results that are comparable to conventional surveys in providing macroscopic forecasts of aspects such as demand and changes in consumption."

[18] Ettredge's study illustrates the potential to use data about web searches to predict an important macroeconomic statistic, specifically the number of unemployed workers in the U.S. The study finds that web-based search data is associated with future unemployment data over the 77-week study period.

Vosen and Schmidt (2011, p. 4) observe that in countries where private consumption represents the largest stake of the gross domestic product (GDP), analysis based on real-time online behavior outperforms leading economic forecasts based on information from consumption surveys. Choi and Varian (2012, p. 2) show that several sources of data from private companies on real-time economic activity are available that allow "short-term economic prediction." According to Google Scholar, the work of Choi and Varian provides the foundation for many other researchers in the field of web search trends and has been cited more than 500 times.[19] Real time online information and data for econometric analysis can be obtained from various sources like Google Trends, Google Correlate, Twitter, Facebook, MasterCard, Federal Express, or UPS (Choi and Varian, 2012). Sources like Google Trends provide geographical information on the regional as well as on the city level that enhances the quality of analysis. Preis et al. (2012), Varian (2014), Jun et al. (2014), Artola and Galán (2012), or Vosen and Schmidt (2011) agree that these new sources of data enhance the precision of econometric models and raise the quality of quantification. The 2014 survey of Eurostat on information and communication technology (ICT) usage in households and by individuals reiterates the importance of online information, as the usage of ICT increases steadily in comparison to a survey conducted in 2012 (Eurostat, 2015). The survey of Eurostat (2015) further outlines that:[20]

- "The proportion of internet users who go online on a daily basis was high in all 28 European Union (EU) States and in Iceland, Norway and Switzerland"
- "In 2014, half of the EU population aged 16-74 used the internet on portable computers or handheld devices through a mobile phone network or wireless connection when not at home or at work."
- "Just under two thirds of all EU citizens (65%) used the internet every day or almost every day."
- "The proportion of individuals living in the EU who have never used the internet dropped to 18% in 2014."

[19] Google Scholar accessed on March 26, 2015.
[20] Eurostat accessed on March 27, 2015.

Table 12: EU 28 Internet use and frequency in 2014 (percentage of individuals)
(Source: Eurostat (2015))

	Internet users and non-users			Frequency of use	
	Used internet within the last three months	Used internet away from home or work	Never used internet	Every day or almost every day	At least once a week (including daily use)
EU-28	78	51	18	65	75
Belgium	85	59	13	71	83
Bulgaria	55	27	37	46	54
Czech Republic	80	37	16	60	76
Denmark	96	75	3	85	92
Germany	86	56	11	72	82
Estonia	84	58	12	73	82
Ireland	80	65	16	65	76
Greece	63	37	33	49	59
Spain	76	62	21	60	71
France	84	58	12	68	80
Croatia	69	41	28	56	65
Italy	62	24	32	58	59
Cyprus	69	43	28	56	65
Latvia	76	35	21	61	72
Lithuania	72	32	25	57	69
Luxembourg	95	70	4	87	93
Hungary	76	44	22	66	75
Malta	73	51	25	63	70
Netherlands	93	70	5	84	91
Austria	81	57	15	64	77
Poland	67	36	28	51	63
Portugal	65	37	30	51	61
Romania*	54	25	39	32	48
Slovenia	72	42	24	58	68
Slovakia	80	50	15	62	76
Finland	92	69	6	81	90
Sweden	93	76	6	83	91
United Kingdom	92	73	6	81	89
Iceland	98	68	1	94	97
Norway	96	79	3	89	95
Switzerland	90	60	8	76	86

* Romania, break in series in 2014 due to 2011 population census.

As illustrated in Table 12, the data presented by Eurostat (2015) show that ICT coverage and internet use are at high levels in all EU-28 states. Furthermore, the usage is increasing steadily, which accentuates the importance and relevance of online behavior concerning economic indicators. This results support the findings of Artola and Galán (2012), who utilized the annual Eurostat survey on Internet Access from 2011 and found that:

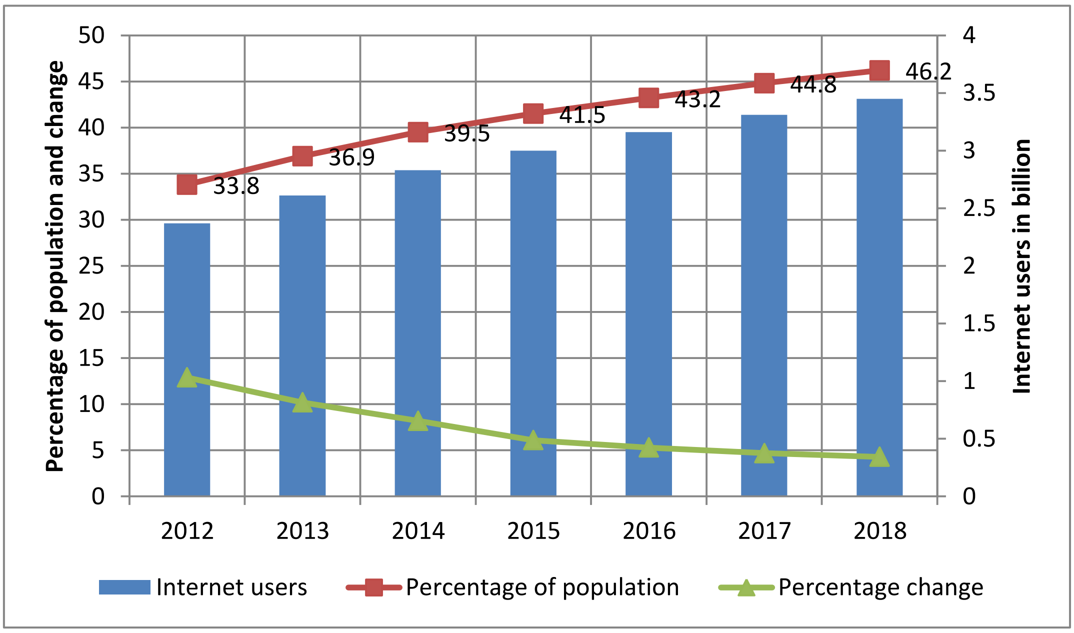
> A fraction of the adult population (aged 16 to 74) without any contact at all with the Internet (so-called digital exclusion) decreased drastically from 42% in 2006 to 24% in 2011. The European digital agenda for 2015 sets a level of digital exclusion not exceeding 15% of the adult population (Artola and Galán, 2012, p. 11).

Furthermore, it has to be pointed out that the target of the digital agenda has already been met in 2014 by at least 15 of the 28 European countries, or 53%. Artola and Galán (2012, p. 12) explain that in 2011, the internet coverage in countries like Bulgaria, Greece, or Romania has been below 50%. The Eurostat results from 2014 show that the coverage is improving. In comparison to the results from 2011, in 2014 only 18% of the adult population had never used the internet, is an improvement of 25% since 2011. Based upon this development, it has to be assumed that usage in the European Union will continue to increase in the coming years.

The availability of data that can be used for the establishment of economic indicators will also increase, having two main implications. One the one hand, this situation leads to better econometric models and to more accuracy in predictions. McAfee and Brynjolfsson (2012, p. 68) provide evidence that the data that is now available may lead to better decisions. On the other hand, new software tools will be required for analyzing and coping with "big data." As Varian (2014, p. 3) points out, "Conventional statistical and econometric techniques such as regression often work well, but there are issues unique to big datasets that may require different tools." This challenge is even more evident when we take the discussion back to the topic of GETs and ask how the internet use looks on a global scale. Miranda and Lima (2012, p. 764) point out that the internet has become the global hub for the information society, and that its usage is constantly increasing.

According to statistics from eMarketer (2014, p. 2), there are more than 2.83 billion people worldwide who use the internet. That number amounts to 39.5% of the global population, assuming that the total population amounted to 7.16 billion people in 2014. According to eMarketer (2014, p. 2), over 3.45 billion people will use the internet in 2018, assuming that annual growth rate of internet users will be single digit growth as presented in Figure 21.

Figure 21: Internet users and penetration worldwide from 2012 to 2018
(Own creation, based on eMarketer 2014)



Based upon the results illustrated in this section, it has to be assumed that with growing coverage of global internet usage, the quality of economic predictability regarding GETs will also continue to improve. Despite the challenges that are involved with big data, econometric analysis based on online data provides the foundation for real-time economic predictions. Starting from this point, the influence of online data analysis for foresighting practices provides further room for analysis.

Operationalizable Conclusion 23: Data sources provide information about online behavior, raise the quality of economic predictions, and enhance the quality of analysis and foresighting practices.

2.2.3.4 *Recent developments in foresight support systems*

In recent literature on foresight and forecasting, foresight support systems (FSS) receive much attention. von der Gracht et al. (2014) point out that the developments in FSS lead to even more complex and mature software solutions for foresight. The ancestors of FSS were the group support systems (GSS) that provided support for decision-making processes. Earlier work from Salo and Gustafsson (2004) mentions that GSS demonstrated their strength in research and technology development programs. In this case, the GSS system provided communication and data retrieval capabilities. The next step in the development is the FSSs that provide even more enhanced capabilities, due to the development of information and communication technology (ICT). Banuls and Salmeron (2011) point out that FSSs can be used standalone or can support a foresight study or process by providing additional capabilities to the participants to foster collaborative thinking and group decision making. These capabilities include business intelligence possibilities as well as communication capabilities that enable participants to coordinate and to synchronize decision-making processes (Skulimowski, 2012, p. 247).

From the practitioner's point of view, Rohrbeck et al. (2013) illustrate that FSS connected to the innovation process of a corporation is able to add value to foresight practitioners as well as to internal stakeholders. In this regard it is required that (1) an FSS is integrated into the communication process, (2) an FFS is easy to access and easy to use, (3) an FSS provides guidance for users, and (4) stakeholders are trained beforehand. Spithourakis et al. (2015) provides a learning system for students that extends forecasting information by collaboration capability that allows students to cooperate in the learning process. The authors claim that the value that is added by the collaboration process of the students could be transferred into the realm of business decision-making. This reflects the ideas of researchers such as Klein (2012, p. 354), who describe that the initial idea behind FSS is to continuously readjust the outcomes of the foresight results to foster "individual and team learning as well as organizational learning." Researchers like Ondrus et al. (2015) illustrate in their work about multi-criteria decision-making methods that FSSs enhance foresight processes more than traditional qualitative methods that depend on expert opinion, such as Delphi, expert panels, or focus group. Developments in information and communication technology (ICT) are the key drivers for the development of even more complex FSSs (Keller and von der Gracht, 2014; Skulimowski, 2012). An IT foresight-oriented decision support system provides econometric methods for forecasts or scenario development (Skulimowski, 2012). Modern FSSs provide powerful reporting and analysis mechanisms that are easy to use, which will foster the use of quantitative methods and lower technology barriers (Keller and von der Gracht, 2014, p. 90). Keller and von der Gracht (2014, p. 90) explain that that seven ICT related drivers will influence the development in foresight, which are "(1) Accessibility, (2) Efficiency, (3) Collaboration, (4) Linkages, (5) Quantitative Data Handling, (6) (ICT-) Progress and (7) Market."

The Delphi study of Keller and von der Gracht (2014) supports the idea of Skulimowski (2012) that the focus of FSS will shift from the mere gathering of information to providing data interpretation capabilities that enable practitioners to build even more robust scenarios with the help of the FSS. The study included different projections. One projection was codified as Delphi projection No. 13, which inherits the idea that those agent-based modelling systems (ABMSs) should be used in decision-making processes. In general, this projection is founded on Farmer and Foley (2009), who argued that ABMSs help to estimate the effect of decisions to present policies (Keller and von der Gracht, 2014, p. 85). They criticize that the capabilities of ABMSs were not used to guide the economy out of the subprime crisis (Farmer and Foley, 2009). Furthermore, Keller and von der Gracht (2014) refer to the tutorial on agent-based modelling and simulation of Macal and North (2010), which demonstrates the capability of integrating autonomous interacting agents into a complex systems model that maps dynamics and behavior between agents and enables the agents to self-organize themselves due to the autonomous nature of agent-based modelling.

The expected probability was ranked highly (79%), and the convergence rate between the estimates (-10.7) and the high desirability of participation indicate the potential that is inherited in these type of systems. Keller et al. (2015, p. 4) presents five basic premises to the development and design of an FSS in the context of facilitating regional innovations, which are listed in Table 13.

Table 13: Basic premises for the design of an FSS
(Source: Keller et al. (2015, p. 4))

No	Basic premise and explanation
1	**Information platform:** Support creating, linking, and processing information about future relevant developments in government, economics, society, and technology.
2	**Collaboration:** The FSS should stimulate collaboration among cluster stakeholders in order to activate the cluster's innovative and competitive potential.
3	**Incentivization:** The FSS should motivate stakeholders and provide them with the tools to systematically deal with their future and strategic options as well as to foster innovation. We argue that iterative bottom-up processes are much more effective than singular top-down exercises.
4	**Systemic FSS:** The FSS should integrate different electronic foresight applications into a "true" FSS for the cluster. The integration of different instruments facilitates in tackling foresight problems more effectively from multiple angles.
5	**Support:** The FSS should provide educative information on futures studies and teach future skills in order to overcome the resource constraints of small and medium enterprises (SMEs). The FSS is designed to strengthen SME foresight and innovation capability at the network level.

The above premises qualify as a vehicle for the qualitative development of individual FSS system. This position is shared in the context of regional foresight. The results are significant in four aspects. FSS could be able (1) to drive knowledge creation by integrating knowledge from various sources (experts) and systems, (2) to create knowledge spillover effects, (3) to foster innovation processes, and (4) to strengthen economic growth among the agents of a cluster or region, which lead to further economic growth in the long-term (Geenhuizen et al., 2009; Keller et al., 2015).

Keller et al. (2015) reveals also that resource-constrained SMEs have a high entry barrier to apply foresight in their business processes, due to lacks in resources and in knowledge. In this context, Spithourakis et al. (2015, p. 21) point out that special training is required that "should include a balanced mix of a good understanding of the underlying processes, algorithms and statistical methods of these systems […] to maximize the performance of the forecasting process. However, the design of an FSS could enable the integration of SME into the foresight process, fostering the quality of outcome for foresight and enabling SMEs to profit from economies of scale (Keller et al., 2015).

3 RESEARCH APPROACH

3.1 CORE RESEARCH CONCEPT

3.1.1 From literature review to operationalizable research goals

From the literature review, 24 operationalizable conclusions (OC) were extracted to motivate further research. These operationalizable conclusions provided the foundation for identifying the requirements of the empirical model. This was done by conducting a pilot study that founds on the operationalizable conclusions to refine the knowledge gained from literature review. The main goal was to develop a conceptual trend model of global economic trends (GETs) that incorporates the complete perspective from the trend to the impact on corporations and regions based on the current state of research. The pilot study aimed to proof the basic premises based on a set of operationalizable conclusion gained from literature review. Therefore, three basic operationalizable hypotheses were created. In this regards, operationalizable hypothesis one was also investigated in the literature review of this thesis.

In addition, it should be mentioned that the basic assumption was that if investor-related activity and data reveal patterns that indicate direct or indirect influence of GETs, then it has to be concluded that the influence is perceived as important by the corporation itself. Furthermore, it was assumed that if a corporation actively implements trends into communication activity, then there is a chance that the corporation also develops strategies or practices foresight activity. If so, this finding closes the gap between environmental scanning activity and integrating trends into strategy. Therefore, investor relation information had to be conceived as highly valuable for the analysis, as it is direct information used by a corporation to promote the company to interested investors.

1. Similarities of GETs and Megatrends in the context of annual reports

Over the course of the review, the important publications in the field of GETs and foresight were revealed and discussed. It could be observed that the terminology of trends is arbitrarily used in the literature and terms like ″GETs,″ ″megatrends,″ and ″global ″trends″ are often used in the same context to describe the same phenomena. Up to now, the majority of the literature tended to focus on megatrends rather than on reflecting the fact that megatrends have a rather low quality of information and might have a negative effect on foresight activities (Groddeck and Schwarz, 2013).

Section 2.1.1 emphasized global economic trends are not defined well. In total, five conclusions were drawn from the discussion in that section. Within the discussion, the term GETs was portrayed as a vehicle to demonstrate that the literature provides the same meaning to the terms GET and megatrend (cf. OC 1,2,5). Environmental scanning as a management practice is a crucial competence for corporations, and therefore it is used by many corporations to determine what trends might effect business success. Existing research approaches lack information quality, requiring that either corporations need experts to make predictions and assumptions about future development or robust trend studies that deliver enough knowledge to make profound decisions (cf. OC 6). However, trend studies do not provide a consistent picture of trends, and terms like megatrend obfuscate real economic development (cf. OC 5). The literature does not provide an approach that specifically recommends the use of compound terms like ″environmental trend″ or ″GET″ to emphasize the context of trends. Furthermore, it has to be assumed that the term ″GET″ is especially important to corporations that have a high degree of internationalization (cf. OC 9).

Operationalizable Hypothesis 1: GETs and megatrends show similarities with respect to globalization, market competition, changes in the organization of production, and innovation. They aim to gain knowledge about the current economic situation and economic downturns, or economic crises to anticipate the actual as-is situation and future development (foresight).

2. **Global Economic Trends in investor relations**

Why are these trends important and what could be revealed from theory on GETs? These questions were discussed in section 2.1.2. The literature emphasizes that GETs do effect an entire macroeconomic environment like a nation, region, or a certain geographical area. In modern economic theory, this type of influence is codified in leading economic indicators like gross domestic product (GDP), gross domestic product per capita (GDPpc), and foreign direct investment (FDI) (cf. OC 8). Hence, the impact and influence of GETs on an economic condition are measureable by key performance indicators.

Specifically, the impact to competitive advantage requires that experts think collectively on these economic events and prepare measures for securing the economic development of regions (cf. OC 8). Therefore, knowledge of the development of GETs in a certain regions means competitive advantage in business decision-making (cf. OC 10). However, there is no unique in macroeconomic theory that emphasizes for decision-making the development of GETs. Several attempts in macroeconomics and microeconomic theory could be identified that emphasize GETs. In this regard, economic growth and innovation are the anchors that link the dynamics of global markets to local development (cf. OC 11). In this regard, it is valid to conclude that GETs are not only important in the sense of economic decision-making and business strategy, but corporations might use these terms in their communication politics. Ideal grounds for research are the publications provided by investor relations. Notably, because this type of document addresses an expert public, the impact of these tools cannot be underestimated. As pointed out by Stittle (2003, p.18), "the groups are often key financial opinion-formers and the effect of their commentary, reporting and analysis (...) in the public arena should not be underestimated."

Operationalizable Hypothesis 2: GETs are especially interesting to multinational enterprises (MNEs). Therefore, future-orientated corporations like MNEs use terms like "global trends," "megatrends," "GETs" actively in their business practices.

3. Impact of web search activity to GDPpc

As outlined in OC 12 - OC 18, foresight is a comparative advantage and is a key competency for corporations that operate in multinational or global markets. Foresight studies are able to deliver a complete exhaustive view with a focus on a certain topic (cf. OC 12, 13). The ideas that are developed in these types of studies are then used for innovation processes to create better products or services. Forms of innovation processes are manifold and vary from different closed and open type of processes. This variety means that innovation can happen within public academic institutions, privately funded research institutes, corporations, or other forms of corporative environments, e.g. innovation or foresight conferences. Consequently, the integration of foresight processes and practices requires a strong collaboration between stakeholders, which might be costly and time-intensive. As outlined in OC 14, foresight practices require careful planning and preparation to integrate stakeholders.

The discipline of foresight is a rather young discipline that provides room for scientific research. In this thesis, the practical application of foresight based on foresight support systems (FSSs) is analyzed. The development of qualified tools is a key requirement to develop this research strain further, even though foresight theory is the dominant research stream when it comes to GETs. As the term foresight implies, the theory focuses on future development. Corporations that conduct environmental scanning, which is a part of foresight practice, have a strong orientation towards the future. Especially concerning Ansoff's theory, weak signals are considered one of the main works in this field (cf. OC 13). Furthermore, innovative corporations actively communicate their interest in future-oriented studies publically to foster collaboration among stakeholders (cf. OC 16). This measure increases attractiveness for investors. In this case, it is interesting to ask if MNEs are motivated to use terms like "megatrends" in their investor relations communication (cf. OC 18). In conclusion, the pilot study researched the following operationalizable hypothesis (OH 3).

New developments in information and communication technology (ICT) allow new approaches to collect data and provide an ideal ground to test the interest of corporations in GETs. In this research, it was considered especially interesting to determine the interest of MNEs by using information about web searches to find out which corporations in what regions have the most interest in future topics (cf. OC 22, 23). This information was used as an additional component to the qualitative data used in the discussion. As shown in the analysis (cf. OC 19-21), most of these stakeholders are experts that are integrated into panel analysis, such as Delphi analysis or online Delphi analysis. At the same time, modern data sources like Google Trends may provide useful information about the development of trends. The assumption of the thesis was that this knowledge could be transformed and integrated into a foresighting or decision-making process when certain expertise is unavailable or is available only in a small amount. When multiple stakeholders from different public, industrial or governmental backgrounds work together, smooth collaboration processes are the key level for successful results.

As outlined in OC 17, tacit or collective knowledge is transformed into explicit knowledge or information only when a fruitful culture is created that fosters knowledge creation. Even more demanding is this process across regions. Therefore, modern information and communication technology (ICT) plays a central role in enabling collaboration and communication among stakeholders. It is a required key competency in the development of modern foresight systems, not only from the enabling or effective perspective, but also from the perspective of cost efficiency and cost reduction. Hence, new technology raises the efficiency of the decision-making processes and fosters the creation of valuable knowledge. The above line of reasoning was translated into an operationalizable hypothesis that was researched in the pilot study.

Operationalizable Hypothesis 3: Literature indicates that regions with a higher GDP tend to be more future-oriented. MNEs are future-oriented and have a special interest in and actively search the web for future oriented terms like ″megatrends,″ ″GETs,″ or ″global trends.″ Therefore, web searches should correlate with the geographical locations of MNEs.

3.1.2 Required capabilities of an operational model

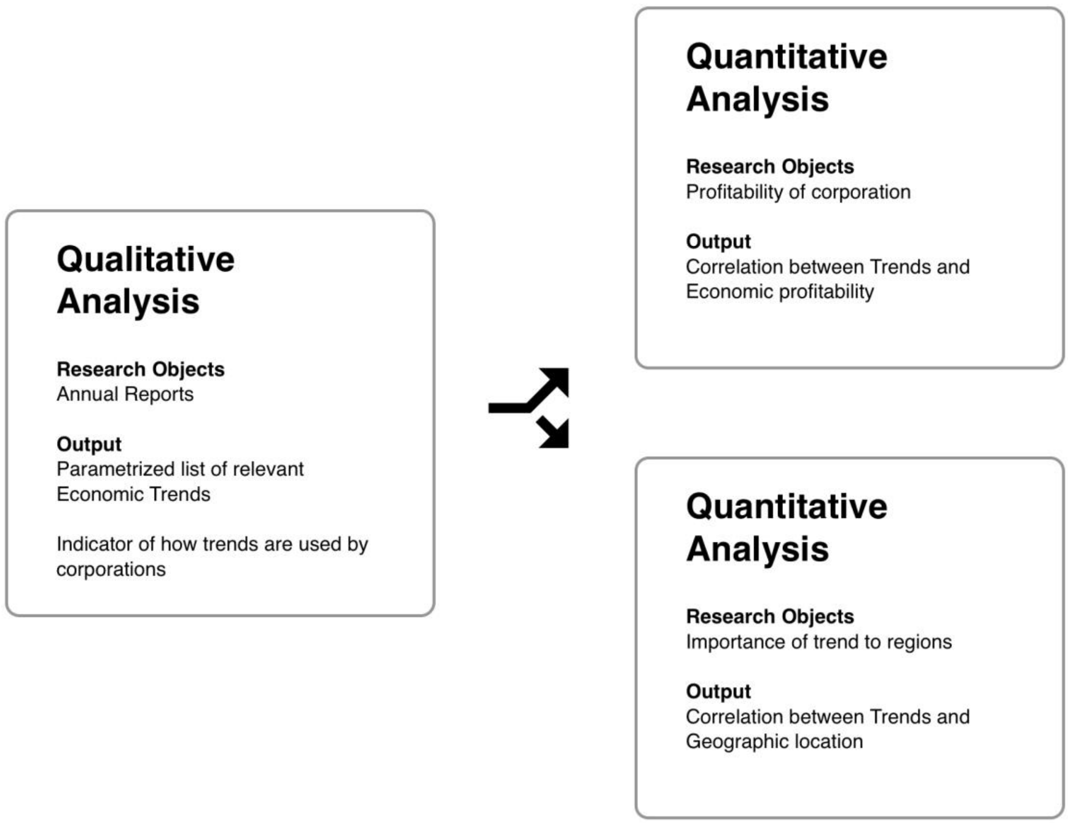
The operational model is the tool to verify and to test the hypothesis formulated in the preceding analysis that aims at different aspects of GETs. An operational model must incorporate these aspects and deliver reliable data and information that fulfills the requirements of empirical research. Based on the formulated hypotheses, the model has to cope with trends in the context of annual reports and in the analysis of trend data provided by Google Trends. Hence, the operational model incorporates qualitative and quantitative data, which requires a special form of design. Based on Hypothesis 1, investor relation activities by corporations are the subject of explorative research of the occurrence of the term "megatrend," "GETs (global economic trends)," "global trend," or other forms of trends. In this case, the question of trend existence and the question of how the trends are described and depicted drove the exploration. Typical capabilities that could be derived from the analysis are depicted in Table 14.

Table 14: Capabilities for an operational model of a trend

Dimension	Explanation
Name	The name of the trend like megatrend, GET, global trend, etc.
Impact	Push or pull
Categorization	STEEPV
Time / development	What has been known about a trend? Is the trend new or emerging?
Ranking	What is known about a trend? What could be improved concerning the confidence and the quality of information?
Communication	Is the trend communicated by a single entity? Is it used in a strategic measure or tool like a trend radar?
Strategy	Does the corporation provide a strategy against the trend?

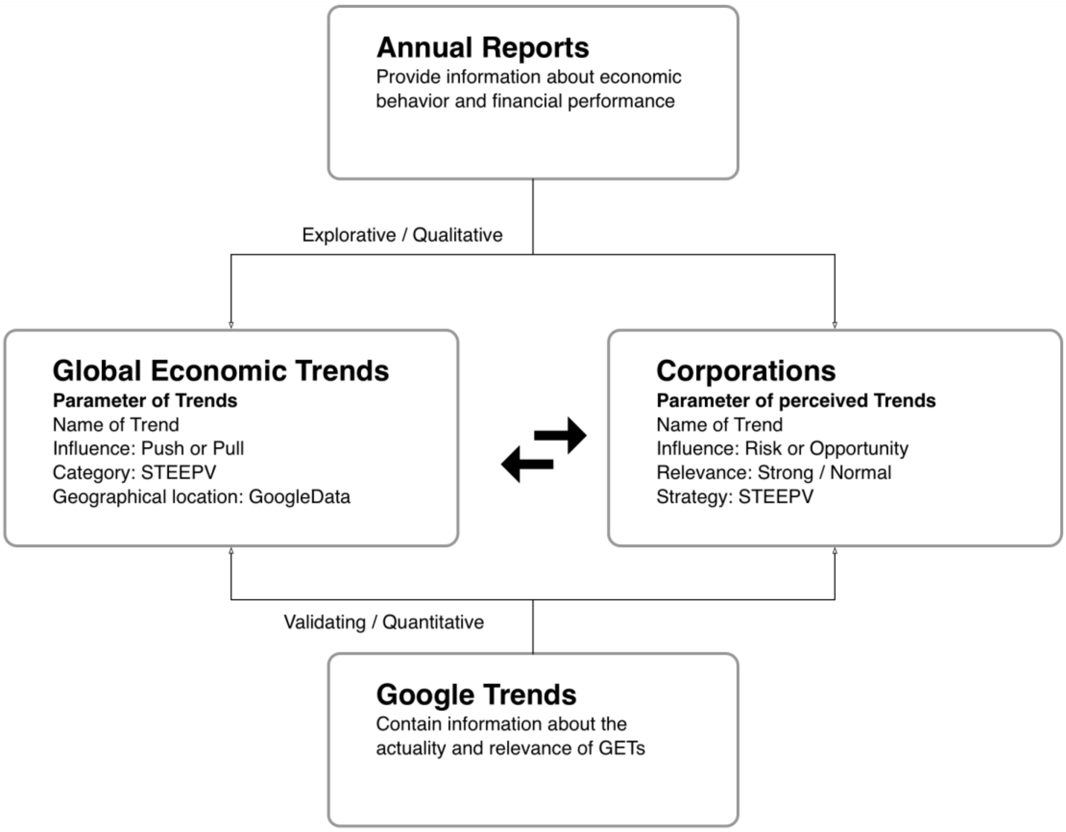
At the same time, the identified trends that are used in investor relations have certain characteristics and information quality. The important parameters from the information perspective are the textual context or passage, the exact phrasing of the printed trend, and the individual form of presentation that might play a role in emphasizing the relevance of a trend to the corporation. The textual context contains information about the trend and lays the foundation for the interpretation work of the text. The suggested approach to text processing contains qualitative and quantitative variables. In this case, the concept of qualitative content analysis (QCA) plays an important role in analyzing and interpreting the text based on categorized variables. The interpretation and categorization process delivers a set of testable trend objects that could be used for further research. There are two possible research strains after the categorization and interpretation process of the data, as depicted in Figure 22.

Figure 22: Identified research strains



The first strain in Figure 25 focuses on correlating analysis between economic profitability and trends. The second strain aims at analyzing correlations between the parametrized data gained from the annual report analysis and the data provided by Google Trends. Correlation may occur between regional or geographical interest, amount of research results in total, or other yet to be defined parameters. A conceptual model was created to integrate the parameters, which could then be used for operationalization and empirical analysis, as depicted Figure 23.

Figure 23: Conceptual model

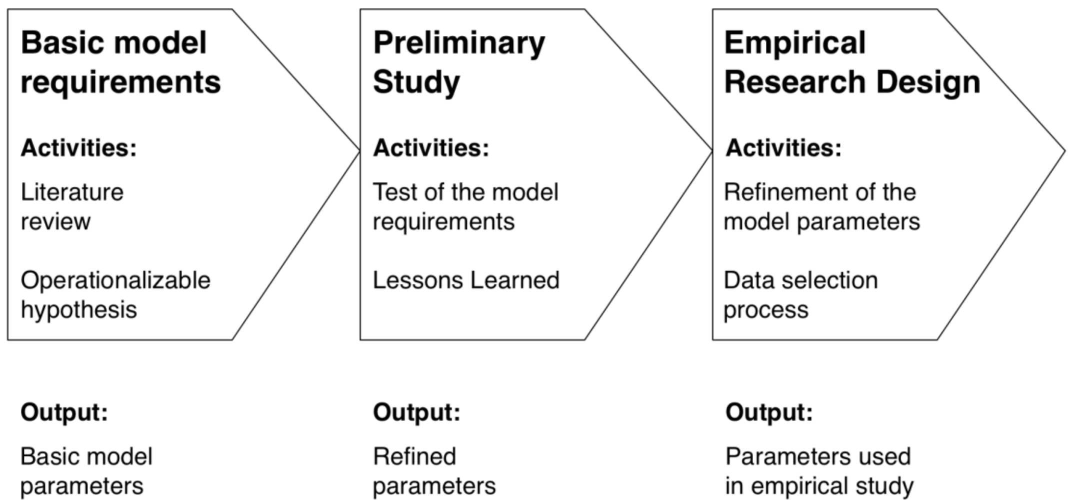


As depicted above, the sources of information, Google Trends and annual reports, furnished relevant information for the determination of object parameters. One part of the model aims at the exploration of trends, and the other part at analyzing the trends from a corporate perspective. The model provides two coherent views of trends to identify the economic and regional relevance.

3.1.3 From conceptual model towards empirical research design

The conceptual model guided the development of the empirical model by verifying and testing the developed capabilities. Testing and model refining in this study was done by testing the results within a preliminary study. This approach revealed the maturity of the developed hypothesis, and identified what variables and parameters needed to be refined and aligned with the overall research strain. The refined variables and parameters were then utilized in the empirical study. This process is shown schematically in Figure 24.

Figure 24: Research design towards an operational model



Hence, the preliminary study was an important step in the empirical research design. Especially in exploratory research, refinement of parameters is crucial towards a mature research design. The preliminary study was published as "GETs and Regional Development." The paper resulting from this study was published in 2015 in "Yearbook – UCAM-FOM Doctoral School of Business." The results of this study set the course for the research design of the thesis including the choice of the methods that were applied in its empirical component.

3.2 PILOT STUDY ON GLOBAL ECONOMIC TRENDS

3.2.1 Core concept of the pilot study

The preliminary study, published as "Global Economic Trends and Regional Development" (Bezjak, 2015), aimed to verify whether global economic trends (GETs) provide enough qualitative and quantitative data for the analysis of topics on economic growth. To evaluate this data, GETs were analyzed in terms of their occurrence in business and academic literature, and in terms of availability of web search data delivered by Google Trends. The study tested three hypotheses against web data and delivered the following three main conclusions that set the path for further research:

- GETs and megatrends show similarities with respect to globalization, market competition, changes in the organization of production, and innovation (Bezjak, 2015);
- Web searches correlate more strongly with geographical locations of MNEs on a regional level than on a municipal level, and (2) corporations address megatrends directly within their investor relationship (Bezjak, 2015);
- Regions with a higher gross domestic product (GDP) are more future-orientated, which is in line with the study of Preis (2013). MNEs within this regions have a special interest in future-oriented topics like megatrends (Bezjak, 2015).

The study researched if the combination of qualitative and quantitative data was useful for hypothesis testing and if the data or the methodology could be used for the qualitative enhancement of existing models within regional and corporate development. Furthermore, it was demonstrated that "Google Trends reveals valuable insights on the discussion of GETs and regional development, and provides further ground for enhancements in the field of corporate and regional forecasting models"(Bezjak, 2015). Consequently, web search queries for terms like "megatrends" occur in regions and cities where MNEs reside. Furthermore, terms like "megatrends" are proactively used investor relations and leadership and are inherited in strategic management culture.

The results of the analysis and the most important implications of the study are outlined below. GETs, in conjunction with annual reports published by MNEs, and modern analysis tools like Google Trends are valuable grounds for research on trends and their impacts. The interpretation of the data gathered in this preliminary study confirmed that GETs influence households, corporations, and governments in several ways. Furthermore, findings from other sources were validated within this study. In this regard, it must be mentioned that the use of Google Trends provides valuable data in the context of regional economic development. The following points summarize the findings in the preliminary study:

1. GETs and megatrends show similarities with respect to globalization, market competition, changes in the organization of production, and innovation (Bezjak, 2015, p. 14);

2. Web searches (1) correlate with geographical locations of MNEs stronger on a regional level than on a city level, and (2) corporations address megatrends directly within their investor relations (Bezjak, 2015, p. 16);

3. Regions with a higher GDP are more future-orientated, which is in line with the study of Preis (2013). MNEs within this regions have a special interest in future-oriented topics like megatrends (Bezjak, 2015, p. 21);

4. Global trends are important to MNEs to the extent that corporations do actively use the term GET, global trend, or megatrend to refer to sectoral changes to markets;

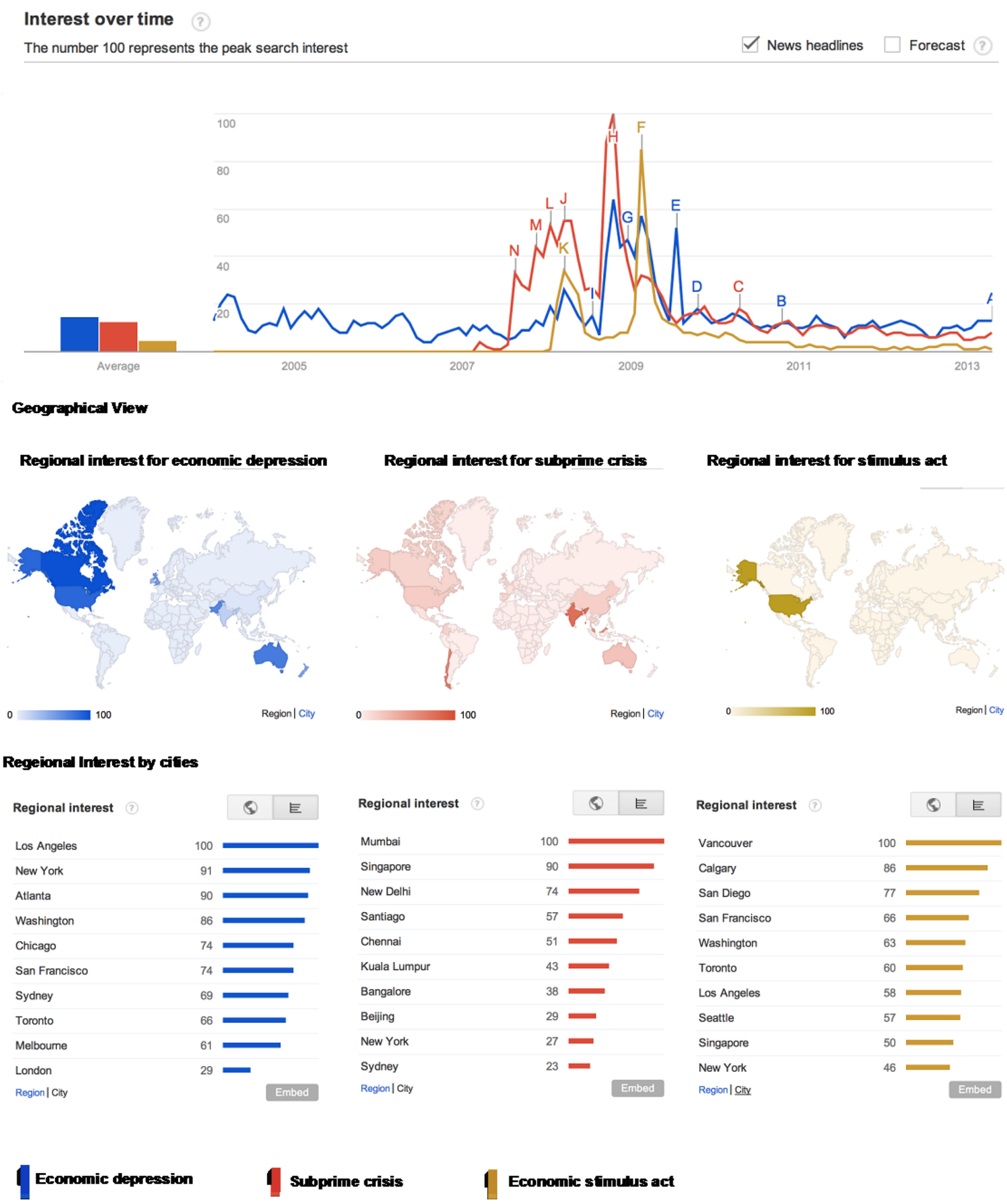
5. Web searches related to economic trends occur in economically wealthy regions that have enough cash flow for investments. This tendency is as well true for MNEs that invest nationally and internationally.

3.2.2 Detailed results of the pilot study

3.2.2.1 Trends and economic crisis

The literature shows consensus on the logical connection between global economic trends (GETs) and economic crises. In fact, the term GET itself is used in conjunction with economic downturns, especially in studies that anticipate upcoming economic progress based on actual economic conditions (Bezjak, 2015). Researchers like El-Erian and Stiglitz use the term GET to improve methodology, to develop governance and regulation concepts for international finance and trade, and to improve the quality of political decision-making (El-Erian, 2008; Stiglitz, 2010, 2011). In this context, it is important to point out that the authors focus on (a) institutional changes, (b) the influence of global financial markets to regional communities, (c) the determinants of investment decisions, (d) paradigm changes in terms of changes to existing academic approaches, and (e) the social, economic, technological, and geographical aspects of change. Furthermore, the paper demonstrated the critique in academic literature of the theory of efficient markets and regional development theories that relate to economic growth models and theories. The new approach that was introduced in the preliminary study of this thesis was the integration of Google Trends data to research relations between GETs and economic crisis. In this paper, the discussion centers on the fact that if the term GETs relates to economic crises, then web search queries have to reflect the public interest. Due to the informative value of the data, it is further assumed that the geographical information of web search data is also beneficial for research. The term occurs in web searches frequently after the emergence of the economic crisis, or the subprime crisis, in 2007-2008, which was followed by a period of economic depression. The terms were particular queried in the US. In more detail, it was assumed that political measures that address economic growth stimulate the public opinion positively. A textbook example that was found during the research was the Economic Stimulus Act of 2008 (Public Law 110-185) signed by former US president George W. Bush. This finding, while preliminary, suggests that the timely and political interrelation between events of crisis, the phase of economic depression, and measures like the Economic Stimulus Act provide a strong foundation for analysis with Google Trends.

Figure 25: Google Trend evaluation
(Source: Bezjak, 2015)



Additional supportive evidence was provided by the media. In one article, the US government is interested in Google Trends, a comment made by the Economic Advisor of the White House, Larry Summers (Dargham 2009). Within the interview, he mentioned that the economic stimulus act was the right approach to recover economic growth, using the web searches as an indicator (Bezjak, 2015). Figure 25 illustrates the results of web search queries that contain the terms "economic depression," "economic stimulus act," "economic crisis," as discussed above. The important implications of the above analysis are as follows:

- Language influences the results of the queries significantly. Significant is the regional interest of the Stimulus Act in the US and in Canada. Also, the interest in the term "economic depression" is found in countries where English is the primary language like the US, England, India, Australia;
- Google Trends data confirm the emergence of the subprime crisis in 2007, the succession of the economic depression, and the measures of the Economic Stimulus Act;
- There were two major acts for economic stimulus packages in 2008 and in 2009, the Economic Stimulus Act of 2008 (Pub.L. 110–185, 122 Stat. 613, enacted February 13, 2008), and the American Recovery and Reinvestment Act of 2009. In the Google Trends data, two major peaks could be identified, one in 2008 and one in 2009. These peaks occur at the same time, when either the interest in the term "subprime crisis" is at its peak in interest over time, or the interest in the term "economic depression" is at its peak;
- It is also important to notice that cities like Mumbai, Singapore and New Delhi show interest into the term "subprime crisis." In fact, annual gross domestic product (GDP) growth data confirms the impact of the US financial crisis to other markets. E.g. in 2008 the economy in India declined down to 3.9 % GDP growth, which is a decrease of 6 % compared to 2007 (The World Bank, 2015). In addition, other non-English speaking cities like Bejing show strong interest into the topic.

3.2.2.2 Analysis of economic growth and Google Trends

An important conclusion from a study conducted by Preis (2012) is the correlation between web searches and location in terms of gross domestic product (GDP) growth. Also important is the fact that excellent corporations choose a quality environment that enables innovation (Maier et. al. 2006, p.19). Preis demonstrated that regions and cities having a strong interest in future-oriented topics like megatrends and using web searches to satisfy their interest also have a higher GDP (Preis et. al. 2012, p.1). The study engaged this insight for an analysis on Germany's federal states with a strong GDP. These federal states are Bayern, Baden-Württemberg, Berlin, Hamburg, Hessen, Niedersachsen, Nordrhein-Westfalen, Rheinland-Pfalz, and Sachsen. It could be demonstrated that these regions have higher activity in with web searches for term like "megatrend." These results are then compared with the mean GDP of the federal state. Table 15 represents the results of the comparison of GDP data and web searches for the term "megatrend" from 2004-2013. One important finding from the analysis is that regions like Bayern, Baden-Württemberg, Rheinland-Pfalz, Hamburg, Nordrhein-Westfalen, Niedersachsen, Berlin, Hessen, and Sachsen are of special interest for excellent corporations. In conclusion:

- all federal states with a GDP share greater than 3.72 percent of the total GDP have a special interest in the web search for megatrends, as depicted in Table 15;
- the interest in megatrends is especially high in regions like Bayern, Baden-Württemberg, and Rheinland-Pfalz;
- the sequence of federal states sorted in descending order according to their GDP is not in line with the sequence of web searches from 2004-2013.

In the same breath, it must be recognized that the support of geographical data for cities was insufficient, and did not provide enough evidence. It is also important to notice that only the term "megatrend" was used in the comparative analysis. The findings here are that the realm of possible search terms needed to be identified and to be determined for the empirical analysis.

Table 15: Comparison between GDP data and Google Trends data
(Source: Bezjak, 2015; Destatis, 2013)

Statistical data GDP from 2004-2013 (as % of total GDP Germany)		Google Trends web search data for "megatrends" and "megatrend" in Germany from 2004-2013	
Federal state (Germany)	**Mean GDP**	**Federal state (Germany)**	**Google index**
Nordrhein-Westfalen	22,19%	Bayern	100
Bayern	17,24%	Baden-Württemberg	96
Baden-Württemberg	14,62%	Rheinland-Pfalz	95
Niedersachsen	8,57%	Hamburg	90
Hessen	8,99%	Nordrhein-Westfalen	88
Rheinland-Pfalz	4,41%	Niedersachsen	86
Berlin	3,84%	Berlin	84
Sachsen	3,72%	Hessen	80
Hamburg	3,72%	Sachsen	72
Schleswig-Holstein	2,95%	n/a	n/a
Brandenburg	2,15%	n/a	n/a
Sachsen-Anhalt	2,03%	n/a	n/a
Thüringen	1,87%	n/a	n/a
Mecklenburg-Vorpommern	1,38%	n/a	n/a
Saarland	1,23%	n/a	n/a
Bremen	1,07%	n/a	n/a

3.2.2.3 *Correlation of web searches and regional location*

A central question in the preliminary study was how the economic behavior of corporations could be analyzed with Google Trends data to reveal further insights about the development of markets. This question also leads to topics like comparative strategy, by comparing multinational enterprises (MNEs) across different regions, or within the same region Nachum (2012). The key assumption was that data about web searches are especially interesting to MNEs. Therefore, "(1) future-orientated web search queries for terms like 'megatrends' occur especially in regions and cities where MNEs reside, and (2) megatrends are present investor relations, leadership and strategic management culture" (Bezjak, 2015). The outcome of the analysis is that web searches correlate "with geographical locations of MNEs stronger on a regional level than on a city level, and (2) corporations address megatrends directly within their investor relations" (Bezjak, 2015, p. 16). The analysis of location and web searches revealed (cf. Table 16):

1. that where no MNEs are located, no geographical activity in regard to web searches is recognized. Within these regions of Germany, no DAX (German stock index) corporation is located. It is significant that out of 16 federal states within Germany, Schleswig Holstein, Mecklenburg-Vorpommern, Brandenburg, Sachsen-Anhalt, and Thüringen do not occur in the dataset (cf. Figure 26).

2. the regional location of MNEs in relation to the federal state that placed the search request for "megatrend'" or "megatrends." The correlation between cities and geographical location of 30 DAX corporations is 66%. Only 10% of the corporations were located directly in a city, or do not reside farther than 20 km from the returned value for city by Google Trends. Furthermore, it is assumed that Germany's capital Berlin is indicated due to government activity in the field of information exchange, innovation, research, and regional development politics (cf. Figure 26).

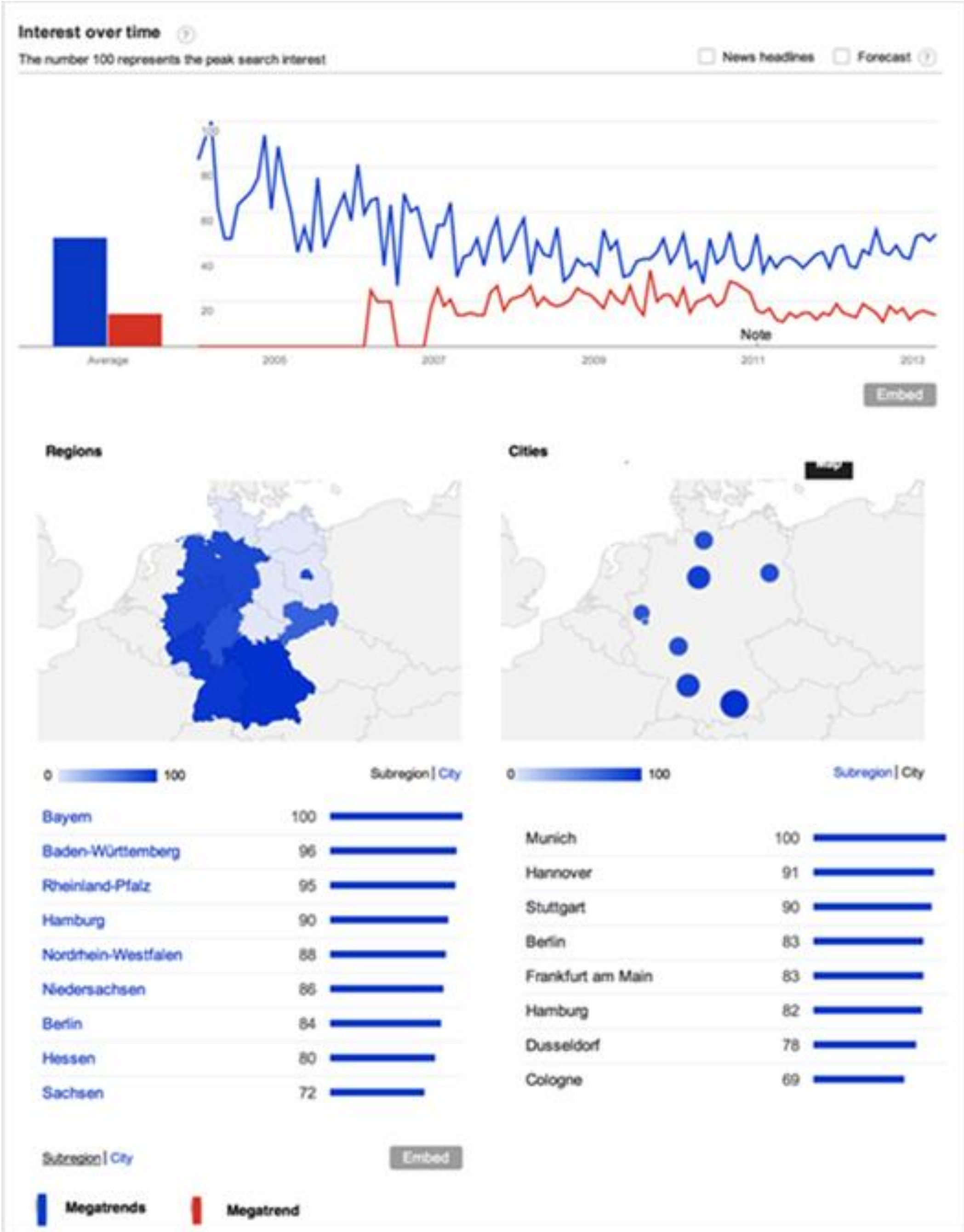
Table 16: GETs in investor relations of German MNEs

(Source: Bezjak (2015))

Name	Industry / Sector	Location (City)	Represented geographically by Google Trends		Relevant in investor relations
			Directly by region	Directly by City	Within report
Adidas	Lifestyle	Herzogenaurach	Yes	No	No
Allianz	Insurance	München	Yes	Yes	Yes
BASF	Chemicals	Ludwigshafen	Yes	No	Yes
Bayer	Chemicals and Life Sciences	Leverkusen	Yes	Yes	Yes
Beiersdorf	Life Sciences	Hamburg	Yes	Yes	Yes
BMW	Automobile	München	Yes	Yes	Yes
Commerzbank	Finances	Frankfurt am Main	Yes	Yes	Yes
Continental	Automobile	Hannover	Yes	Yes	Yes
Daimler	Automobile	Stuttgart	Yes	Yes	Yes
Deutsche Bank	Finances	Frankfurt am Main	Yes	Yes	Yes
Deutsche Börse	Finances	Eschborn		Yes	No
Lufthansa	Transportation	Frankfurt am Main	Yes	Yes	Yes
Deutsche Post	Transportation	Bonn	Yes	No	Yes
Telekom	Communication	Bonn	Yes	No	Yes
E.ON	Energy	Düsseldorf	Yes	Yes	Yes
Fresenius Medical Care	Life Sciences	Bad Homburg	Yes	No	No
Fresenius	Life Sciences	Bad Homburg	Yes	No	Yes
Heidelberg Cement	Industry	Heidelberg	Yes	No	Yes
Henkel	Chemicals	Düsseldorf	Yes	Yes	Yes
Infineon	Electronics	Neubiberg	Yes	Yes	No
K+S	Chemicals	Kassel	Yes	No	Yes
Lanxess	Chemicals	Leverkusen	Yes	Yes	Yes
Linde	Engineering	München	Yes	Yes	Yes
Merck	Chemicals and Life Sciences	Darmstadt	Yes	No	No
Munich Re	Insurance	München	Yes	Yes	No
RWE	Energy	Essen	Yes	No	Yes
SAP	Information	Walldorf	Yes	No	Yes
Siemens	Electronics	München	Yes	Yes	Yes
ThyssenKrupp	Steel	Essen	Yes	No	Yes
Volkswagen	Automobile	Wolfsburg	Yes	No	Yes

Figure 26: Web search interest for "megatrends" in Germany 2004 to present

(Source: Bezjak (2015))



3.3 EMPIRICAL RESEARCH DESIGN AND METHODOLOGIES

3.3.1 Empirical research design

3.3.1.1 Hypotheses for empirical research

The basic premise for the empirical research was that global trends are important to multinational enterprises (MNEs) to the extent that corporations do actively use the term global economic trends (GET), global trend, or megatrend in their investment decision-making. This basic premise leads to the assumption that the utilization of these types of trends can be observed in investor relationship communication. The empirical research was based on different hypotheses that partially stem from the results of the pilot study, and partially from the discussion in the literature review in chapter 2. The pilot study was used as a tool to reshape the perspectives and insights gained in the literature review towards mature hypotheses that are testable by empirical inquiry. This eliminates sources of error to reduce the bias in information interpretation, data selection, and other confounding factors. The insights from the literature review and the pilot study are integrated into a holistic study on trends utilized by German DAX (Stock market index) corporations, which founds on the following hypotheses.

1. Utilization of GETs in investor relation

The pilot study revealed that MNEs in Germany utilized the term "megatrend" in their annual reports in the period from 2008 to 2012. The literature shows that various trend terms describe the same effects as megatrends and differ only in the naming (cf. Operationalizable conclusion (OC) 5). Furthermore, a correlation between the geographical location of MNEs and the use of the term "megatrend" was revealed. These results motivated a more detailed investigation of the application of trends to identify how trends are used exactly by industry practitioners. This investigation included the questions of whether the terminology "GETs" or "megatrends" are used directly or indirectly by corporations, whether they are perceived as a risk or opportunity, and how the trends are distributed across industries. In addition, it was also pertinent to ask, which corporations and industries utilize this type of trend the most. In this case, the assumption was made that the observation would reveal differences in the usage frequency and in spatial distribution across regions and cities. The above thoughts are summarized in the following hypothesis.

Hypothesis 1: German DAX (German stock index) companies actively use GETs and megatrends in annual reports. At the same time, corporations from different industries set different priorities to trends, which is observable in behavioral patterns and in the spatial distribution of trends.

In general, the environment of corporations can have either a push or a pull effect to the business of the companies (cf. OC 4). To be able to make qualitative judgements about the effect, each trend passage found in the annual report was evaluated for the effect. Furthermore, due to its economic and often subjective appeal, it was furthermore assumed that trends are often described as having a pull effect for the corporation. This effect is especially true when this information is presented to a financially strong audience, since then trends are marketed as business opportunities.

Hypothesis 2: Corporations perceive trends business opportunities rather than as risk, and communicate a positive vision to their shareholders.

2. Categorization of trends

A common method for the development of a scenario in the context of foresight is the use of the system STEEPV (Social, technological, economic, environmental, political, values) (cf. OC 3). This systematic is a key tool in strategic foresighting. This management toolbox provides categories for practitioners to shape a discussion of trends and future events for dedicated organizational targets. However, no systematic categorization system could be revealed in the literature to provide experts on GETs and megatrends with a toolset to categorize trends from an ex-post perspective. Consequently, the assumption in this thesis was that the categories provided by STEEPV could also be applied to the categorization of existing trends from an ex-post perspective (cf.

OC3). To deliver sustainable and generalizable results, the determination was that a second type of categorization system should be applied to the data, allowing comparison to the STEEPV system. This application was expected to help to validate the ex-post approach and answer the question of whether the application of these categories is effective. The second type of categorization system, it was determined, should be developed based on the content provided by annual reports analyzed in this study. Mayring (2014) points out that the tool called "inductive category development" from the field of QCA provides this capability and outperforms a deductive approach, such as the application of STEEPV, in terms of quality, effectiveness, and efficiency. Individual named trends found in annual reports can serve as a foundation for the development of an individual categorization system. This motivated the following hypothesis.

Hypothesis 3: Trends be subsumed deductively and inductively in similar categories with the same traits and characteristics, based on the concept of qualitative content analysis.

3. Spatial analysis based on web search data

The literature reveals that data from social media sources such as Google Trends (cf. OC 22, 23, 24) is able to provide valuable insights about the utilization of GETs in the context of industry. The pilot study was founded on this type of data and pointed out that web searches for the term "megatrend" correlate with the geographical locations of MNEs stronger on a regional level than on a city level and occurred in economic wealthy regions (Bezjak, 2015, p. 16). These findings motivated analysis of how the information implemented in annual reports about web search data in relation to trends could be utilized in more detail, for example in the context of geographical analysis as provided in GISs, and adds value to foresight practices. If annual reports are addressed to national and international investors, then the web search interest into these types of trends is reflected in the geographical information about web search activity. Therefore, the demand for this type of information is represented in the location information of Google Trends. A point of optimization that stems from the pilot study was that only the term “megatrend” and the timeframe from 2004 to 2014 were utilized in the assessment. In this case, it was assumed that a larger set of trends in conjunction with a larger period of assessment would deliver better grounds for analysis. In order to understand the cross-border of impact of trends, spatial information of trends is required to find out about the real impact of trends, as illustrated in the literature review (cf. OC 10, 11, 12). In addition, it was assumed that this information is crucial to interpret the impact of a trend correctly. The spatial information of web search data can be integrated into foresight practices and foresight support systems (FSS) to improve the process effectiveness and efficiency. Existing GISs can be used to create visual maps of industry interest. Furthermore, it was assumed that these visual maps of interest reveal patterns for further interpretation. The pilot study indicated a correlation of web search data and economic growth expressed in the gross domestic product (GDP). Even though, the pilot study only utilized the term “megatrend” to download data from Google Trend. Therefore, the data might be biased, which requires further analysis.

Hypothesis 4: Spatial analysis based on web search data related to global economic trends used in annual reports of DAX corporations could be used to analyze economic growth based on macroeconomic indicators like GDP.

4. Behavioral patterns in the utilization of trends in annual reports

The pilot study fueled the idea that financial KPIs can have an influence on the utilization of trends. Therefore, corporations include a certain trend in a report and describe it as a risk to the business, then the management shows high certainty that the risk is effecting the business operations. In addition, this form of trend application is interpreted as a signal to the investment community of a company or industry that the corporation is aware of the impact of the risk to business operations and is capable of handling this risk (OC 12 – OC13). Furthermore, it is assumed that this signal can be expressed by (1) the total utilization of TPs identified as risks and opportunities, as well as by (2) the total amount of direct and indirect TPs implemented. The described characteristics are countable measures that allow interpretation from a quantitative perspective and the creation of an individual index that expresses the demonstrated confidence of a corporation towards trends used in investor relations. The assumption was that such an index might be created for each report included in the overall population of the analysis. In this regard, the created index could be utilized as a dependent variable in a multivariate regression model that depends on financial key performance indicators of the year of report publication. Therefore, the financial results of the previous fiscal year can be used as an explanatory variable in the regression analysis. As the analysis should be extended to longitudinal data analysis, different statistical models can be applied to the data.

Hypothesis 5: Financial KPIs might have a causal relation to the utilization of trends used in annual reports of DAX corporations. Quantitative indicators founded on the information of trends in annual reports are able to portray the confidence of a corporation into the relevance of a trend.

5. Optimization of regression models with web search data

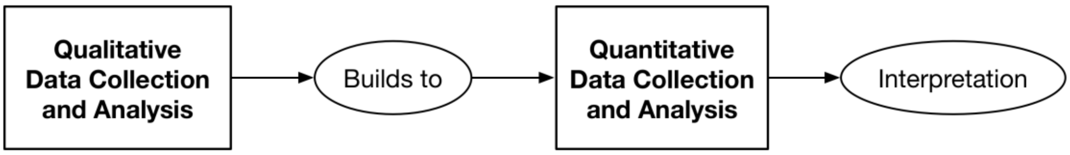
The literature shows that other studies that use Google Trends provide valuable information for the time series models, and improve the quality of forecasting (cf. OC 20 – 24). If it is possible to develop regression models as depicted under hypothesis 5, then the information about web searches should be used to optimize the model quality by implementing the web search data as an additional explanatory (independent) variable. The conceptual model was based on annual report data. It is assumed that an optimization of the model requires using aggregated values of web search data.

Hypothesis 6: Web search information is able to improve existing multivariate models for the assessment of global economic trends.

3.3.1.2 Mixed methods research design

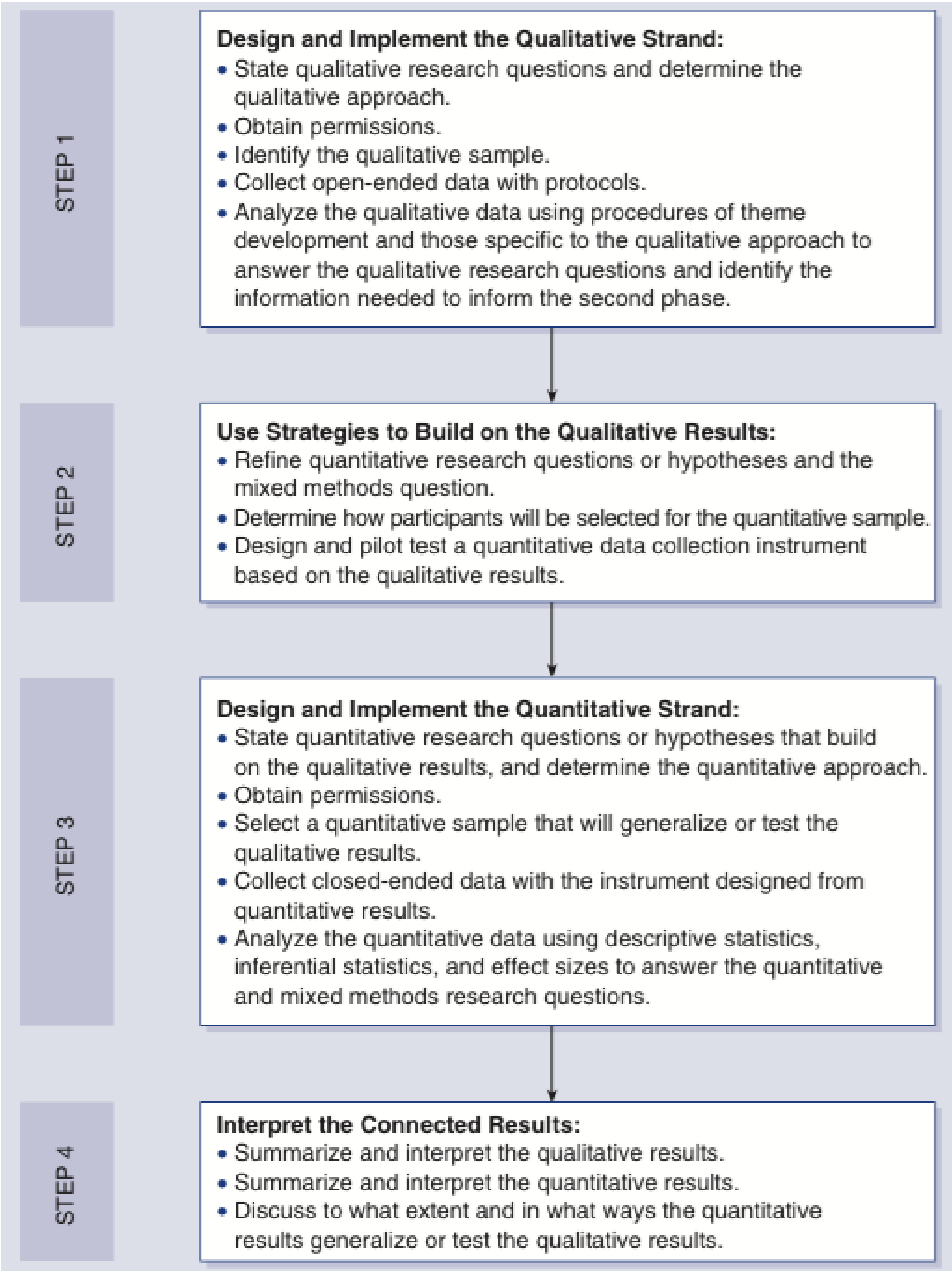
Cameron and Molina-Azorin (2011, p. 256) show that mixed-method research has reached maturity and is a legitimate methodological approach that is "utilised by many academics and researchers from across a variety of discipline areas." Both the emergence of academic journals like the *Journal of Mixed Methods Research* and the publication of books like *The Handbook of Mixed Methods in Social and Behavioural Research* (Tashakkori and Teddlie, 2010) and *Designing and Conducting Mixed Method Research* (Creswel and Clark, 2007) demonstrate the emerging interest into the topic (Cameron and Molina-Azorin, 2011). Creswell and Plano Clark (2011, p. 5) see in mixed methods a "research design that belongs to a research paradigm (methodology) that assumes one or different worldview(s) could be used to study a phenomenon and whose research methods focuses on collecting, analyzing, and mixing both quantitative and qualitative data in a single study or series of studies." Mixed-method research offers six major design options, of which the exploratory sequential design was adopted for this research (Creswell and Plano Clark, 2011). Figure 27 shows the exploratory approach that builds the foundation for empirical analysis.

Figure 27: Exploratory sequential design
(Source: Creswell and Plano Clark 2011, p. 69)



The exploratory sequential design comprises two phases: qualitative data collection and analysis followed by quantitative data collection and analysis. First, qualitative data are collected and analyzed. Quantitative data are collected to help explain, or elaborate on, the qualitative results, as depicted in the Figure 27 and Figure 28. The mix of qualitative data and quantitative data provides a holistic understanding of the research problem (Creswell and Plano Clark, 2011).

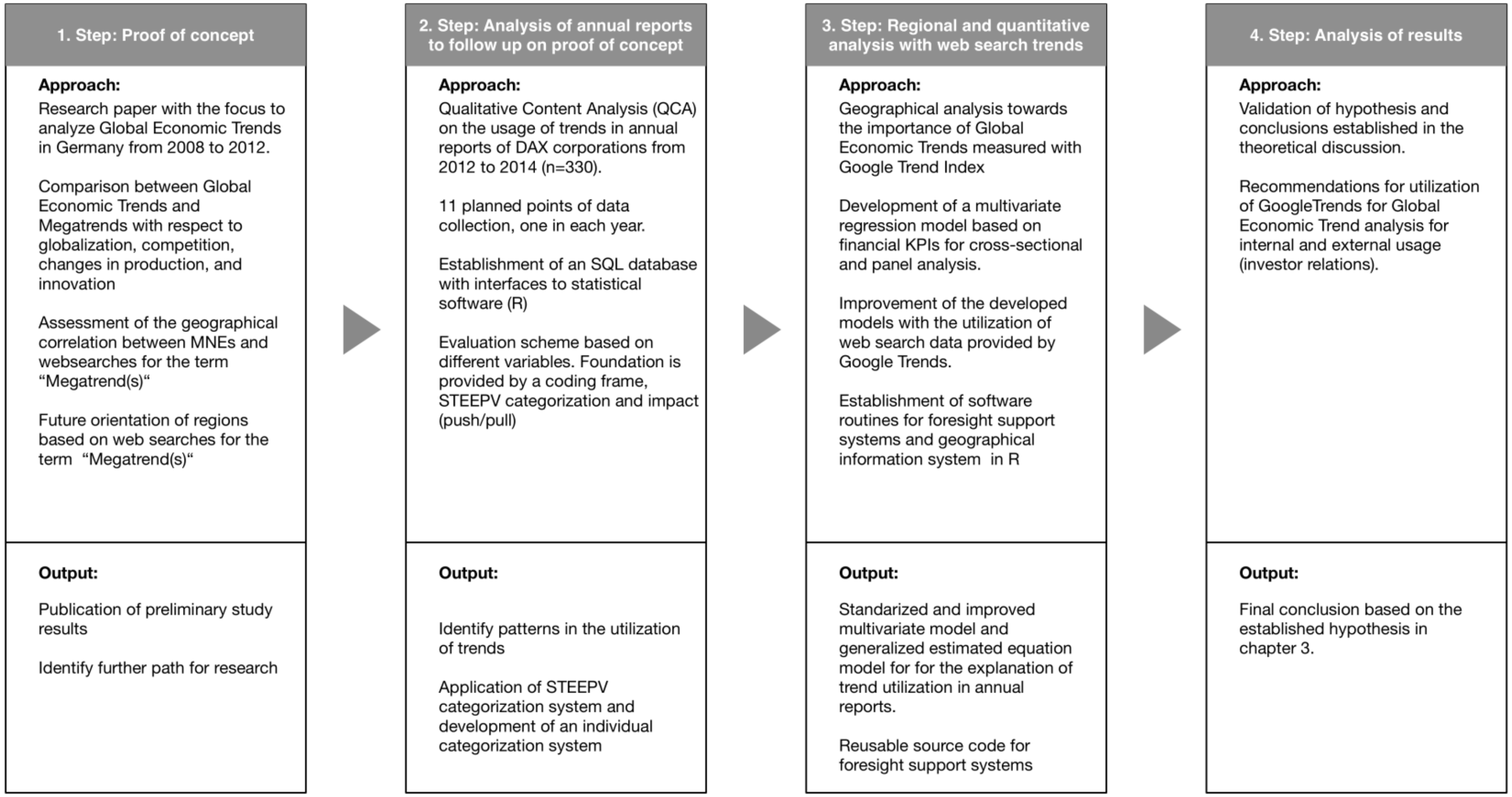
Figure 28: Flowchart of exploratory design implementation
(Source: Creswell and Plano Clark (2011, p. 88))



The concepts illustrated above and the insights from the pilot study shaped the path for the research approach. The proposed research design and sequence illustrates the translation of conceptualized ideas into an operationalized research model. Based on the selected methodology, the research design was customized to the relevant aspects of this research. In addition, the conducted pilot study added further insights to the discussion and helped to focus the research goals. Creswell and Plano Clark (2011, p. 87) state that "the exploratory design is most useful when the researcher wants to generalize, assess, or test qualitative exploratory results."

This situation leads to a high degree of uncertainty, as many of the variables have to be refined during the research. The high degree of uncertainty that is involved in the study can have a negative impact on the outcome, if the results are not worked out systematically and according to strict rules. Especially when an instrument is developed between the qualitative research and the quantitative research phase, safety procedures should be implemented to ensure the validity and reliability of the instrument and the data analysis (Creswell and Plano Clark, 2011). The measures should be applied continuously to assure data quality and logical conciseness. At the very beginning of the empirical research of this paper, a preliminary study was conducted. This step was also a safety measure, as it validated the conceptual suppositions that were the foundation for the research design. Another benefit of the suggested methodology was that specific variables could be designed circularly or dynamically in the qualitative component of the research. This benefit was a key lever in the explorative design of this study. Furthermore, the study delivered ideas and variables for the empirical design. Based upon the previous discussion, two further strains were identified as valuable for further research. These strains were integrated into the quantitative analysis of this thesis. The final research sequence is depicted in Figure 29.

Figure 29: Empirical research design



3.3.1.3 Statistical foundation for panel and cross-sectional research

Frees (2004, p. 4) describes that panel data models are often described as cross-sectional time series, or longitudinal data. From the point of correlation and causation, a longitudinal analysis (LTA) can have further benefits in contrast to cross-sectional designs. Especially in the exploration of not well-researched areas like the analysis of trend use in annual reports, the large amount of data provides insight into individual points in time, as well as into the overall changes between individual data collection points. Baltagi (2011, p. 305) describes, with the example of US panel data surveys, that with the additional "more informative data, one can get more reliable estimates and test more sophisticated behavioral models with less restrictive assumptions." Other benefits of LTA analysis include the close interconnection with multivariate analysis (Frees, 2004). This type of analysis requires some modification to the application of regression analysis, depicted in Equation 1.

Equation 1: General regression model

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_k x_k + e_i \tag{1}$$

β_0	Intercept
β_k	Coefficient for the k-th variable
e_i	Random error or disturbance term

The design of the panel requires multiple points of measurement with the same participants within the panel. In our case, the participants (i=1…n) were the annual reports of 30 German blue chip corporations listed in the index DAX (stock market index) examined over multiple years ($t = 1 \ldots T$). On the one hand, this design provided the change to conduct an analysis over the complete period by not implementing the annual year as a grouping variable. However, to analyze changes between the annual years, the above equation had to be extended.

In the panel, the estimated variables could vary over time, having an important impact on the overall analysis. Alecke (1997, p. 91) points out four important distinctive cases, which are as follows:

1. The weights of the regression (x) are constant, but the regression constant (β) varies.

$$y_{it} = \beta_{1i} + \beta_2 x_{2,it} + \beta_3 x_{3,it} + \cdots + \beta_k x_{k,it} + e_{it} \tag{1.1}$$

2. The weights of the regression (x) are constant, but the regression constant varies over the individuals and time.

$$y_{it} = \beta_{1it} + \beta_2 x_{2,it} + \beta_3 x_{3,it} + \cdots + \beta_k x_{k,it} + e_{it} \tag{1.2}$$

3. All coefficients (weights of regression and regression constant) vary over the individuals.

$$y_{it} = \beta_{1i} + \beta_{2i} x_{2,it} + \beta_{3i} x_{3,it} + \cdots + \beta_{ki} x_{k,it} + e_{it} \tag{1.3}$$

4. All coefficients vary over the individuals and time.

$$y_{it} = \beta_{1it} + \beta_{2,it} x_{2,it} + \beta_{3,it} x_{3,it} + \cdots + \beta_{k,it} x_{k,it} + e_{it} \tag{1.4}$$

The above comparison demonstrates the importance of a coherent selection of individuals within the panel. In our case, the annual reports represent the individuals within the panel, which are analyzed in 11 equidistant points in time.

To distinguish between the individual years or data collection points, we introduce n dummy variable that can have the value 0 or 1, which extends the regression equation (Alecke, 1997; Frees, 2004; Baltagi, 2011). Miller (2005, p. 231) points out that "Dummy variables (also known as ''binary,' 'dichotomous,' or 'indicator' variables) are defined for each of the other categories, each coded 1 if the characteristic applies to that case, and 0 otherwise. A dummy variable is not defined for the reference group (hence the name "omitted category"), resulting in (n - 1) dummies for an n-category variable. Cases in the reference category will have a value of 0 for each of the dummy variables pertaining to that categorical variable."

Equation 2: Dummy variable

$$D_{jt} = \begin{cases} 1 \; with \; j = i \\ 0 \; with \; j \neq i \end{cases} \tag{2}$$

This model can be treated like a regular ordinary least square (OLS) model, and the dummy variable can be handled with the regular testing methods (Alecke, 1997, p. 100). The integration of the effect of annual years is an example in which dummy variables can be added additionally into the OLS model. Each year is integrated as one variable. With the implementation of a dummy variable, the initial regression equation changed into the below equation system (Equation 3):

Equation 3: OLS equation system with dummy variable

$$y_{it} = \sum_{n=1}^{K} \beta_{1n} D_{nt} + \sum_{n=1}^{K} \beta_k x_{n,it} + e_{it} \tag{3}$$

A core question of the analysis was whether the observation of effects within the model will have an impact or effect the dependent variable within the model. This is especially important in the context of categorical analysis of variance with techniques like the analysis of variance (ANOVA). Sahai and Ageel (2000) explain that the nature of effect, whether it is fixed or random, depends on the type of experiment and the nature of the parameters included, which the authors refer to as treatments in the case of drug experiments. In the case of repetitive measures, a fixed effect is an effect measured in each round of the experiment. Random effects are observed only at distinct time points in a measurement series.

A practical rule of thumb is that if an effect can be observed each time, or if the variable can be measured each time, then the effect or variable has to be considered as fixed, otherwise as random. In the research context, researchers can test if an issue can be considered as fixed or random by applying mathematical tests (Alecke, 1997; Hsiao, 2003; Sahai and Ageel, 2000).

In the context of panel data analysis, Hsiao (2003, p. 43) points out that in linear models, a test of independence finds whether the model is still able to produce rational and consistent estimators. In other words, the null hypothesis that needs to be tested is that all treatments or effects within a model have the same effect (Sahai and Ageel, 2000). In the case of random effects, we test whether the factors have the same random effect in the model. Both tests can be based on an F-Fest for variable testing (Sahai and Ageel, 2000). Furthermore, Alecke (1997, p. 109) and Hsiao (2003) explain that an alternative test is the Hausman testing process. The empirical part of this thesis utilized fixed effects included into developed models. Sahai and Ageel (2000, p. 7) explain that random effects occur especially in experimental settings.

3.3.1.4 Study design and data universe

As demonstrated in the preliminary analysis, global economic trends (GETs) are especially important to multinational enterprises (MNEs) that operate on an international scale. In general, MNEs that are relevant for this analysis are index-listed corporations. The rationale is that (a) stock-listed companies are especially dependent on the development of the globalized financial market, and that (b) these corporations have the relevant size and the financial power to operate on international markets. From the overall sum of stock market-listed corporations, a dedicated number of corporations, or a representative sample, was examined in the analysis of GETs.

The empirical study was founded on a population of objects, also referred to as universe, which represents the entire set of subjects whose characteristics are being studied. This population was researched at multiple points in time, which is also called longitudinal analysis. To ensure the efficiency of the research, the population size was sufficiently small, as it covered the annual reports of DAX (stock market index) corporations in the period from 2004 to 2014. The size of the population was 330 (N=300), comprising all reports published in the period. Each year comprises thirty (n=30) annual reports of stock listed MNEs in Germany. In the focus of the analysis are the DAX listed companies. Economically, the index DAX represents the largest players in various industry sectors in Germany, also referred to as blue chips. In addition, economic indicators from data from sources like the World Bank, the federal statistical office in Germany, and Google Trends were added to the economic analysis, which explained in detail in the following section.

Coming back to the DAX reports, the total gross revenue of corporations listed in the DAX 30 index amounts to EUR 1,376.7 bn, which is 47% of the gross domestic product (GDP) EUR 2,903.8 bn in 2014 (Destatis, 2015). The financial impact of DAX corporations to the macroeconomy in Germany has to be rated as significant, as economic performance of these MNEs effects economic growth and regional development. Hence, the sample provided capabilities for economic analysis and was qualified enough to provide information about the macroeconomic development of regions. It is also important to mention that other important German indexes like MDAX, SDAX, and TECDAX were not included into the analysis. Therefore, the focus of the primary data analysis was the annual reports published by corporations listed in DAX from the fiscal period of 2004 to 2014. These companies fulfill the prime standard and follow international accounting standard like International Financial Reporting Standards (IFRS), International Accounting Standards (IAS) and United States Generally Accepted Accounting Principles (US-GAAP). According to Deutsche Börse Group (2014, p. 18) the DAX index is an economic indicator that represents the quoted "market value of the 30 largest German companies listed on the Frankfurt Stock Exchange," also referred as blue chips. Fischer and Wermers (2013, p. 372) point out that the "performance of the index is calculated as the weighted average performance of the stocks included in the portfolio, with each stock being weighted according to its market capitalization." The principle is depicted in the formula below (Fischer and Wermers, 2013, p. 372).

Equation 4: Principle of market index calculation

$$y_{it} = \sum_{i=1}^{N} K_i(t) * m_i \qquad (4)$$

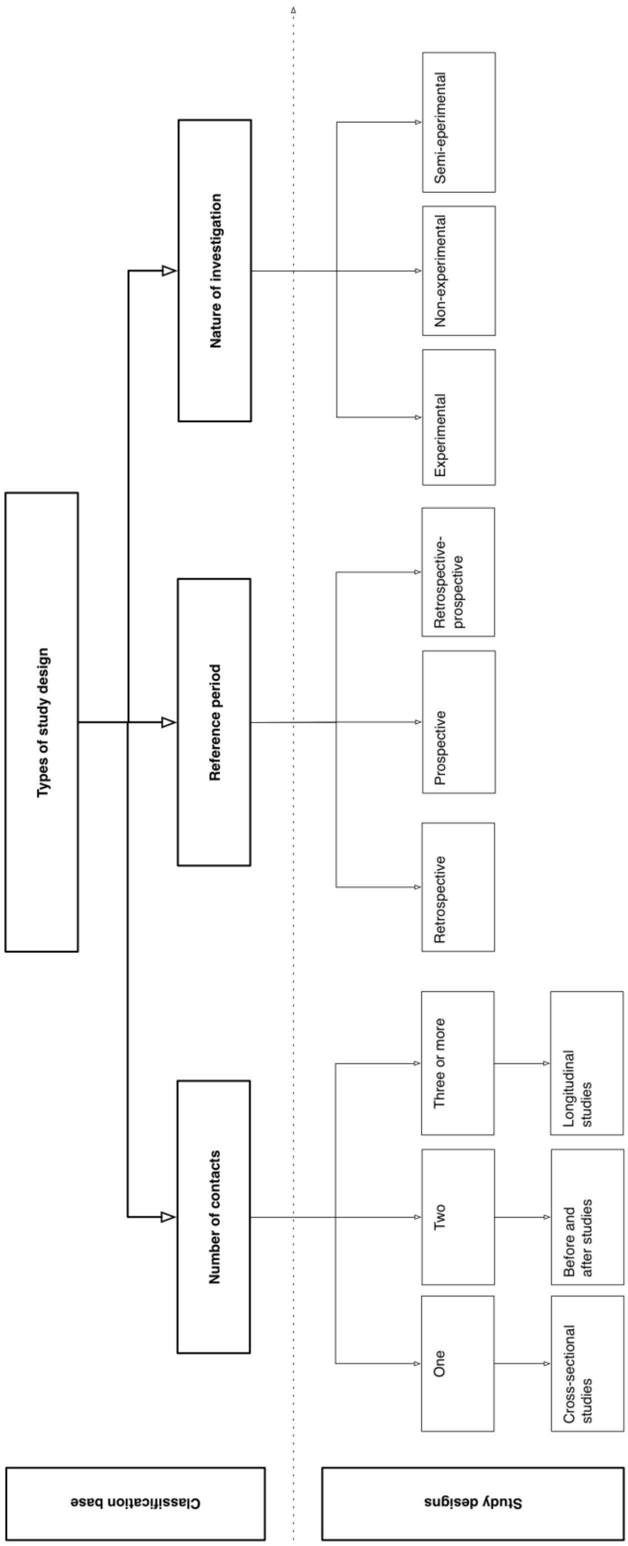
K	Capitalization
m	Coefficient for the k-th variable

The members of the index are rated and validated annually; consequently, the members of the index may change annually. As the members of the index changed, such as the Beiersdorf AG, over the period, all published annual reports by corporations that were listed in 2014 were included in the analysis. Furthermore, the time of publication differs as well, due differing reporting standards. For example, corporations like Siemens and Thyssen publish their annual reports in November or December of the given fiscal year, which starts on October 1 and ends on September 30. In this regard, timely information about the date of publication was obtained from the investor relation section of the individual corporate websites. This information is not available in other research projects or data sources, and required manual extraction from the annual report, especially in the earlier years of the research (2004 – 2007). It is also important to note that some of the electronically publish investor relation reports were copyright protected. This protection hindered the automated data acquisition process and required that the passages needed to be filled in manually into the database.

The data of the overall population with the same objects was acquired over multiple points in time. The benefit of this approach was that we encountered no errors by sampling, such as Type 1 or Type 2 errors. The overall analysis has the character of a longitudinal analysis that is based on primary data acquired from qualitative content analysis (QCA). However, this point has to be discussed in more detail. From the ex-post perspective, the data could be portrayed and interpreted as cross-sectional. This flexibility was beneficial to identify overall characteristics and to depict more general correlations, as well as causal relationships. In conclusion, this approach revealed intra-dependent correlations among the subjects of the population. To reveal interdependencies between the subjects within an annual year, it is important to interpret the overall data as a longitudinal time series. In this case, the correlations between the annual years were also part of the data analysis process. Consequently, the statistical approach had to be adopted to fit the data design. In the later section of the study, the approaches of generalized estimated equations (GEEs) were implemented to meet the demand of the longitudinal approach. From the conceptual viewpoint, the design of the research study was founded on two perspectives that were used separately and in combination to provide the highest effectiveness in research. The main benefit of this approach was that changes and trends could be detected by it, as a dedicated timeframe was the foundation for the design of the study. Figure 30 illustrates the approach propagated by Kumar (2011, p. 106).

Figure 30: Classification base and study design

(Own creation, based on Kumar (2011, p. 106))



The pilot study examined a period of four years, which now extended to a long-term analysis. The literature reveals that the current state of research focuses on the potential of big data in association with economic analysis, especially in the field of foresighting. As big data has various forms, this research utilizes data from Google Trends. Based on the extracted trends from annual reports, Google Trends data was queried and used as a foundation for economic analysis in the period from 2004 to 2014. The empirical research study had eleven dedicated points of contacts, referring to the fiscal years from 2004 to 2014. The points of contact relate to the time of publication of the annual report (ARP) for each individual corporation. The overall amount of data provided two facets to the analysis. The first facet was the analysis of the overall panel data, treated as one individual sample group. In this case, the overall sum of report was treated as one coherent dataset not distinguished by its years. On the other hand, the design corresponded to longitudinal study or LTA and provided capabilities for the analysis of intra-individual changes within the same sample group that could not be determined by a cross-sectional point of analysis (CSA). The data acquired in this study is available from 2004 to 2014. The reference period analyzed in this context had to be considered as retrospective-prospective. Kumar (2011, p. 68) states that these types of studies "focus on past trends in a phenomenon and study it into the future."

Consequently, the empirical study had the characteristics of a panel design, considering multiple years in the analysis, based on the same objects that were analyzed in different states of time. Kumar (2011) segregates the overall research design into the sections “classification base” and “study design.” “Classification base” aims at the practice of clarifying aspects based on three categories, the number of contacts, the reference period, and the nature of investigation. These categories were defined for the empirical analysis. The nature of the investigation was non-experimental, because no experiments were included in the research, and because the study started with observed effects, in this case the use of GETs in annual reports of corporations. Kumar (2011) describes that these type of studies aim to identify the effects behind the observation, or link the cause and the observed outcome.

Other data implemented into the research was obtained from secondary data sources from the World Bank Group and Destatis were associated to the data from the annual reports. Mainly, GDP indicators for regions and cities were obtained that are important in the regional or geographical analysis of trends and economic growth. This information was important in combination with the regional information that was obtained from Google Trends. The database provides the capability to combine and to integrate the different forms of data. As described in section 3.3.1, the mixed-method approach integrates qualitative and quantitative research into a coherent and interdependent form of research. The integration of data on a consistent platform like a database lays the groundwork for the mixed-methods research approach. In addition, the financial key performance indicators acquired from the annual reports were integrated into the database. These indicators were also obtained from the annual reports.

This information was applied in regression testing in the empirical part of the analysis. The method was to identify and evaluate cause and effect relations based on the correlations between trend utilization and financial data. For the empirical analysis, four dedicated KPIs were selected as a foundation for the analysis: net income, operating income or earnings before interest and taxes (EBIT), shareholder equity, and total assets. The profit and loss statement of a corporation contains the values net income and operating income, which represent the profitability of a corporation simply by comparing the difference of the actual value to the value of the previous year. On the contrary, the balance sheet of a corporation contains the value total assets and shareholders' equity that refer to the size of corporation and the total stake that belongs to the equity shareholders of a corporation. Vause (2009, p. 46) explains that "the net worth or net assets of the company – is the amount available to shareholders after all assets and liabilities are liquidated (and) is usually called shareholders of stockholders equity." Based upon these values, profitability ratios like return on equity (ROE) and return on assets (ROA) can be calculated. Table 17 illustrates a general overview of the financial KPIs utilized in the empirical analysis.

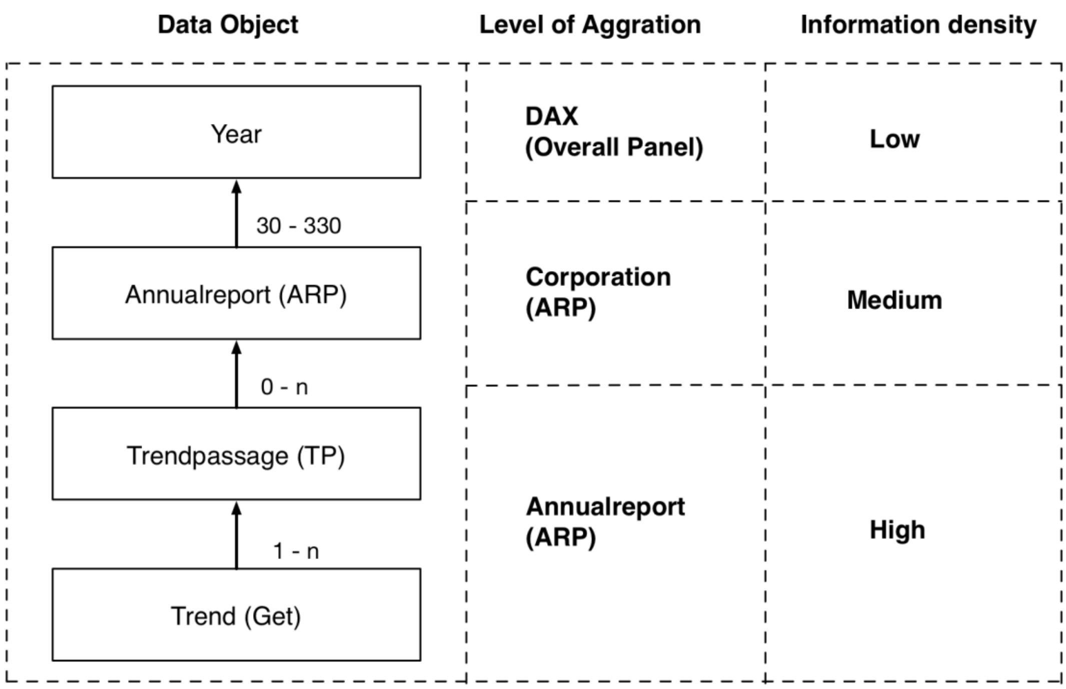
Table 17: Financial KPIs utilized in the empirical analysis

Financial KPI	Explanation
Net income	Also referred to as "the bottom line," this value represents the total profit of a corporation, attributable to the shareholders of a corporation. As explained by Investopedia (2015): "Net income is calculated by taking revenues and adjusting for the cost of doing business, depreciation, interest, taxes and other expenses." It is the foundation to calculate earnings per share and it is therefore of high interest to shareholders.
Operating income / EBIT	Operating income, also referred to as EBIT (earnings before interest and tax), is the measure to identify how much profit a company can generate based upon their operating activities. Like net income, operating income belongs to the income statement of a corporation.
Shareholders' equity	The equity that is attributable to the shareholders of a company is called shareholders' equity. Together with the indicator net income, this measure is the foundation to calculate the return on equity and demonstrates how profitable the corporation is based on its equity. This measure is return on equity.
Total assets	Total assets represent the size of a corporation based on its assets (tangible and intangible) accounted in the balance sheet of a corporation. Vause (2009, p. 153) shows that "Total assets as set out in the balance sheet represent the total amount of physical and financial resources a company had available for use during the year to generate profit shown in the income statement." Financial metrics like return on assets (ROA) utilize this measure in the denominator to calculate the total profitability or performance.

3.3.1.5 Implementation and aggregation of data

Before the sample design is introduced and discussed below, the hierarchical aggregation concept, and the integration of Google Trends are shown here. Information is gathered and aggregated from the bottom up. The lowest level of data aggregation is the trend passage (TP) that contains the trend utilized by the corporation. Each TP may have one or many trends. As this information is provided as raw text passages, the density of information is considered high. This information is aggregated in the next level, which is the annual report and represents the level of corporation. Each annual report (ARP) may contain zero to many TPs. The sum of all 30 ARPs per year represents the DAX (stock market index). The overall sum of years is 11. Therefore, the total amount of ARPs is 330. The overall systematic of data aggregation is represented in Figure 31.

Figure 31: Data objects and the aggregation concept



Trends or combined trend phrases like global economic trends (GETs), which are used in ARP, are embedded in written passages that might include further information about the specific trend. This analysis describes these passages as trend passages, which include further information that complete the intended view of the individual trend. Consequently, TPs require expert judgement, and their data needs to be handled as well. This treatment was realized by extracting the individual sentence that includes the trend or the combined trend term out of the ARP and by adding the sentences below and above.

The trend term was then utilized to download information in the form of time series from Google Trends. As each annual year was analyzed in this study, the overall results on the level of year could be arranged in the form of a time series. As the period of analysis covers the years from 2004 until 2014, the data was available in the same period as the web search data from Google Trends, which was first acquired in 2004. The data of Google Trends is available from the period of 2004 down to the present day in a weekly format. This timeframe of the availability of Google Trends matches with the period of analysis of the annual reports. This matching allowed analysis of the specific period and provided further capabilities for proactive analysis or forecasting. For this study, that means that part of the data was collected retrospectively which refers to the analysis of the annual report data. To this data foundation, the data of Google Trends was aligned to serve as a vehicle for future trend analysis or projection. This process represents the prospective part of this research study.

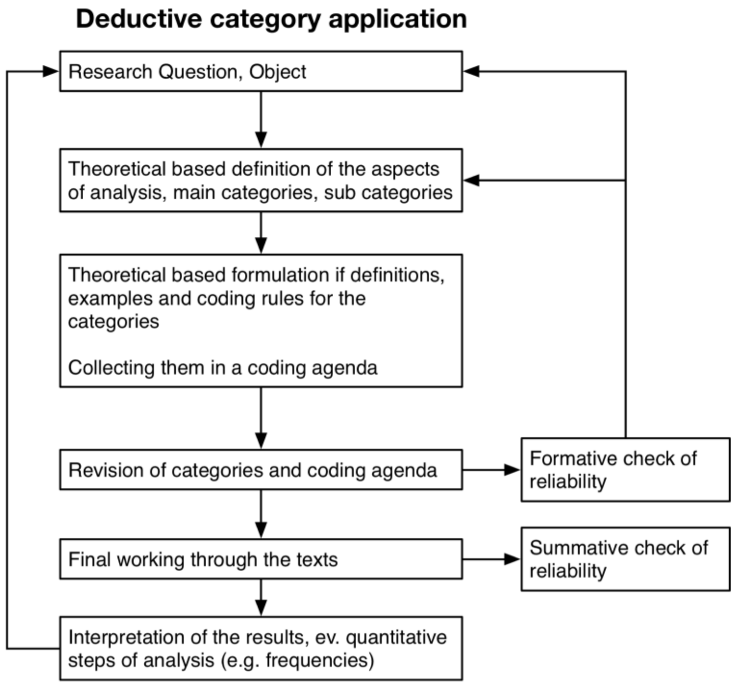
To be able to integrate Google Trends into the analysis, it was important to aggregate the information provided in a weekly format into an annual format, in order to be able to integrate the information into the multivariate analysis. This integration was realized by implementing an automated aggregation after the Google Trends data was downloaded. The mechanism and functionality is provided in the documented source code.

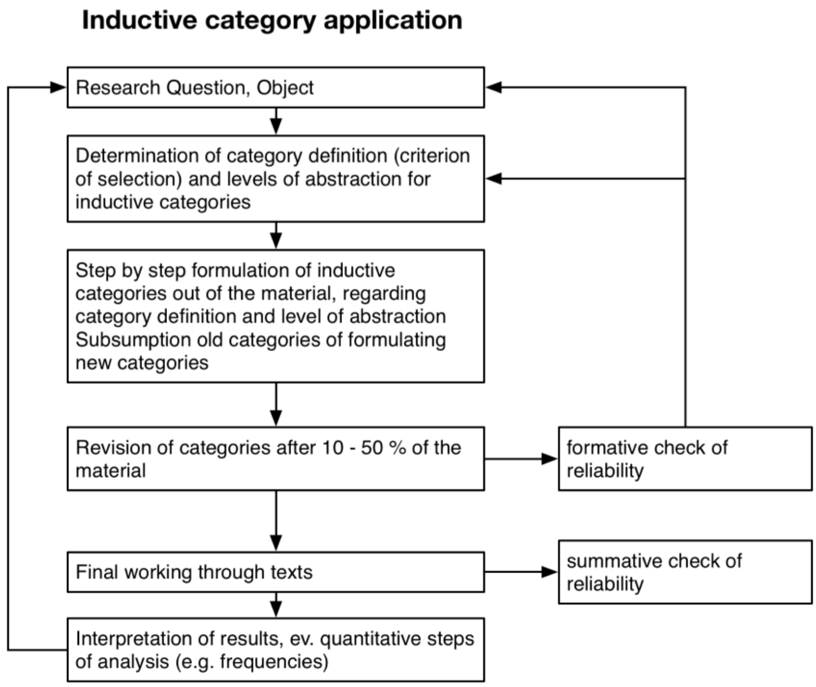
3.3.2 Research methodologies and variable implementation

3.3.2.1 Qualitative analysis of annual reports

Qualitative content analysis (QCA) is a data-driven and iterative process that involves the interpretation of symbolic material and the assignment of units of meaning based on categories specified in a coding frame (Flick, 2014, p. 173). Qualitative data comprises codified texts and verbal descriptions. To analyze codified information, QCA uses a mixed-method approach that combines qualitative and quantitative data (Mayring, 2008). Quantitative data is gathered through the process of segmentation and categorization of the information provided. The formal evaluation of the data has certain requirements for availability, quality, and quantity. Furthermore, it is mandatory that the aspects and rules of evaluation are stringent and exact to be able to work through the material and receive quality results. At the core of QCA is the development of categories, which can be inductive or deductive. Inductive category development and deductive category application are two central approaches developed mainly by Mayring (2008). They follow a stringent codification process that creates interpretable data and quantitative results, such as frequencies. The codification process requires the development of a coding guideline with decision criteria. Each of the category variables is either nominal or ordinal-scaled. In the first approach, the coding guideline stems from theory on the analyzed material and builds the foundation for the analysis. During the development phase, the guideline is developed further until it reaches maturity, and then it is consequently applied to the material (Mayring and Fenzl, 2014, p. 548). The deductive approach demands that theory- based definitions and coding rules are applied to a set of material. Rules and guidance on how text passages can be coded into categories are defined prior to the analysis, and may be refined during the analysis. Refinement of the categories is an important step in QCA, as the level of discovery increases during the analysis. As a result, QCA delivers a full category system that could be applied to other material as well. On the other hand, the analysis delivers frequencies of the applied categories. The level of confidence about the impact of a certain trend is examined in the empirical analysis. Figure 32 shows the approaches of QCA that are applied in this study.

Figure 32: Deductive and inductive category development
(Own creation, based on Flick (2014, p. 174))



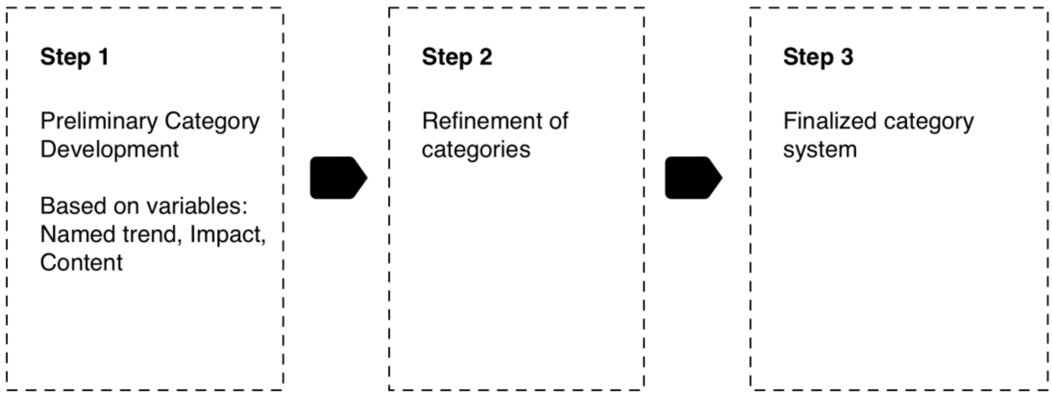


The operational model in this study provides “STEEPV_VALUE” and “NAMEDTREND” as two original variables used to develop the categorical system. In general, the category variable “STEEPV_VALUE” represents the deductive category application, and “NAMEDTREND” represents the inductive category application. STEEPV is segregated into "social,” "technological," "economic," "environmental," "political," and "value," which represent the individual variables applied to the content. Here it is important to mention that the individual variables were operationalized by utilizing dummy variables for each category applied to the content. An additional revision of data ensured the quality of application. The outcome of this process was that all extracted text passages from the annual report were categorized according to STEEPV, providing further options for quantitative analysis. In this study, annual report data was prepared and compared to reveal further insight on the implementation of GETs in annual reports.

In contrast, the application of the inductive categorical system is more iterative, the level of abstraction grows continuously with the application of categories, and the process of category formulation involves reorganizing and combining or translating old into new categories (Mayring, 2008). The result of the categorization is an individual set of categories that are derived from content analysis. Therefore, the outcome has a strong relation to the content of analysis, in comparison to the deductive application of STEEPV categories. It is a stepwise formulation of inductive category definitions and requires steps of revision after certain milestones, or after a certain percentage of the content has been categorized. Mayring (2008) suggests to review the categorization after approximately 10 or 50% has been reviewed. Additional data in this study acquired via a manual extraction of the trend text passages is compared to the data acquired via the automated process. This comparison provides further steps of quality assessment. To be able to judge the quality from an expert-based view, it is useful to capture at least the starting point and the endpoint or the final point of the categorization process. Here, the mentioned variable “NAMEDTREND” represented the outcome of the categorization process. The process of categorization was also codified into the data model of the analysis.

A key requirement was a detailed documentation of the overall process, especially when the development process of categories should be revised for quality purposes or if the process steps should be codified. To track the overall progress in the development of categories, it was required to provide logical links between the iterative steps of the categories. This was realized by in the database design. The codification process stored in the table “eval_tpinductive” refers to the original table “tp_evaluation” that holds the evaluation data of the trend passages. Figure 33 shows the inductive categorization process.

Figure 33: Inductive categorization process



Notably, the inductive application process did not distinguish between the direct and indirect trend passages used. This relation was established due to the database interlink between the evaluation table and the inductive categorization table. Overall, the categorization was oriented to identify general trends, whether they were used in conjunction with “GETs”, “global trends” or “megatrends.” The results should be comparable to the categorization process of the deductive approach. Consequently, a distinction between direct and indirect TP did not make sense.

3.3.2.2 Foundation of the variable design

The first variable codified in the process of data acquisition was the variable "INCLUDE". It is the doorkeeper or the first stage of data filtering and cleaning. "INCLUDE" is a dichromatic variable that is either true (represented as zero) or false (represented as one). Its status determines whether the extracted trend passage (TP) was utilized. Only the TPs were further evaluated that add value to the analysis. The key requirement was that the trend passage contained written text in closed sentences. No headlines or additional graphical content that contains a trend term was implemented into the analysis. From the statistical point of view, the application of a mixed-method approach requires descriptive and inferential statistical techniques applied to the variables implemented in the model. The analysis of qualitative data that stems from qualitative content analysis (QCA) required a descriptive approach founded on descriptive statistics. In addition, the empirical analysis required parametric techniques. Variables range from nominal, ordinal, scaled, binary, and open ended (string) variables, as shown in Table 18.

Table 18: Variables and scales

(Based on Miller (2004, p. 204))

Scale / Variables	Description
Scales	
Ordinal scaled	Nominal scaled + hierarchy
Interval scale	Ordinal scale + equal steps
Ratio scale	Interval scale + natural zero point
Variable	
Nominal	Variables that capture qualitative characteristics
Ordinal	Nominal scaled + hierarchy
Binary	Ordinal scale + equal steps
String	Interval scale + natural zero point
Dichotomous / binary	Binary variable or dummy variable

The qualitative content analysis founds a set of nominal, ordinal, scaled, binary, and open-ended (string) variables that are codified during the content analysis process. Table 19 shows all utilized variables that are introduced in the following chapter.

Table 19: Variables used in the analysis

Name of variable	Type of variable	Application and context
TRENDREPORT_ID	Ordinal / Ordinal scaled	Used for the identification of annual reports used in the analysis
ANNUALYEAR	Ordinal/Interval scale	Reflects the annual year of the publication
CORPORATION_ID	Nominal/ Categorical	Used for the identification of the corporation used in the analysis
DIRECTLYNAMED_VALUE	Dichotomous	Represents if a TP is directly mentioning a trend
INDIRECTLYNAMED_VALUE	Nominal/ Binary	Represents if a TP is indirectly mentioning a trend
STEEPVTYPE	Nominal/ Categorical	Nominal description of the STEEPV category
STEEPVTYPE_VALUE	Ordinal / Categorical	Ordinal representation of the nominal STEEPV type
NAMEDTREND	Nominal	Trend of the annual reports represented as a nominal variable
NAMEDTREND_VALUE	Ranked/ Ordinal	Ordinal representation of the nominal variable "namedtrends"

Name of variable	Type of variable	Application and context
INFLUENCE	Nominal	Either Push or Pull. Represents the influence of the TP to the corporation
INFLUENCE_VALUE	Ranked/ Ordinal	Value based representation of the influence variable.
INFLUENCE_DESC	Nominal	Verbal description of the influence to follow up on research from a qualitative point of view
CRI	Ranked/ Ordinal	Measures and indicates the confidence of a corporation in the utilization of a Global Economic Trend.
INCLUDE	Nominal/ Binary	Indicates whether a trend should be integrated into the empirical analysis
AUTO	Nominal/ Categorical	Indicates how a trend passages was inserted into the database.
NAME	Open Ended/ String	Name of trend used for trend queries
RI (Regional indicator)	Ratio scale	Represents the aggregated value of searches for global economic trends in a certain region or city based on a filtered dataset.

3.3.2.3 Direct and indirect referencing

“DIRECTLYNAMED_VALUE” and “INDIRECTLYNAMED_VALUE” are variables in the data model that represent whether a trend passage (TP) mentions a trend directly or indirectly. If the text contains the word "megatrends" or the phrase "global economic trends," then the variable is set to one. The variables “DIRECTLYNAMED_VALUE” and “INDIRECTLYNAMED_VALUE” are Boolean variables. A value of one represents true, where zero represents false. Direct utilization of global economic trends (GETs) in annual reports demonstrates that a corporation has information or knowledge about the existence of GETs. It could be demonstrated that these combined phrases are often used in the descriptive context of strategic measures. In this case, trends are often used as a vehicle to describe business decision-making. A direct utilization furthermore emphasizes that a corporation is especially affected by a certain trend. Another interpretation is that it might have foresight capabilities or scan the environment proactively for GETs. The following quote from the passage “Risks and Opportunities of Future Development” from the annual report of Lufthansa Group (2004) is an example of where the variable “DIRECTLYNAMED_VALUE” is positive:

> The effects of and fluctuations in global economic trends and the general macroeconomic setting have a fundamental impact on the Lufthansa Group’s course of business development (…). Thus Lufthansa AG profited in 2004 from the global economic recovery, especially in long-haul traffic, where it carried 15.8 per cent more passengers (…). A general economic slowdown, by contrast, usually tends to dampen demand in scheduled passenger business and also weakens the Lufthansa Group’s business performance. Opportunities for future development lie in particular in a speedy fall in fuel prices from the historic peak reached in 2004 and a resulting overall economic upturn (Lufthansa Group, 2004, p. 116).

Lufthansa Group’s management mentions the positive effect from the macroeconomic upturn in 2004, and the positive effect of falling fuel prices, which improved the economic performance of the group in the fiscal year of 2004. It is also important to note that the text was printed in the section “Risk Report.” This placement emphasizes that the positive effect of the GET was due to fortunate macroeconomic circumstances. Another example of a directly mentioned GET is the annual report (ARP) of LANXESS AG (2004), as illustrated below:

> The world economy recorded growth of about 4% in 2004, which was higher than in the previous year. This encouraging performance was driven primarily by the positive developments in the USA and China. The increase in the oil price weakened global economic trends in the course of the year. The economy in Europe developed comparatively slowly, growing by 2.2%. (…) The development was attributable in particular to the positive impact of demand from countries outside Europe. Economic growth in Germany was somewhat lower at 2.0%. The only stimulus came from higher exports. Domestic demand continued to be poor, on the other hand. The economy in the USA reached growth of 4.3% in spite of the high oil price. Consumer expenditure and commercial investments boosted the economy and compensated for the lack of any support at the fiscal policy level (LANXESS AG, 2004, p. 42).

LANXESS AG (2004) mentions GETs directly to portray the influence of the oil price to gross domestic product (GDP) growth. Macroeconomic developments especially in the United States, Europe, and Germany are discussed to emphasize the beneficial markets of the previous fiscal year. This leads to the fact that the variable "DIRECTLYNAMED_VALUE" is set to true and the variable "INDIRECTLYNAMED_VALUE" is set to false. "DIRECTLYNAMED_VALUE" and "INDRECT" are logically connected via an exclusive or (XOR) condition. Either "DIRECTLYNAMED_VALUE" or "INDIRECTLYNAMED_VALUE" can be true for one trend passage (TP). The variable "INDIRECTLYNAMED_VALUE" is true if the TP describes the impact, the effect, or the context of a GET, but does not mention the trend directly. Such an example can be found in the ARP of Continental AG (2004):

> Automobile manufacturers are increasingly being impacted by a simultaneous mixture of innovation, costcutting pressure, and ever shorter product development cycles, and are passing this pressure on to their suppliers. The broad-based structure of our Corporation means we are prepared to handle the risks associated with these trends (Continental AG, 2004, p. 45).

Continental mentioned the trend innovation, cost-cutting pressure, and shorter product development cycles to emphasize potential risks that stem from these industrial developments. The term "GET" is not used in this context. However, "innovation" could be perceived as a GET. In this case, the trend passage is categorized as indirect, and the variable "INDIRECTLYNAMED_VALUE" is set to true.

3.3.2.4 *Risks and opportunities*

To understand which trends are perceived as threats or as opportunities by a corporation, the variable "INFLUENCE_VALUE" codifies whether a trend passage (TP) is a risk or an opportunity. This information may be indicative of how corporations behave economically, and whether the impact of the trends has an environmental push or pull effect. The following example of an annual report of Volkswagen AG (2009) presents a typical risk (Volkswagen AG, 2009, p. 20):

> In the automotive industry, there is enormous pressure to change – pressure that also has an impact on design. New legal requirements, changing social attitudes and new technologies all need to be factored into the design equation. Winterkorn describes the trend towards "downsizing" as "offering more while using fewer resources." (Volkswagen AG, 2009, p. 20)

The above TP explains that Volkswagen perceives an environmental push effect due to new legal requirements, changing social attitudes and new technologies that set pressure towards change in the automotive industry, and that requires changes in company. The trend that is used within the passage is named "downsizing," and refers to efficiency measures. This example shows that the trend mentioned in the passage is not self-explanatory, and requires the context of the TP to understand the full perspective. A TP that qualifies as a risk can be found in the annual report of 2012 of the Commerzbank Group:

> Due to the systematically restricted options for reducing default risk on a short-term basis, it is important to take account of expected trends in credit risk (medium-term and long-term) in order to remain within limits. For this reason, plan/forecast values of capital ratios and comparison with actual trends observed plays a key role in ongoing management. It has to be assured that limits are met as a result of keeping to plan/forecast (Commerzbank Group, 2012, p. 144).

In the above passage, the corporation explains that the observation and continuous comparison between the forecast of credit risk trends, and the comparison to actual trends is a lever to reduce default risks. In this regard, the mentioned trend called "credit risk trend" is used in the context of a strategic measure, and outlines how the corporation handles perceived risks.

On the contrary, to codify a TP as an opportunity requires that the passage refers to strategic measure, or that business opportunities are mentioned directly in the context of the trend. The exception here is if the strategic measure refers to a reorganization of business units or change processes as demonstrated in the above example of Volkswagen (Volkswagen AG, 2009). The following TP of Lufthansa Group (2013) is an example for a passage that is codified as an opportunity:

> Our policies for the strategic development of the Group, but also of each individual operating segment, range from organic growth to strategic acquisitions, and from the expansion of existing partnerships to the establishment of new ones. As part of the ongoing global trend towards consolidation, we will continue to examine all possible acquisitions which have the potential to significantly increase the competitiveness of the Lufthansa Group and create value for our shareholders (Lufthansa Group, 2013, p. 27).

The above passage outlines the growth strategy of the overall business that ranges from organic growth to strategic acquisitions. The trend that is mentioned in this context is the global trend towards consolidation. The opportunity for Lufthansa is to extend the competitiveness in the markets. The following example of the 2014 annual report of Adidas requires careful examination:

> The Risk Owners use various instruments in the risk and opportunity identification process, such as primary qualitative and quantitative research including trend scouting, consumer surveys as well as feedback from our business partners and controlled space network. These efforts are supported by global market research and competitor analysis. Through this process, we seek to identify the markets, categories, consumer target groups and product styles which show most potential for future growth at a local and global level (Adidas Group, 2014, p. 155).

In this case, Adidas explains that a strategic component is that they employ key stakeholders that identify trends based on consumer surveys and feedback from business partners, and the component is supported by competitive analysis. In this case, the act of trend scouting could be judged as an opportunity or as a risk. The crucial point is embedded in the last sentence of the TP, as Adidas seeks to identify new growth opportunities. Therefore, this TP is considered as an opportunity. Based upon this process, all TPs are consequently codified.

3.3.2.5 CRI and RI indices

Key elements in the empirical research process are two indices called confidence ranking index (CRI), and regional indicator index (RI). Both are ratio scaled variables used to emphasize behavioral aspects for (a) how confident corporations are that a trend has a direct or an indirect impact to the business operations of the company, and (b) represent societal web search activity within a certain region or city.

The idea behind the CRI indicator is that if corporations perceive a trend to have a direct or an indirect impact to the business operations, then the reference to the trend within the annual report as one of the key communication tools in the investor relations community is a strong signal. CRI tries to measure the strength of the signal by integrating the variables "INFLUENCE", and "DIRECTLYNAMED_VALUE" or "INDIRECTLYNAMED_VALUE" an overall score, which is founded on the concept of the weighted formula, as shown in Equation 5.

Equation 5: Weighted sum as an evaluation criterion

$$CRI = \sum_{i=1}^{I} w_i(i)Cr(i) \quad \text{and} \quad \textstyle\sum_{i=1}^{I} w_i(i) = 1 \tag{5}$$

w_i	Weighting factor
$Cr(i)$	Coded ranking variable

The idea is to create the index for each trend passage analyzed. Furthermore, the individual indicators are aggregated into an overall index for the annual report, which allows cross-sectional and panel comparison. The weighting factor ranks risks higher than opportunities and ranks directly mentioned trends higher than indirectly mentioned trends. The process is founded on the psychological concept of loss aversion, which belongs to the prospect theory introduced by Daniel Kahnemann and Amos Tversky

(Kahneman and Tversky, 1979). The idea is that if corporations include a certain trend in a report and describe it as a risk to the business, then the management shows high certainty that the risk is effecting business operations. Furthermore, if the trend is mentioned directly, then the level of certainty is reinforced. This study evaluated this signal as being a message to the investment community that the corporation is aware of the impact of the risk to business operations and is capable of handling this risk. As pointed out by Kahneman and Tversky (1979, p. 3), a subject, in our case an investor, is averse to risk or choices "involving sure losses." In the context of trend passages, we can observe the patterns of certainty and possibility that further support the utilization of such an indicator. Kahneman (2012, p. 312) points out that due to the certainty effect, subjects "tend to overweight small risks and are willing to pay far more than expected value to eliminate them." Furthermore, if the risk is also portrayed as having a high likelihood of occurrence, then the signal to the investor is that the management already has the expectation and is prepared or in preparation for the event to happen. This combination is an effective tool for managing the expectations of investors. Laskin (2010, p. 23) explains that if the investor relations personnel are able to decrease risk for an investor, it "thus decreases the cost of capital for the company."

Motivated by the above concepts, the variables are integrated into the CRI index. As a requirement, the sum of all weighting factors needs to amount to one. As stated above, the formula includes dichotomous or dummy variables for influence value, and the variables for direct or indirect value with a dedicated weighting index. As risk has the biggest impact to the awareness of the investor, the variable "risk" is weighted with 0.6. If corporations include risky trends into their annual report, it is assumed that the confidence in managing this type of trend is high. On the contrary, "opportunities" have a rather low influence with 0.1, because an opportunity raises much lower awareness. If a trend is directly addressing a global economic trend, then the variable "direct" impact amounts to 0.2. If a passage speaks about a global economic trend and does not mention this trend directly, then the variable "indirect" amounts to 0.1. Finally, the total sum is multiplied by 100 for better scalability, and for a better fit in the overall data model, as depicted in Equation 6.

Equation 6: Confidence ranking index (CRI) for trend passages

$$CRI_{Annualreport} = (0.2\ DIR + 0.6\ RISK + 0.1\ OPP + 0.1\ IND) * 100 \tag{6}$$

IND: Indirectlynamed_value (0 or 1)

RISK: Risk (0 or 1)

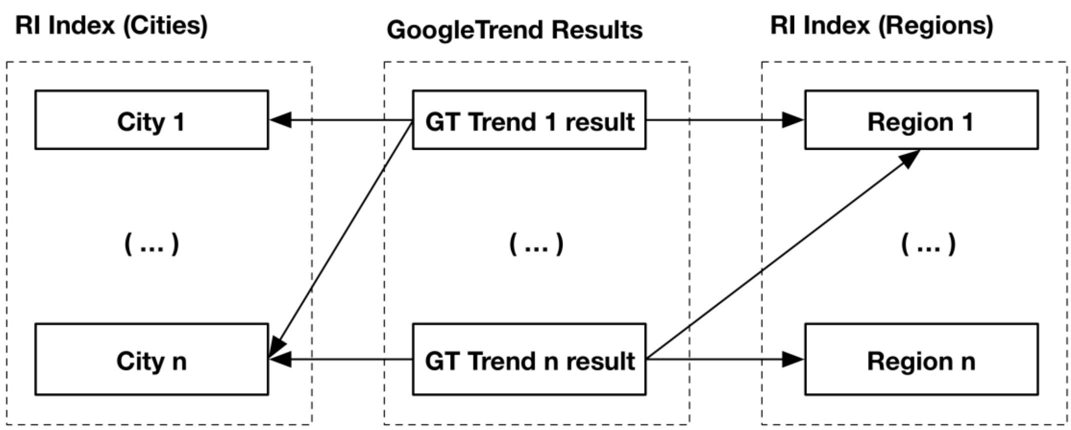
DIR Directlynamed_value (0 or 1)

OPP Opportunity (0 or 1)

The motivation for the RI index stems from the concepts of foresight in the context of regional innovation systems (RIS). Before the indicator is introduced, the following conceptual thoughts need to be outlined. Hanssen et al. (2009, p. 1742) explains that foresight in the context of RIS implies participatory collaboration between a broad range of actors that fosters knowledge creation through innovative processes. Groddeck and Schwarz (2013, p. 28) explain that trends are important in developing foresight and strategic management. Gertler and Wolfe (2004, p. 691) point out that in the context of local social knowledge management, "successful regions must be able to engage in regional foresight exercises that identify and cultivate their assets, undertake collaborative processes to plan and implement change, and encourage a regional mindset that fosters growth." In this context, several authors, such as Bastian (2006, p. 603) and Ghemawat (2011), explain that innovation is strongly coupled to a region that is the location for specific innovation processes. The importance of innovation and future is emphasized by van der Duin and den Hartigh (2011, p. 48), who point out that innovation and future is strongly coupled. Web searches of innovative trends or industry matters symbolize future aspiration. Preis et al. (2012) has already emphasized the effect of future aspiration, web searchers and economic growth. Based upon the above insights, it can be concluded that geographical information about web searches has the potential to indicate the future aspiration of regions and cities and is an explanatory condition for economic growth. As multinational corporations listed in the DAX (German stock index) operate in an international environment, it is valid to assume that the trends that are used in DAX reports from German corporations are also important in other regional contexts. Furthermore, the nature of the economic system has changed systematically towards more internationalization, and is therefore more knowledge intensive and competitive (Pike et al., 2006). Therefore, foresight needs to incorporate regional information about trends to identify its role in the internationalized economy and to understand markets abroad. Therefore, this information is also an additional competitive advantage in industry foresight (Cooke and Leydesdorff, 2006; Hamel and Prahalad, 1994). Google Trends already provides regional information on where web searches occur, by city and by region.

This information can be utilized to create an indicator that represents the search activity for trends used in annual reports. As stated above, the trends represent the interest and future aspiration that are present in German corporations. The pilot study utilized the keyword "megatrend" to emphasize this interest. In the empirical study, a set of trends was utilized to create an individual index representing the overall interest within DAX-indexed corporations. This index is the sum of the Google Trends values reported in relation to a certain city or region. The systematic is depicted in the Figure 34.

Figure 34: Process of regional information (RI) index creation



Equation 7: Regional information (RI) index

$$RI_{Region/City} = \sum_{i=1}^{n} GT_{Region/City}(Trend) \tag{7}$$

$RI_{Region/City}$	RI for region or city based on a dataset
$GT_{Region\,/\,city}$	GoogleTrend Result for each city of region

Each Google Trends result contains an index (0 – 100) for a subset of cities and regions per year. The RI index represents the aggregated value for all regions and cities represented in the overall results set of Google Trends. Therefore, each region and city represented in the overall result set has an individual RI Index. The purpose of this index is to determine how well geographical locations respond to the overall set of trends used by DAX corporations. Each index can be calculated based on the local and global dataset that were acquired from the Google Trend database. Therefore, four indices were calculated in total. Two indicators based on the global dataset for cities and regions, and analogous two RIs for the local datasets. The results of these indicators are used in the empirical part of the analysis for correlation analysis.

3.3.3 Instrumentation design

3.3.3.1 Databases systems and interfaces

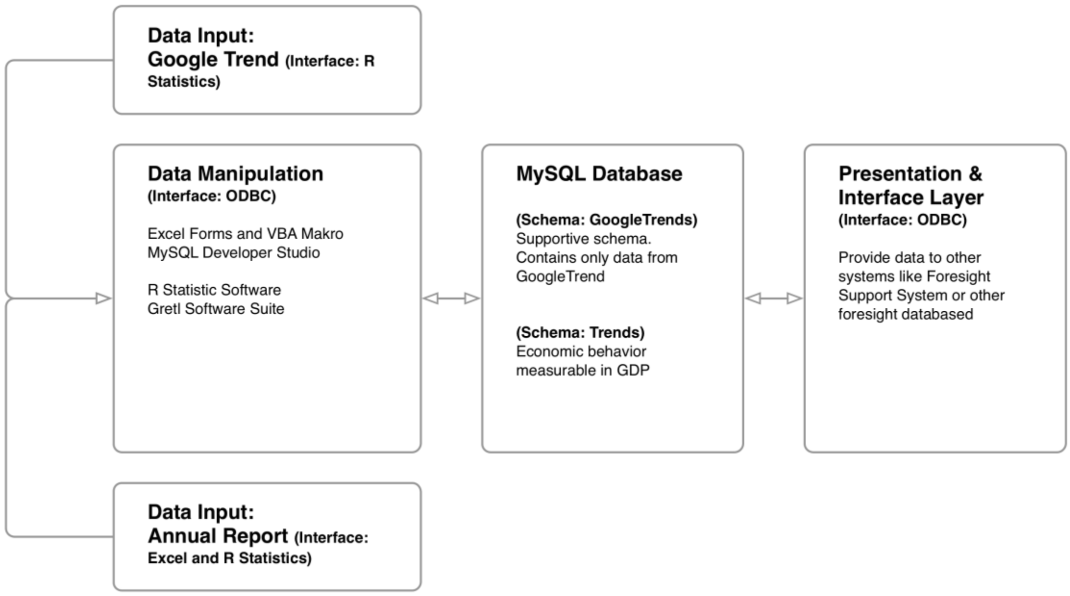
The foundation for information and data collected and processed during the research was a central database providing interfaces to other statistical software solutions, data report solutions, or to other FSSs. The foundation for the statistical analysis was an ordinary MySQL database (Version 5.6.17). To differentiate types of data, five schemas were employed. Some schemas were used as placeholders for the statistical software packages that create tables for the storage of the individual tables produced by the automated routines. Table 20 illustrates the database schemas that were utilized and that provided space for the tables of the inquiry.

Table 20: Database schemas utilized for the empirical design

Database Schema	Description
Mydb	The schema held the data of the QCA. In addition, data produced in the evaluation process was also stored in the schema.
Webtrend_evaluation	The statistical procedures for correlation analysis produced single results that were stored in this schema. In this context, trends acquired on the global level were stored in this schema.
Webtrend_evaluation_germany	The schema had the same functionality as webtrend_evaluation, but focused on trends acquired on the local level (Germany).
Webtrends2	Data acquired with the Google Trends routine realized in R were stored in this schema. Additional tables for the aggregation of monthly and annual data were stored in this schema as well. Data was acquired on the global level.
Webtrends_germany	Has the same functionality as Webtrends2. However, this schema focused only on data related to the local setting of Germany.

Through an interface realized in the statistical software package R, data from Google Trends and annual reports were entered into the database through automated processing over the standardized interface ODBC. The MySQL database served as a platform for other software packages. Figure 35 visualizes this interplay of different layers.

Figure 35: System landscape with interfaces and software tools utilized

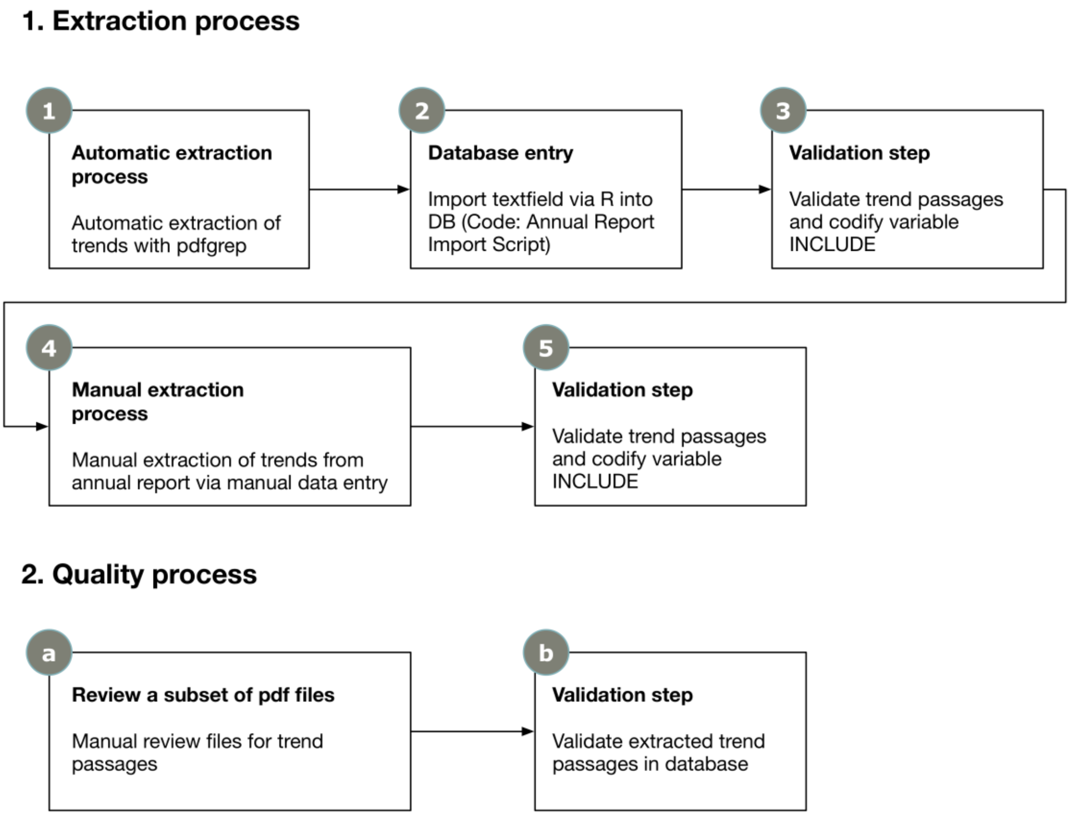


Despite the central database, the overall landscape had different capabilities, like data input, data manipulation, and the presentation and interface layer. The idea was to utilize the transactional database as a platform for data manipulated either in Excel, in MySQL Developer Studio, or in statistical software packages like R and Gretl. This segregation of duty provided enough flexibility for data acquisitions and analysis. The important part of the data process was the data input or acquisition process that provided the foundation for analysis. These processes are described in more detail below.

3.3.3.2 Automatic and manual extraction and process

In this study, data was provided in the form of multiple elements of free text also referred to as "trend passages." The content of each of these free text elements determined the type of category applied deductively and inductively. Elements that were extracted via the statistical package "annual report export" comprised the composited trend searched for, and two additional sentences above and below the composited trend term. Examples for composited terms are "GET" or "Sustainability Trends," and the additional text provided. This context was important for an expert to determine the correct category, or, if a trend passage represented multiple aspects, then the amount of correct trends could identified by the experts. The overall process with the relevant control measures is depicted in Figure 36.

Figure 36: Data extraction and quality measures



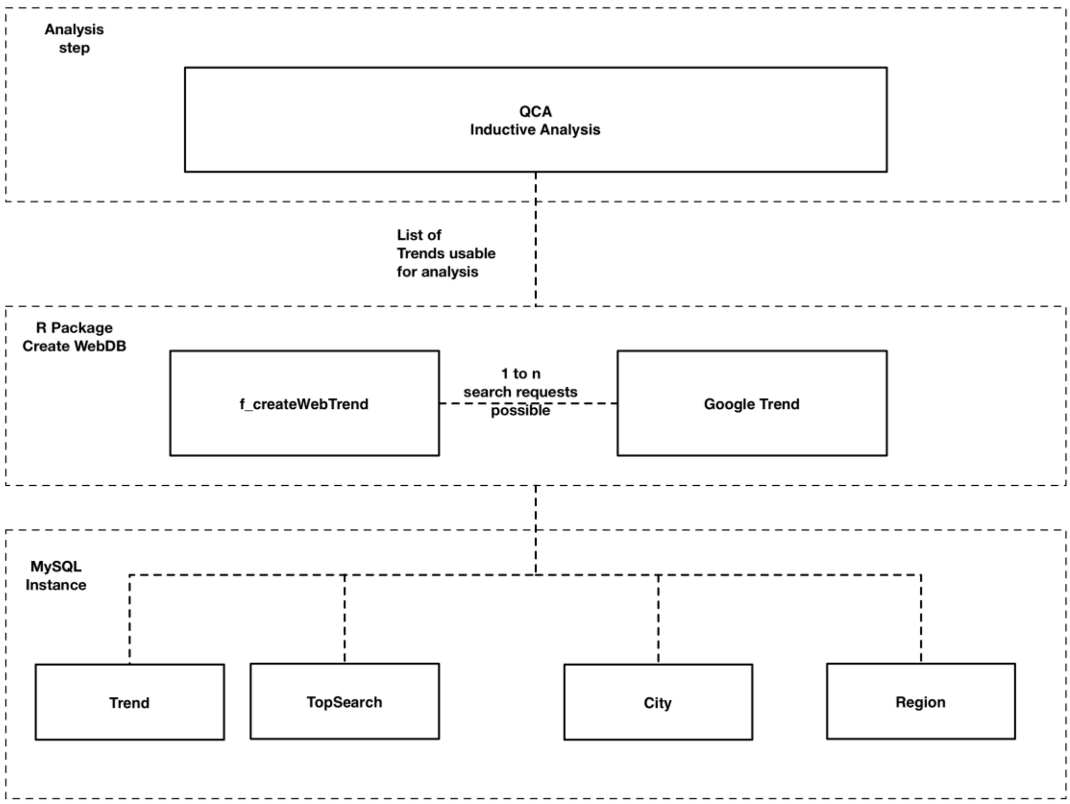
The extraction of trend passages from annual reports was done in two ways. Where annual reports, provided as pdf files, were not copyright protected, the extraction was done with the software tool "pdfgrep", which provides text files with the extracted passages. Then the text files were uploaded into the database. To extract exact phrases of composited terms, an additional quality step was applied that was done via an additional check of each term extracted by the software routine. During the preliminary analysis, multiple occurrences of these types of errors could be observed, which led to three corrective actions. One corrective measure was the additional expert judgement (see step two and step five in Figure 36). This corrective measure involved the examination of data by scanning the documents and extracting the information manually via the functionality provided by a standard pdf reader. The extracted information was stored together with the referenced page, the combined trend term, and the complete text passage.

The manual extraction process (see step four in Figure 36) was applied where the pdf files were copyright protected. In this case, the annual reports were searched for trend passages, and the text was inserted manually into the database. Furthermore, quality measures were applied to the extracted trend passages (see Quality process in Figure 36). In this process, a subset of annual reports were revealed to identify patterns like headlines, additional notes, graphical elements, or other forms of designs or illustrations that were added to the report. As this information was not used in the analysis, it had to be deleted from the database. Therefore, the extracted passages in the database were validated, and corrected or deleted if they did not fulfill the quality requirements.

3.3.3.3 Implementation of Google Trend into the research process

The statistical software R is expandable by additional software libraries, which provide extra capability to download and to analyze data provided by the platform Google Trends. After comparing various free to use packages, the package provided by Chris Okugami was chosen, which is available on the internet platform "GitHub".[21] The package stores the returned results, like related keywords determined by the nearest neighbor algorithm, the relevant categories, and the information about the city and the region where the trend has been recognized. The package is customizable to provide data as a simple dataset or as a set of four individual *r* arrays. These arrays contain either the overall search ranking results labelled "_topsearch," the ranking per city represented as "_city," the ranking per region written as "_region." or the related key terms named "_trends." The Figure 37 shows the overall process.

Figure 37: Schematic representation of R package "WebTrendDB"



[21] Downloadable package for google trends https://github.com/okugami79/googletrend

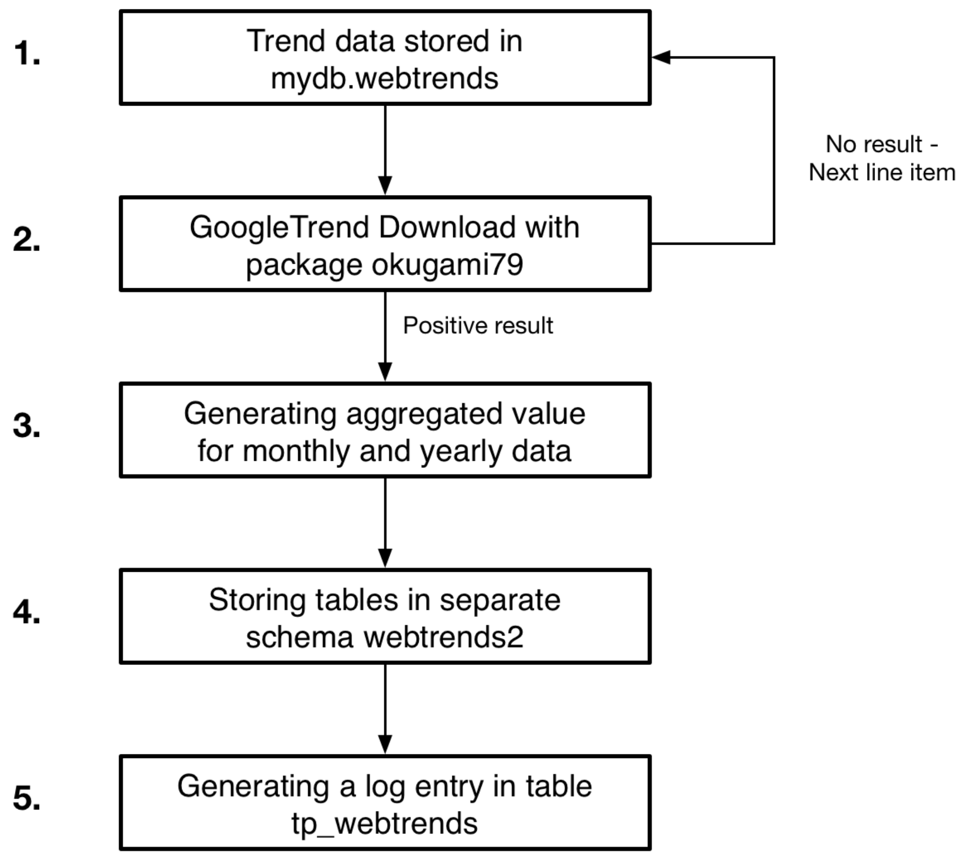
After the download of information is completed, the results are stored in the MySQL database, and are available for further research. Every result that is provided by the R package is also stored in the relational database. The R package “CreateWEBDB” processes Google Trends requests and processes completely new instances in the MySQL database based upon the results gained from Google Trends. As a requirement, package “CreateWEBDB” also implements the R package RMySQL that provides an interface for MySQL. The function “f_getTrend” of the “CreateWEBDB” requires an individual array as an input that is processed in the routine and is able to create multiple tables, based on the multiple keywords that were passed to the routine. The results that are stored results identified with the suffix “_topsearch” contain all related terms identified related to the original term entered in Google Trends. The related terms provide additional keywords that rank similar to the keyword that has been requested and has been processed via the R package. Based on these results, further trends can be identified. These results can be utilized either for further research on a specific trend, to verify the results returned in the array, labelled as "_topsearch." This array contains the original information about the web search rank that was returned by Google Trends, which can be utilized in a comparative analysis on the trends identified via the inductive categorization approach. This functionality is based on the nearest neighbor algorithm implemented. The paper by Vanderkam et al. (2013) explains this correlate algorithm:

> Correlate searches across millions of candidate query time series to find the best matches, returning results in less than 200 milliseconds. Its feature set and requirements present unique challenges for Approximate Nearest Neighbor (ANN) search techniques (Vanderkam et al., 2013, p. 1).

The outcome of the time-series comparison is a set of best-matched trends. In addition, the Pearson correlation is provided with the data, which allows expert judgement about the relation between the original keyword used for the query and provides data for comparative analysis. The algorithm finds web search terms that fit the Google Trends results that the user provided. Furthermore, it matches the popularity over time that best matches the provided time series (Vanderkam et al., 2013).

To be able to utilize the Google Trends information, further transformations were implemented in R. As depicted above, each data frame is a structure that contains four tables that are stored in the databased. Furthermore, an aggregated table was implemented that transformed the trend index into a yearly index. This information is needed in the analysis of the trends utilized in annual reports. For better handling of data, the aggregated values were stored in a separate schema of the database, which were “webtrends2” for data without a regional restriction and “webtrends_germany” for data for the local settings of Germany. This process is shown in Figure 38.

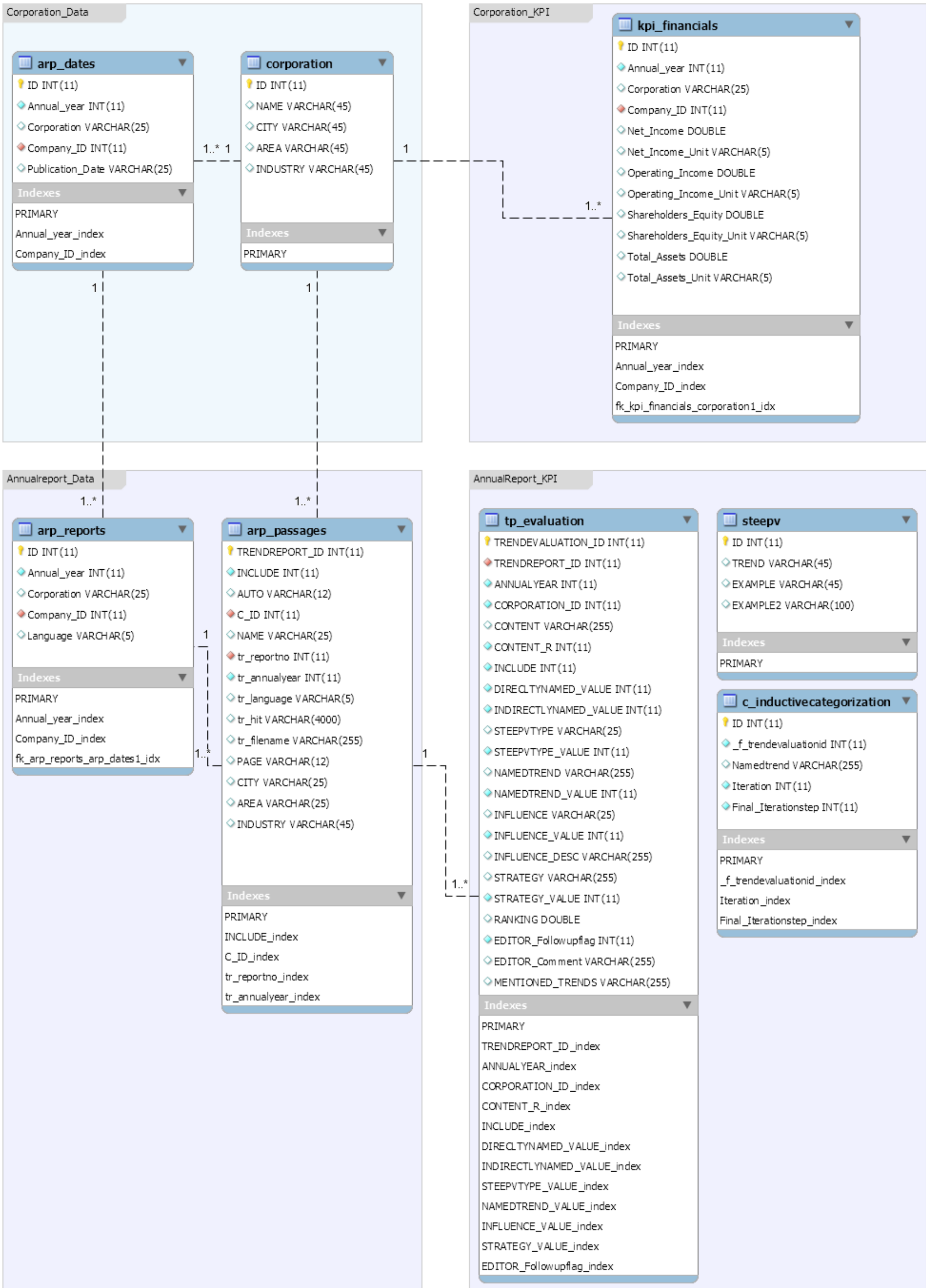
Figure 38: Data mining approach



3.3.3.4 *Entity relationship model*

The entity relationship model (ERM) provides the overview of all tables used to store the data gained in the qualitative and quantitative analysis. Information and data were stored in interrelated tables, and database views were used for presentation and analysis. Views provided by the database system provided the aggregated and processed perspective to the data that is used for evaluation. To secure quality, the data model was dissected into different areas that represent the objects used in the research. Objects that were relevant in the data model were text passages from annual reports, internet trend data from web searches, variables used for the operationalization of the empirical model, data relevant for corporations (e.g. financial performance data), and geographic data. MySQL version 5.1 was chosen as a database system to store and process the data, but the model is not restricted to the platform. To get the most efficient design flexible enough to fulfill the requirements of the qualitative and quantitative analysis, software tools such as MySQL developer, as well as Microsoft Excel were used throughout the design and development process. The data model comprised five sections: "TrendsinReport_Evaluation," "AnnualReports_Data," "CorporationKPIs," "Webtrends," and "DataConfiguration." These sections connected to "corporation," which represented the population of DAX (stock market index) corporations used in the sampling process. The section "AnnualReports_Data" contained data about the downloaded reports from corporate websites. In addition, relevant evaluation data like the frequencies of trends found in each report were stored in this section. The section "CorporationKPIs" contained the data of the financial performance of the corporation, and the publication date of published annual reports. The area "TrendsinReport_Evaluation" stored the trend passages identified in the annual report via the script in R statistic software. All information and strings extracted from the reports were stored in this table. The table "trend evaluation" contained the data gained during the evaluation process. The general design followed the concepts of specialization and generalization. Generalization is the creation of new entities referring to commonalities among datasets. Specialization serves to provide new subclasses and relations where an individualization of data is required. Figure 39 shows the complete ERM excluding the views that were used.

Figure 39: Data model for QCA



The overall data model consisted of two schemas, "MyDB" and "Webtrends." "MyDB" was divided into a transactional data and master data. Master data for the analysis is stored, for example, in the table "Corporations and Dates." This information was acquired once and not changed during the course of the analysis. Transactional data was acquired in the other tables. The two relational schemas were interlinked via the table "Webtrends." This table holds the link between the trends used from the inductive trend analysis and the automatically acquired webtrends via the programmed data module. This relation is depicted in Figure 40.

Figure 40: Database link between mydb and webtrends

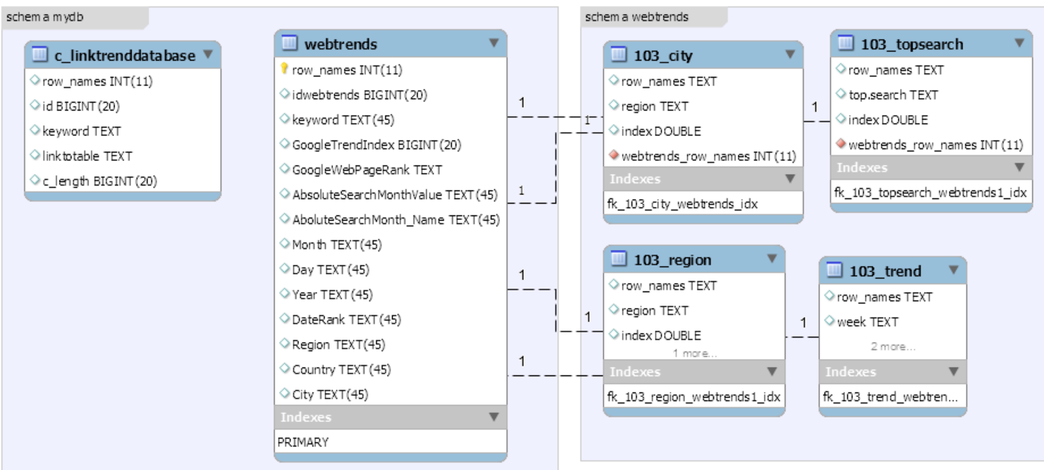
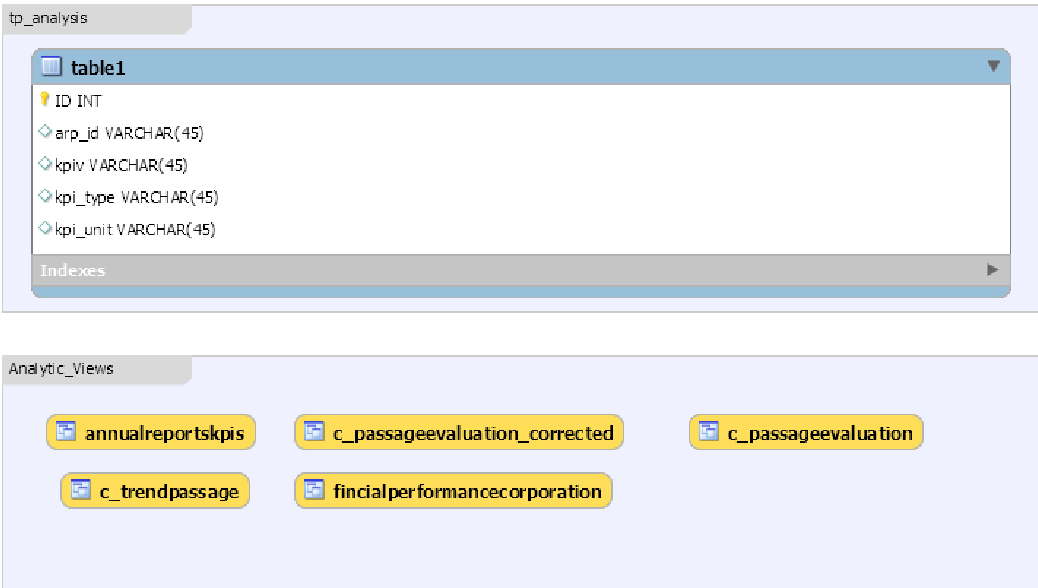


Figure 40 demonstrates how the schemas were interlinked. The set of four tables in the squared area on the right side represents the information downloaded from Google Trends. It contains geographical information about cities and regions, related search terms, and the trend data itself. The table webtrends in the schema "MyDB" links these tables in relation to the trends extracted from the contextual analysis. With two schemas in place, the data could be kept separately, which had a benefit for data management and for the systematic software development in R.

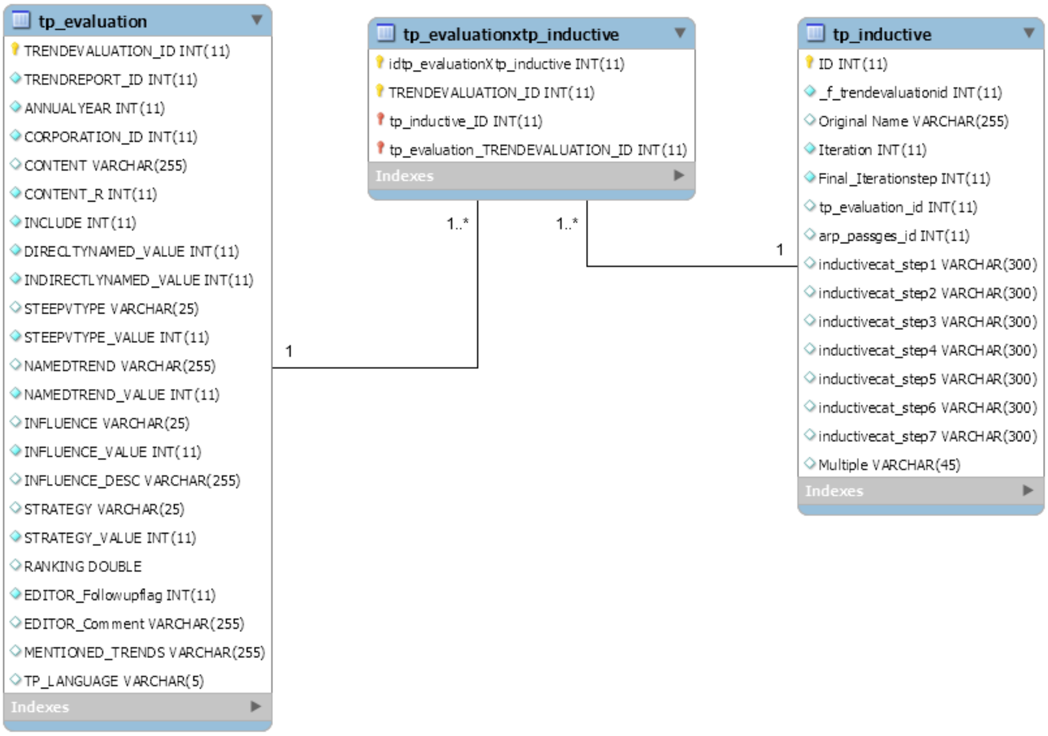
Capacities for analyzing the data in external software tools, were provided via views stored in the relational schema "MyDB." These views provides an aggregated view on the data tables that contained the data based on textual content analysis, the quantity data on financial performance, and the data downloaded from Google Trends. This information was provided in the table "analysis_views." This table held the information about the views and interfaces provided for external analysis. Furthermore, these views could be used for an external FSS that aimed to acquire the data for analysis. This logic is depicted in Figure 41.

Figure 41: Analysis model



To enable further functionalities for the inductive categorical analysis, the database schema MyDB provides another n:m relation. Figure 45 demonstrates how the original trendpassages that were stored in the table "tp_passages" were interlinked with the table "tp_inductive." With the n:m relation, the assessment of trends, and the categorization were handled independently. This approach provides the most flexibility in the handling of the data. Figure 42 depicts the table relation in the format of an entity relationship diagram.

Figure 42: N:M relation between tp_inductive and tp_passages



In conclusion, the tables provided the data that were gained throughout the analysis either by analysis or by inquiry with Google Trends or from the annual reports that were processes with the R software packages. The database views provide the logical view on the data. In other words, the views comprise the data used in the mathematical analysis, in the creation of graphical expressions, or for special data figures shown in the empirical analysis. This logic separates the functionality relevant for the analysis of data from the storage of data, which is a surplus in flexibility.

3.3.3.5 Data acquisitions process and evaluation process

The data acquisition processes aimed at acquiring data from pdf files and providing this data for evaluation, downloading web-based data from Google Trends and conducting financial analysis based on the qualitative information from annual reports. Two individual database instances were used for the process. The data acquisition from pdf files was a three-step process:

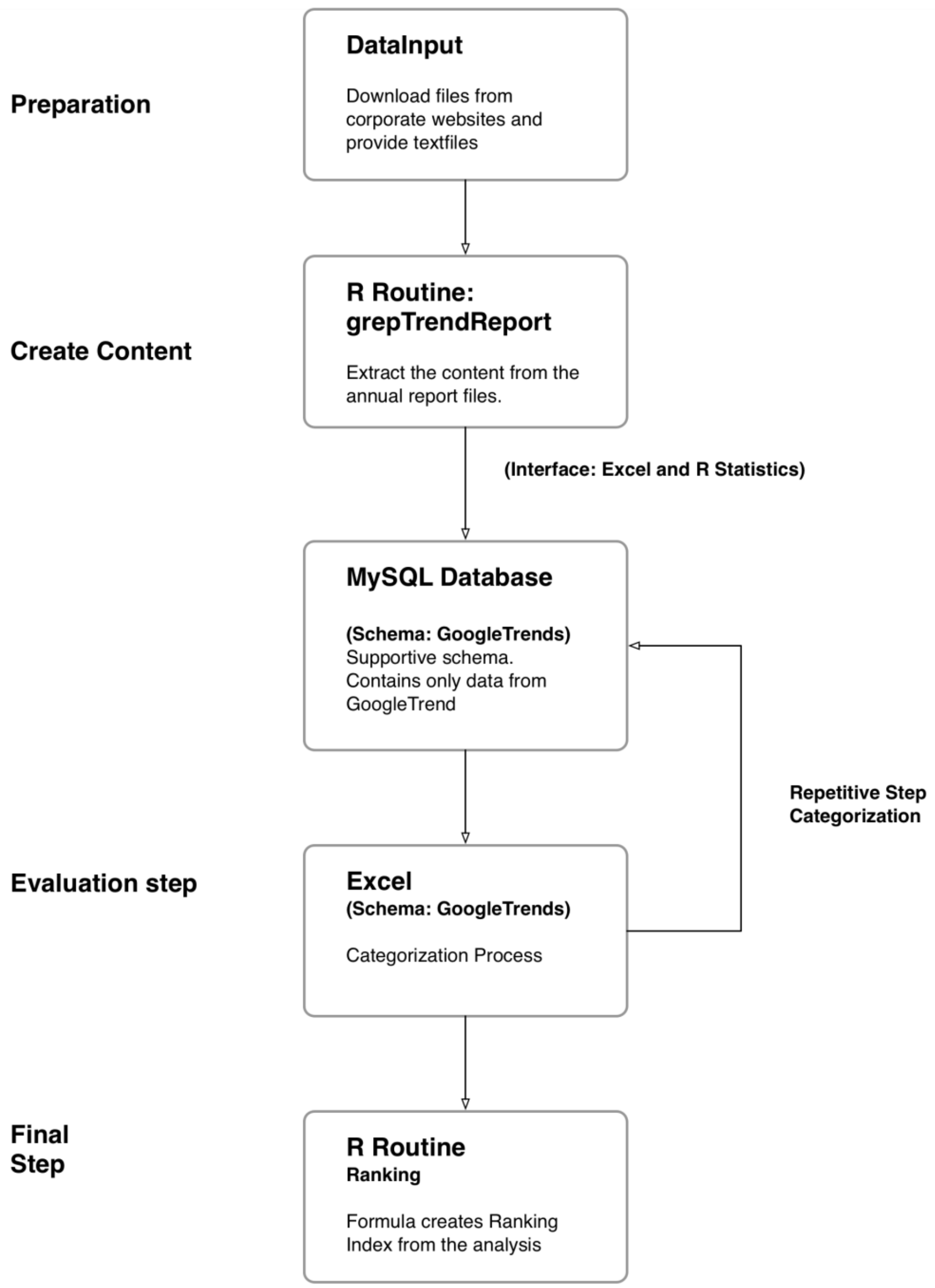
1. Annual reports were downloaded from the corresponding corporate websites. All documents were downloaded in English and in German. Reports downloaded range from the period 2013 to 2014;
2. The downloaded files were then converted into raw text files. This allowed automatic software routines to process the files;
3. Textiles were scanned with the UNIX function "grep" to identify text passages containing the term "trend." This information was extracted as raw string code and stored in the database (see Figure 43).

The outcome of this empirical work was then utilized in the quantitative analysis; for example, the exact phrasings of these terms were then stored in the database and used as search query terms for Google Trends, as described below:

1. The terms from process the list are used to query Google with the routine provided by r;
2. The Google Trends results are provided as datasets and each request; in stored in separate tables in the second instance MySQL database.
3. The table entries of the queried trend are then interlinked with the newly created dataset.

This information was the grounds for qualitative and quantitative analysis. Each part of the data acquisition involved the utilization of the statistical software packages in the software solution RStudio, and additional libraries like "GGPlot2", "Devtools", "RMySQL", "TM", and "Google Trends" that is available on "GitHub". In conclusion, a detailed figure for each of the analyzed processes was outlined in the following flow diagrams.

Figure 43: Qualitative data acquisition and evaluation process flow



In addition to the schematic representation above that shows the acquisition process of annual report data, and the categorization process that finally leads to the data matrix used in the analysis, two further processes complete the discussion. The quantitative analysis utilized these processes. Consequently, these processes are illustrated in Figure 44 and Figure 45.

Figure 44: Data processing of financial metrics

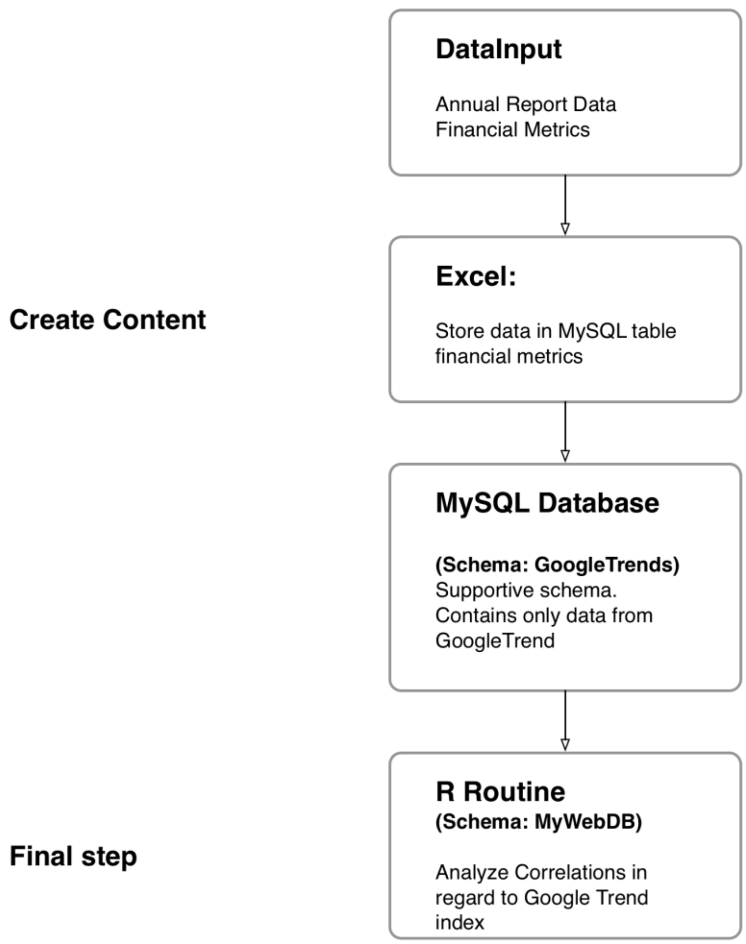
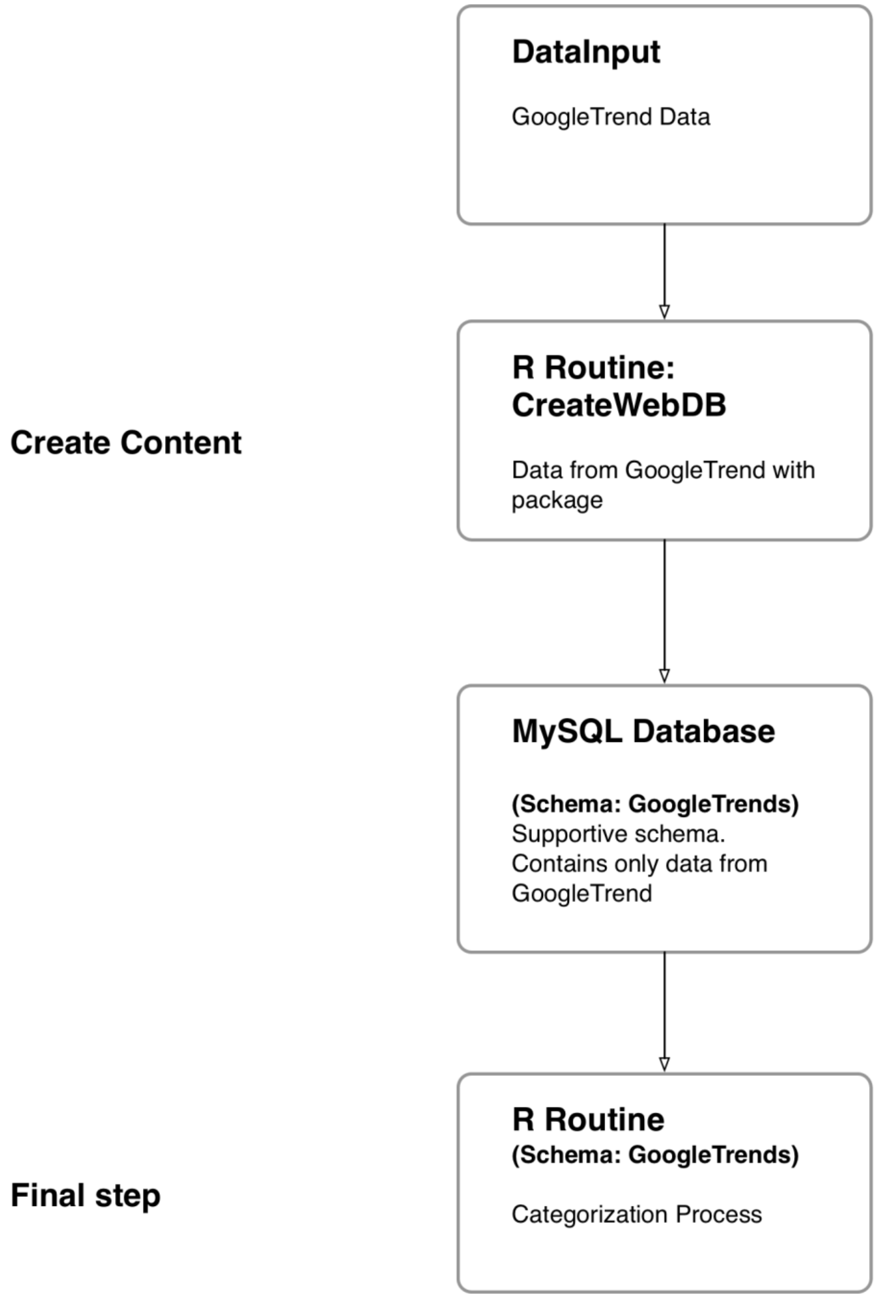
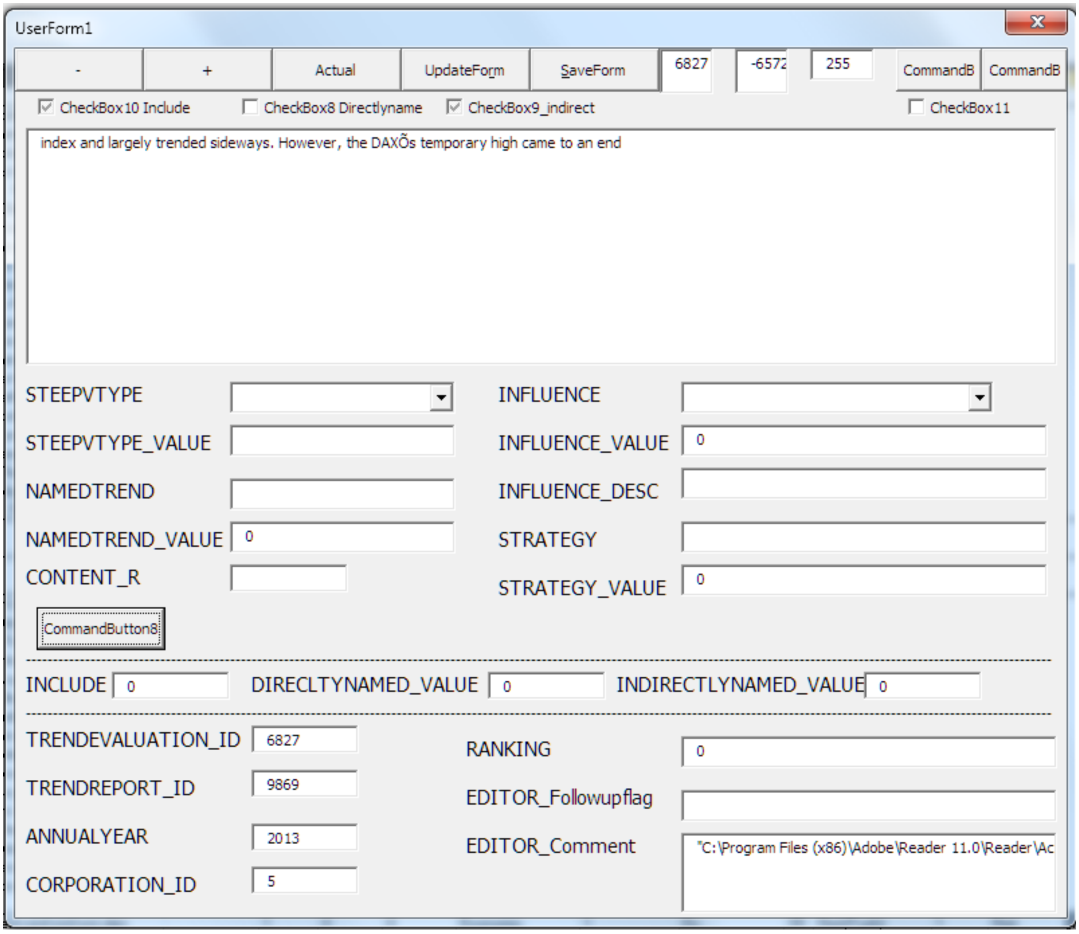


Figure 45: Acquisition process flow for Google Trends data analysis



To raise the efficiency of the QCA, an individual tool realized in Excel provided the foundation for data manipulation and for the evaluation of the trend passages. In short, the tool displayed the content of the individual trend passage and required the user to codify the variables utilized for the empirical analysis. Figure 46 depicts the graphical user interface.

Figure 46: Graphical user interface for qualitative content analysis



The above interface was able to visualize the database content and was used to evaluate the extracted trend passages by loading each individual line of Excel into the interface. In the interface, the steps of evaluation were performed. Afterwards, the content was uploaded into the database.

4 EMPIRICAL RESEARCH

4.1 ANALYSIS ON GETS AND ANNUAL REPORTS

4.1.1 Qualitative analysis of trends in annual reports

4.1.1.1 Trends identified in annual reports from 2004 to 2014

In total 5,920 trend passages (TPs) were identified in the annual reports (ARP). Of these, 4,770 passages were integrated automatically via the software package, and 1,150 were implemented by manual inquiry. It could be observed that the overall data revealed different uses of the term "trend" from 2004 to 2014. The amount of trends passages that were extracted from the ARPs varied from year to year. Furthermore, the individual annual reports of the corporations contained a varying number of TPs. An interesting result was that the data revealed that the term "megatrend" was used in 2005 the first time by Siemens AG (2005, p. 9): "Our business is based squarely on opportunities in markets derived from the major megatrends of tomorrow – namely changing demographics and the growth of cities worldwide." In this and in the following fiscal year from 2005 until 2006, only Siemens used this term in their reporting. In the overall panel, 19 companies utilized this term.

This result led to the question of what the distribution of TPs looks like and confirmed that the inclusion of eleven years into the analysis was a rational decision, as it provided enough room for the analysis of intra-individual changes. As demonstrated by (Kumar, 2011), before-and-after (BAA) studies as well as longitudinal analysis (LTA) studies provide the capability to discuss intra-individual changes within the same sample group. Kumar (2011, p. 110) points out that LTA allows one to measure "pattern of change, and obtain factual information, requiring collection on a regular or continuing basis." Therefore, the overall result was satisfying from the quality point of view. Table 21 gives an overall representation of the results of the data acquisition.

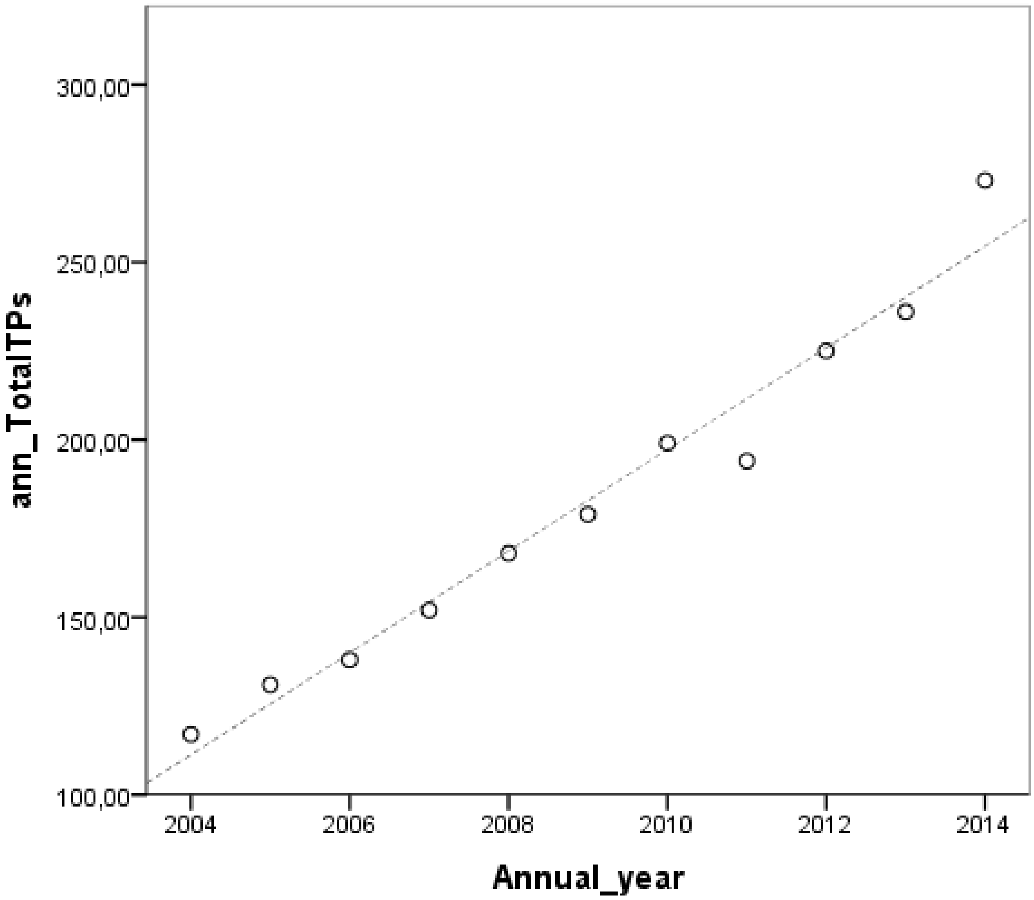
Table 21: Utilization of trends by corporations

No.	Corporation	Trends Total	Direct TPs	Indirect TPs
1	Adidas AG	**55**	5	50
2	Allianz SE	**102**	2	100
3	BASF SE	**86**	15	71
4	Bayer AG	**90**	9	81
5	Beiersdorf AG	**63**	5	58
6	BMW AG	**37**	2	35
7	Commerzbank AG	**57**	2	55
8	Continental AG	**68**	31	37
9	Daimler AG	**48**	2	46
10	Deutsche Bank AG	**61**	8	53
11	Deutsche Börse AG	**70**	1	69
12	Deutsche Lufthansa AG	**49**	9	40
13	Deutsche Post AG	**82**	3	79
14	Deutsche Telekom AG	**71**	8	63
15	E.ON SE	**31**	5	26
16	Fresenius Medical Care AG	**62**	4	58
17	Fresenius SE	**59**	0	59
18	HeidelbergCement AG	**56**	1	55
19	Henkel AG & Co. KGaA	**40**	9	31
20	Infineon Technologies AG	**46**	8	38
21	K+S AG	**43**	13	30
22	LANXESS AG	**122**	84	38
23	Linde AG	**52**	27	25
24	Merck KGaA	**34**	12	22
25	Munich RE AG	**92**	2	90
26	RWE AG	**48**	0	48
27	SAP SE	**61**	11	50
28	Siemens AG	**126**	71	55
29	ThyssenKrupp AG	**45**	16	29
30	Volkswagen AG	**156**	29	127

.

The total amount of TPs from the years 2004 through 2014 revealed a general upward tendency in the data that needed further analysis. In Figure 47, the overall trend is shown.

Figure 47: Overall TPs identified in the reports from 2004 to 2014



As demonstrated above, the use of TPs is continuously rising, with only a few negligible irregularities. Figure 48 also shows the overall linear trend with the dotted line. The overall data was further divided into two pieces. The measure of segregation was the use of the variables “DIRECT” and “INDIRECT” that were acquired in the data acquisition, and if the variable “INCLUDE” was set true. This view provided the differentiation of passages that address global economic trends (GETs) directly, and passages that use other terms or even describe other trends that do not relate to GETs.

Figure 48: Direct and indirect trendpassages from 2004 to 2014

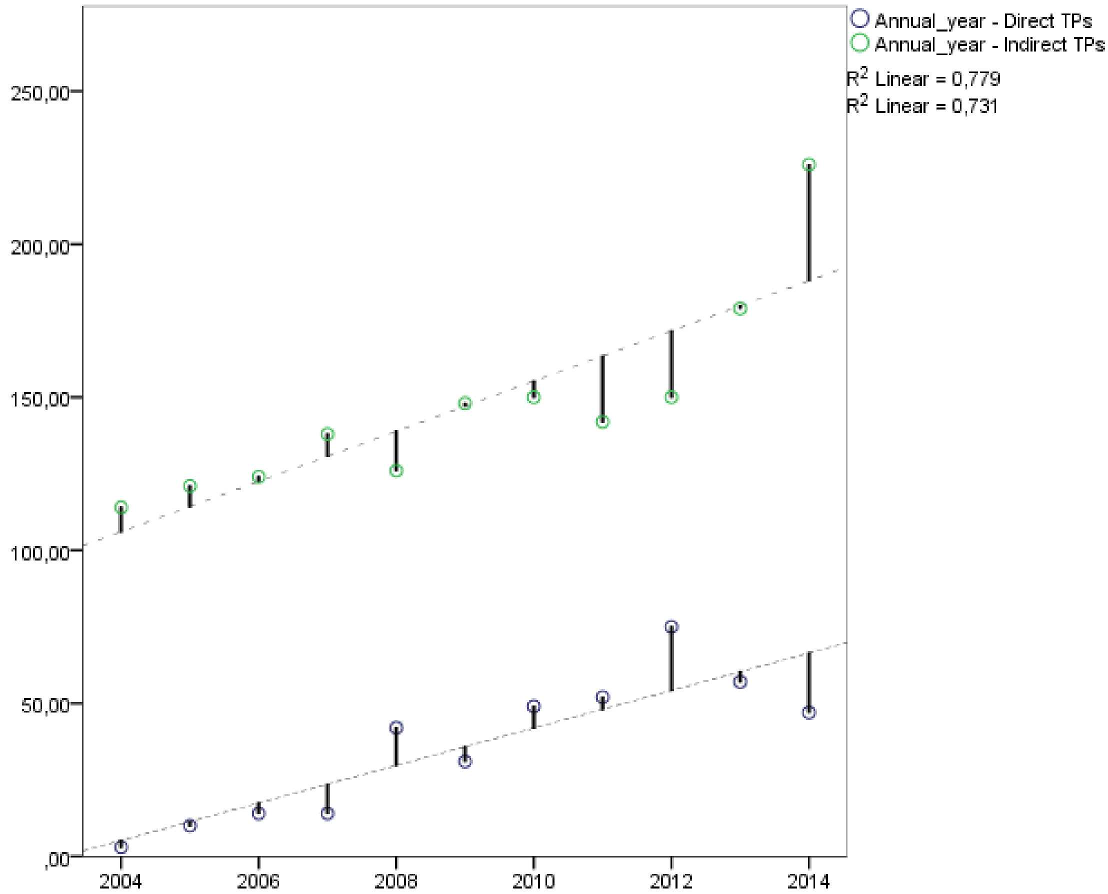


Figure 48 demonstrates in which years trends passages used the term "GET," "global trend," or "megatrend," both directly and indirectly. In both cases, the development of the trend was in-line with the overall TPs found in the report, as shown in Figure 47. Furthermore, linear trend lines with additional spark lines are illustrated. The figure reveals a continuous linear upward trend in the use of the terms related to "trend" in annual reports. In addition, it could be observed that direct passages were used more frequently from the beginning of 2008. Figure 48 also shows that direct TPs are less frequently used from 2012 to 2014. The question in this case is whether there is a statistical relation between the variables "ANNUALYEAR", "DIRECT" and "INDIRECT".

The Person Correlation coefficients of 0.883 between variables “DIRECT” and “ANNUALYEAR,” and 0.855 between “INDIRECT” and “ANNUALYEAR,” reveal a strong correlation between the variables. The underlying assumption that there is no linear relationship between the annual year and direct TP, and annual year and indirect trend passages had to be rejected. Equation 8 demonstrates the regression function for the variables “DIRECT” and “ANNUALYEAR“, which is discussed exemplarily.

Equation 8: Results of the simple regression model for time and direct TPs

$$f(t) = -12{,}278.87 + 6.127t \tag{8}$$

As explained by Backhaus (2006, p. 82), to test the goodness of fit for the regression function, the coefficient of determination (R^2), the f-statistic, and the standard error have to be calculated. As a follow-up, the regression coefficients are tested for their goodness.

The linear regression model has a coefficient of determination of 78% (R^2). That means that 22% of the total observations cannot be explained by the model. The standard error of the regression model is 11.4. As a null hypothesis, or H_0, we assumed that time is not able to explain the overall distribution of direct TPs. Furthermore, the f-statistic value or F_{emp} is 31.7 based on the coefficient of determination, as shown in Equation 9. Compared to the F-Statistic table with 95% probability, F_{emp} is greater than F_{Tab} with 31.7 > 4.84. Consequently, H_0 has to be rejected.

Equation 9: F-Statistic with coefficient of determination

$$F_{emp} = \frac{\sum_{n=1}^{K}(\hat{y}_n - \bar{y})^2/J}{\sum_{n=1}^{K}(y_n - \hat{y}_n)^2/(K - J - 1)} \tag{9}$$

$\sum_{n=1}^{K}(\hat{y}_n - \bar{y})^2 = R^2$	Explainable dispersion
$\sum_{n=1}^{K}(y_n - \hat{y}_n)^2 = (1 - R^2)$	Unexplainable dispersion
J	Dependent Variables
K –J – 1	Number of observations

The model has one degree of freedom. The Durbin-Watson test resulted in a value of 1.785, which excludes autocorrelation between the variables. A linear regression model with the variables “DIRECT” as a dependent variable and “ANNUALYEAR” as the independent variable has a coefficient of determination of 78% (R^2). 22% of the total observations cannot be explained by the model. In addition, a t-test was performed for the regression coefficients, as depicted below.

Equation 10: t-test

$$t_{emp} = \frac{b_j}{s_{bj}} \tag{10}$$

t_{emp}	Empirical t-value for regressor j
b_j	Regression coefficient for regressor j
s_{bj}	Standard error of b_j

To test the goodness of the regression coefficient, the model assumes a confidence level of 95% with 11 total observations. In addition, the standard error for each coefficient needs to be determined, as shown in Table 22.

Table 22: t-test values for the regression coefficients

	Unstandardized Coefficients		Standardized Coefficients	
	B	Std. Error (SE)	Beta	t_{emp}
b_0	-12273.873	2185.746		-5.615
b_1	6.127	1.088	.883	5.632

As a hypothesis H_0, we assume that the coefficient has no influence. The alternate hypothesis assumes an influence for the regression coefficients, which is depicted below.

$$H_0\colon\ \beta_j = 0 \tag{11}$$

$$H_1\colon\ \beta_j \neq 0$$

The theoretical t- value t_{tab} amounts to 2.262 and is based on the confidence level of 95% and a calculated degree of freedom of nine (Number of observations – Degree of freedom - 1). The value was extracted from a t-test table (cf. Backhaus, 2006, p. 630). In the next step the absolute empirical t-values t_{emp} are compared against t_{tab} to test if the relevant coefficient has a significant influence. If $|t_{emp}| > t_{tab}$, then H_0 needs to be rejected. In both cases, H_0 needs to be rejected (5.615 > 2.262 and 5.632 > 2.262). Hence, the coefficients have a significant influence. The confidence intervals for the regression variables are calculated based on:

Upper bound $$b_j + t_{quantile}\, s_{bj} \tag{12}$$

Lower bound $$b_j - t_{quantile}\, s_{bj} \tag{13}$$

$t_{quantile}$	$(1 - \frac{a}{2})$ quantile of the t-distribution with (n-m-1) degrees of freedom
s_{bj}	Standard error of b_j

The underlying assumption is that the variable "ANNUALYEAR" is able to predict "DIRECT" with a confidence of 95%. The resulting confidence intervals are illustrated in Table 23.

Table 23: Confidence intervals for the regression coefficients

	Upper Bound	Lower bound
b_0	-12,273.873 + 2,185.746 · 2,281 = -7288.186374	-12,273.873 - 2,185.746 · 2,281 =-17259.55963
b_1	6.127 + 1.088 · 2,281 = 8.608728	6.127 - 1.088 · 2,281 = 3.645272

Conclusion 1: The utilization and distribution of direct and indirect trends passages in annual reports by DAX corporations depends on the annual year. The frequency of both categories grows annually, which represents a growing interest in the topic of GETs.

4.1.1.2 Overall utilization of trends by corporation

The following passage shows which corporation used the term “trend” most in their annual reports (ARPs) from the cross-sectional and longitudinal analysis perspectives. The overall results are shown in Table 24. By analyzing the passages for the usage of direct trends passages (TPs), it could be revealed that the terms “megatrend,” “global trend,” or “GET (global economic trend)” are not applied by all corporations. The top five users of direct TPs are Siemens AG (71), Lanxess AG (84), Continental AG (31), Volkswagen AG (29), and Linde AG (27). These five corporations use 61% of all direct TPs identified. Siemens AG and Lanxess AG alone used around 40% of all direct TPs. Other corporations like Adidas AG (5), or Daimler AG (2) used this trend sporadically. On the contrary, Fresenius SE and RWE AG did not use these terms in their ARPs. However, these corporations describe the effect of trends in several TPs found. For example, RWE AG (2006) indirectly refers to economic trends by addressing changes in the general economic climate: “Economic trends in our core markets can affect the degree of capacity utilization, having either a positive or negative impact on results.” Also, Fresenius SE & Co. KGaA (2006) mentions demographic changes, but the term megatrend was not used. The latter examples show that the effect of the trend has an impact on the business performance of the corporations. In the first example, RWE AG describes that economic trends have an impact on the use of energy, which leads to more or less sales for the corporation in the specific market. In this case, the effect of the trend to the business is described as being important to the business operation of the company. In the second example, Fresenius SE & Co. KGaA describes that the demographic development in developing countries will lead to a higher demand of medical health care. The effect has an impact on the business. In conclusion, the discussed TPs are not referred directly as a megatrend but describe the same effect. Fresenius SE & Co. KGaA utilizes the effect of demographic change in combination with the term “megatrend” to underline the importance of growth market to their business.

Table 24: Trends used by corporations

ID	Corporation Name	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
1	Adidas AG	2	4	3	5	4	4	12	6	4	5	6	55
2	Allianz SE	5	8	10	14	9	5	6	7	14	12	12	102
3	BASF SE	4	1	2	6	13	12	7	6	10	11	14	86
4	Bayer AG	7	7	9	13	9	9	7	8	3	4	14	90
5	Beiersdorf AG	2	4	2	4	4	6	4	4	9	12	12	63
6	BMW AG	1	1	2	5	2	2	2	3	3	4	12	37
7	Commerzbank AG	1	2	1	5	7	2	6	6	6	7	14	57
8	Continental AG	4	2	3	2	5	7	7	4	13	8	13	68
9	Daimler AG	3	5	5	4	2	2	5	5	8	4	5	48
10	Deutsche Bank AG	2	1	8	15	5	4	5	7	4	5	5	61
11	Deutsche Börse AG	4	4	5	6	3	4	8	5	10	14	7	70
12	Deutsche Lufthansa AG	3	5	6	2	3	3	3	7	3	6	8	49
13	Deutsche Post AG	9	3	5	5	6	10	11	11	12	5	5	82
14	Deutsche Telekom AG	10	3	3	6	2	4	5	5	11	12	10	71
15	E.ON SE	2	2	2	3	1	2	5	3	2	3	6	31
16	Fresenius Medical Care AG	4	4	3	6	6	11	8	9	6	2	3	62
17	Fresenius SE	4	4	6	6	8	7	6	7	3	3	5	59
18	HeidelbergCement AG	2	5	3	3	7	3	6	10	4	9	4	56
19	Henkel AG & Co. KGaA	1	1	2	3	3	1	3	5	8	10	3	40
20	Infineon Technologies AG	2	4	3	2	2	6	5	4	5	4	9	46
21	K+S AG	2	5	5	1	3	4	5	5	5	5	3	43
22	LANXESS AG	1	1	3	1	5	5	12	19	30	30	15	122
23	Linde AG	8	1	2	2	8	1	6	4	2	5	13	52
24	Merck KGaA	2	1	1	1	3	1	1	1	7	7	9	34
25	Munich RE AG	8	8	13	7	9	15	9	4	2	6	11	92
26	RWE AG	6	5	4	3	7	4	5	2	1	2	9	48
27	SAP SE	4	3	5	1	5	3	5	5	6	16	8	61
28	Siemens AG	4	14	13	5	12	18	21	15	11	8	5	126
29	ThyssenKrupp AG	3	9	4	6	5	3	2	1	3	4	5	45
30	Volkswagen AG	7	14	5	11	11	21	12	16	18	13	28	156
Total		**117**	**131**	**138**	**153**	**169**	**179**	**199**	**194**	**223**	**236**	**273**	**2012**

In comparison, the latter example is emphasized more strongly than the above example of Fresenius SE & Co. KGaA. In light of the results based on the confidence ranking index (CRI), this example demonstrates how the impact of a trend to a business is portrayed as a strategic option for the corporation. As stated above, several corporations could be identified that used direct TPs more frequently than others did, especially in the context of business development. Lufthansa Group (2011) describes demographic change as being a megatrend. In their ARP of 2011, the corporation points out:

> Megatrends such as demographic change and the shifting tectonics of global markets are important economic factors. They have a decisive impact on air traffic. Passengers are not only getting older, more individualistic and more discerning – they are also coming from regions which previously were not in focus. Especially in countries like China or Brazil, increasing affluence means greater demand for mobility. We are responding by realigning our global flight network to ensure that we continue to expand our profitable long-haul routes (Lufthansa Group, 2011, p. 5).

Figure 49: Boxplots of direct and indirect TPs (cross-sectional)

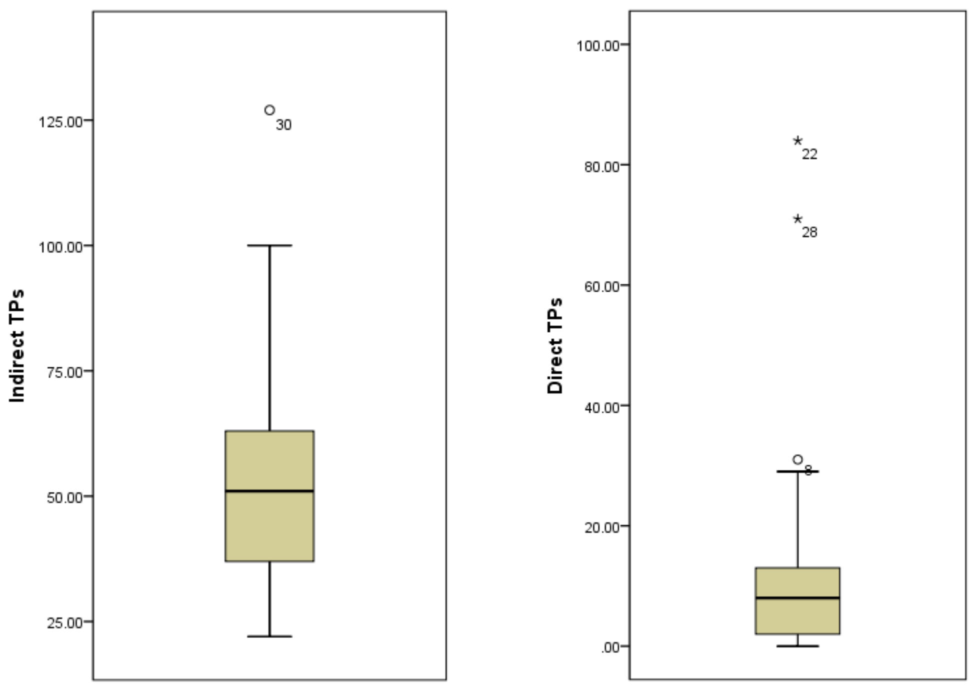


Figure 49 illustrates both variables from the cross-sectional point of view. As demonstrated in the beginning of the section, Siemens AG and Lanxess AG used direct TP most extensively from all corporations in the DAX (German stock index). These two values are symbolized with the stars in the boxplots, which are out-of-range values. However, from the point of data quality these results are correct. Furthermore, we can observe a positive correlation between corporations and direct TPs. With a Pearson Correlation coefficient of .242 there is a rather weak but significant correlation between the variables with $p < 0.001$. The variables "CORPORATION_ID" and "INDIRECT" do not correlate significantly. Again, from this perspective, the correlation between the variables does not imply any causality for our analysis and has no explanatory character.

To have a better understanding of the relations between the variables, we have to look from the panel point of view. For this purpose, the overall values for indirect and direct TPs have been collapsed into groups according to their annual year. Table 25 illustrates the Pearson correlation coefficients between the variables in the overall panel.

Table 25: Correlation analysis of TPs and corporations in the overall panel

Annualyear	Direct	Indirect
2004	.023	.141
2005	.259	.289
2006	.242	.025
2007	.375*	-.409*
2008	.283	-.097
2009	.218	.171
2010	.201	-.011
2011	.274	-.109
2012	.294	-.387*
2013	.323*	-.109
2014	.481**	-.249

* $p < 0.05$ level (1-tailed) ** $p < 0.01$ level (1-tailed)

The analysis from the LTA, or panel point of view, revealed that the correlations between the variables “DIRECT” and “INDIRECT” and corporations are rather spurious. Significances for direct TPs and corporations could be obtained only for 2007, 2013, and 2014 and are rather weak, except for 2014, with a significance of .481 ($p < 0.01$). “ANNUALYEAR” and “INDIRECT” correlate negatively in the years 2007 and 2012 ($p < 0.05$), which is also perceived as rather a sporadic correlation. A causal explanation cannot be obtained from this perspective. In conclusion, the correlation between the variables “CORPORATION_ID” and “DIRECT” and “INDIRECT” is rather a coincidence. No causal relationship explains the observed correlations found in the data.

Conclusion 2: From the cross-sectional view, the use of ”GETs” is not equally distributed in the overall index. Instead, five corporations use 60% of all “direct TPs” identified. From the LTA perspective, there is no relevant correlation between the variables “DIRECT”, “INDIRECT” and “CORPORATION_ID.”

4.1.1.3 Annual distribution of trends across industries

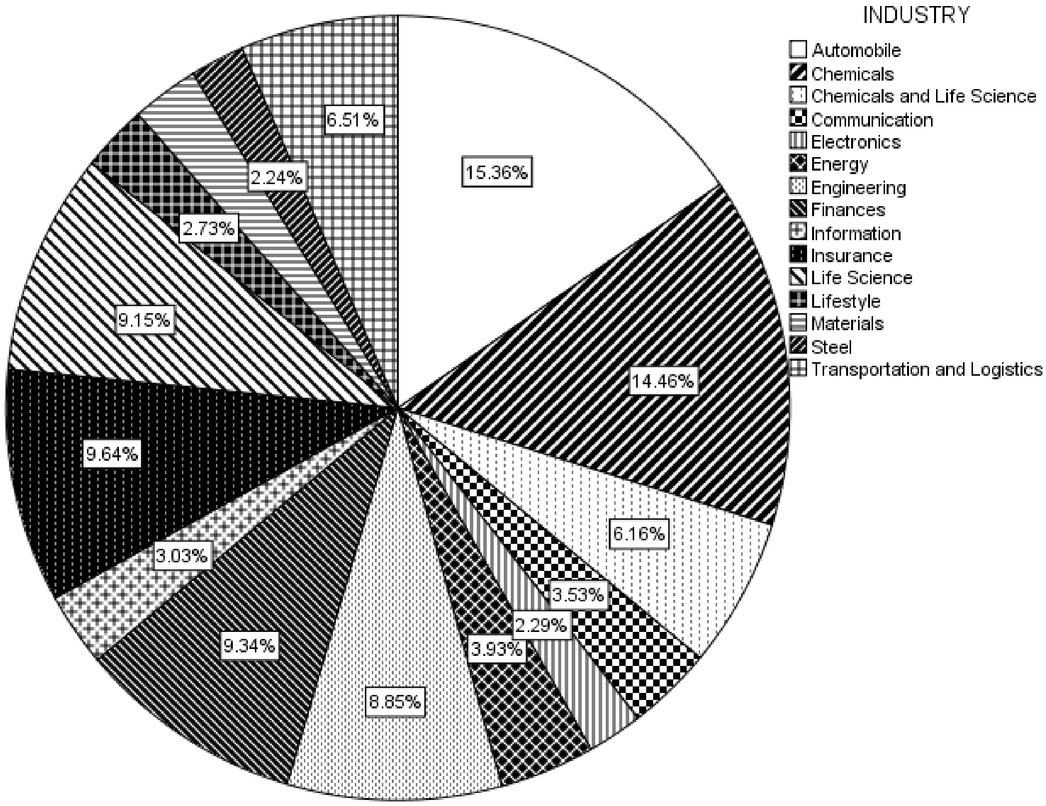
This sub-chapter provides a view of the acquired trends distributed by industry from the cross-sectional and from the longitudinal points of view. Table 26 presents the overall result of direct and indirect trend passages (TPs) used in the period of 2004 through 2014 by absolute numbers depicted as frequencies, by percent, and by cumulative percent.

Table 26: Overall trend distribution by industries

Industry	TPs	Percent	Cumulative Percent
Automobile	309	15.4	15.4
Chemicals	291	14.5	29.8
Chemicals and Life Science	124	6.2	36.0
Communication	71	3.5	39.5
Electronics	46	2.3	41.8
Energy	79	3.9	45.7
Engineering	178	8.8	54.6
Finances	188	9.3	63.9
Information	61	3.0	66.9
Insurance	194	9.6	76.6
Life Science	184	9.1	85.7
Lifestyle	55	2.7	88.5
Materials	56	2.8	91.3
Steel	45	2.2	93.5
Transportation and Logistics	131	6.5	100.0

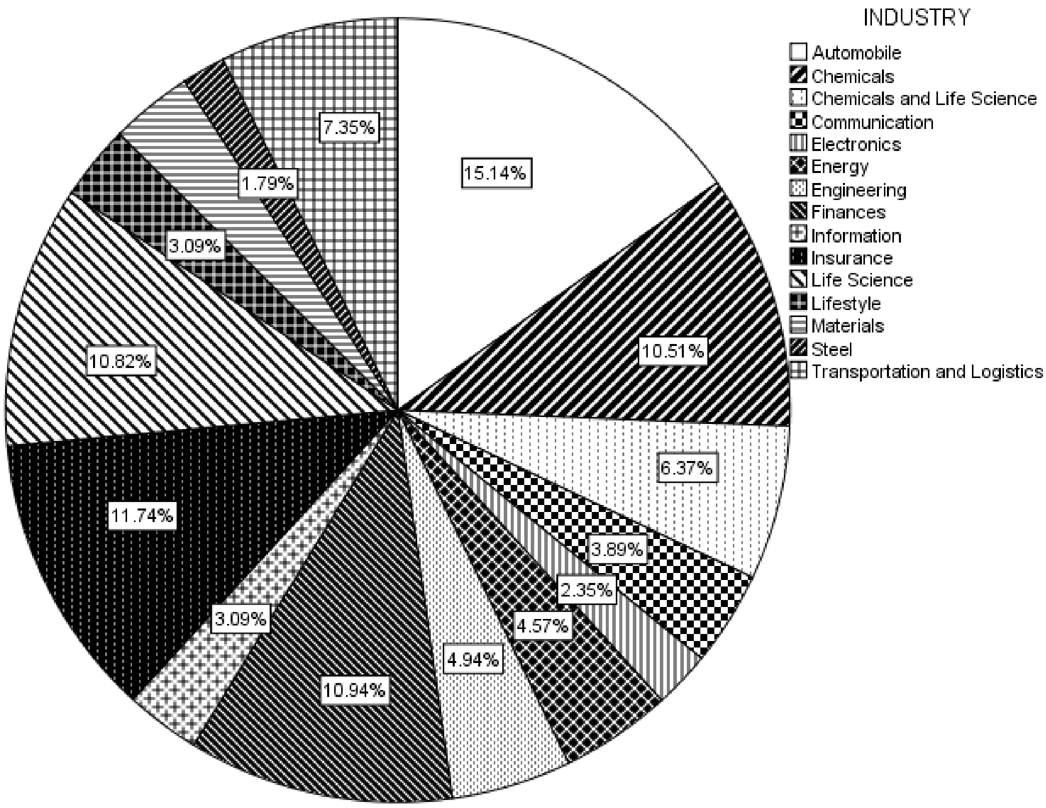
The automobile industry, which comprises four corporations, utilizes GETs most oftenly in their annual reports (ARPs). In total, 309 TPs could be identified by four big automobile corporations that are listed in the index DAX (German stock index). This amount represents a total percentage of 15.4%. The chemical industry follows next with 291 trends in total, or 14.5%. This category includes only three corporations, Henkel AG & Co., KGaA, K+S AG, and LANXESS AG. However, corporations from the industry of Chemicals and Life Sciences do also have a stake in the chemical industry. For example, until 2015, Bayer AG and Merck KGaA also ran chemical operations. In this case, both categories could be perceived as one category, which leads to the conclusion that these industries use trends predominantly. The results are depicted in Figure 50.

Figure 50: Distribution of trend passages across industries



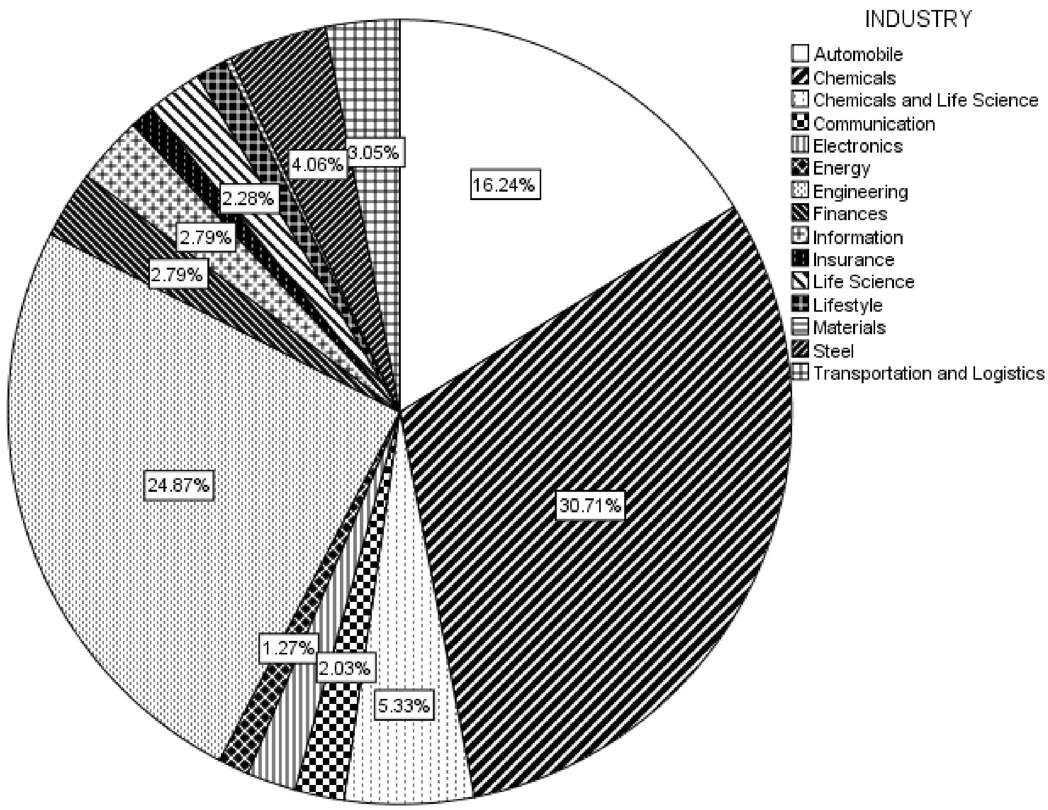
The industries "Chemicals and Lifesciences" and "Chemicals" combined amount to a total result of 414 TPs, or 20.7%. "Insurance" (total number of 194, or 9.4%) "Finances" (total number of 188, or 9.3%), and "Engineering" (total number of 178, or 8.8%) were in the same region. These industries comprise seven corporations. The TPs of the other industries, which comprise 15 corporations, utilize trends less, and have a total amount below 100. The industries "Electronics," "Energy," "Communication," ""Information," "Lifestyle," "Steel," and "Materials" industries used 413 trends in total, or 21%. Figure 51 shows the distribution of indirect TPs in annual reports.

Figure 51: Distribution of indirect trend passages across industries



In total, 1,620 indirect TPs were found. The results are comparable to the overall results that were demonstrated above. The “Automobile” industry used the most indirect passages with 245 TPs in total, or 15.1%. Different to the results above is that the “Finances” and ”Insurance” industries use trend-related terms more frequently than the “Chemicals” and the ”Chemical and Life Science” industries. There were 179 indirect TPs found for the “Finance’ industry, or 11%, and 190 indirect TPs or 11.7% were found in the “Insurance” industry. However, the ”Chemicals” industry (170 TPs in total or 10.5%) and the “Life Science” industry (175 TPs in total or 10.8%) follow next. Therefore, the mentioned industries are in the same region. In the region between 70 and 120 TPs are the industries “Transport and Logistics” (119 TPs in total), ”Chemical and Life Science” (103 TPs in total), and Engineering” (80 TPs in total). The other industries are in the range between 29 and 74 TPs used in the annual reports (ARPs). Figure 52 illustrates the distribution of direct TPs across industries.

Figure 52: Distribution of direct trend passages across industries



As demonstrated in Figure 52, the "Chemicals" industry utilizes the terms "GETs" and "global trends" mostly in their annual reports. In total, the industry "Chemicals" applied direct TP 121 times, which amounts to 30.9%. The industry "Engineering" ranks second place, with a total amount of 98 TPs used in ARPs. "Automobile" uses direct TP 64 times in their investor relations. The correlation between the industry and the variable "DIRECT" is significant and moderate with a Pearson Correlation of -.512 ($p < .05$).

Conclusion 3: Energy- and resource-intensive industries like the chemical, engineering, and the automobile industries are predominantly addressing direct TPs (GETs) in their investor relation communication.

4.1.1.4 Annual distribution of trends across regions and cities

As discussed in the preliminary study, corporations have a strong economic influence on the development to the region where they are located. Within this passage, the relation between global economic trends (GETs), corporations, and regions and cities is revealed based on the data acquired. The above data reveals that multinational enterprises (MNEs) in Nordrhein-Westfalen utilize the GETs mostly within their Annual Reports (529 cases in total). Corporations in Bayern (510 trends in total) and Hessen (437 trends) follow. The observed trends follow a relatively constant development, and match the general observation from the previous passages. However, it is important to mention that until 2010 Bayern ranked first in the use of trends, measured in trend passages (TP). From 2011 to 2014, Nordrhein-Westfalen took over that position. To be able to draw conclusions based on these results, attention must be paid to the fact that only half of Germany's regions accommodate DAX (German stock index) corporations. These corporations reside in the old part of Germany. From this perspective, it is possible only to draw a conclusion for the economic performance for the regions considered, but not for the overall performance in Germany. In numbers, most of the DAX corporations reside in Nordrhein Westfalen (8 corporation in total), Hessen (8 in total) and Bayern (7 in total). Consequently, the resulting geographical distribution does not surprise. The analysis of the distribution of trends across cities reveals that Munich ranks first in the utilization of trends (in total 104 from 2004 until 2014). Four DAX corporations reside in Munich. Cologne ranks second, with a total of 93 trends, and two DAX corporations that reside in the area. This result is also in line with the regional analysis. However, it is important to point out that trends are used predominantly in Cologne, where two DAX corporations reside, which are the Deutsche Lufthansa AG, and Lanxess AG. According to the results, Wolfsburg, where the Volkswagen AG resides, ranks third in the utilization of trends (29 in total). The other cities are in the range of 0 to 20 trends. Table 27 and Figure 53 - Figure 56 reveal the detailed results.

Conclusion 4: The results of the long-term analysis match the results from the pilot study concerning the distribution of gross domestic product (GDP) and the use of trends.

Table 27: Distribution of trends across cities and regions

Region	City	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
Baden-Württemberg	Heidelberg	2	5	3	3	7	3	6	10	4	9	4	56
Baden-Württemberg	Stuttgart	3	5	5	4	2	2	5	5	8	4	5	48
Baden-Württemberg	Walldorf	4	3	5	1	5	3	5	5	6	16	8	61
Bayern	Herzogenaurach	2	4	3	5	4	4	12	6	4	5	6	55
Bayern	München	26	32	40	33	40	41	44	33	32	35	53	409
Bayern	Neubiberg	2	4	3	2	2	6	5	4	5	4	9	46
Hamburg	Hamburg	2	4	2	4	4	6	4	4	9	12	12	63
Hessen	Bad Homburg	8	8	9	12	14	18	14	16	9	5	8	121
Hessen	Cologne	3	5	6	2	3	3	3	7	3	6	8	49
Hessen	Darmstadt	2	1	1	1	3	1	1	1	7	7	9	34
Hessen	Eschborn	4	4	5	6	3	4	8	5	10	14	7	70
Hessen	Frankfurt am Main	3	3	9	20	12	6	11	13	12	12	19	120
Hessen	Kassel	2	5	5	1	3	4	5	5	5	5	3	43
Niedersachen	Hannover	4	2	3	2	5	7	7	4	13	8	13	68
Niedersachsen	Wolfsburg	7	14	5	11	11	21	12	16	18	13	28	156
Nordrhein-Westfalen	Bonn	19	6	8	11	8	14	16	16	23	17	15	153
Nordrhein-Westfalen	Cologne	1	1	3	1	5	5	12	19	30	30	15	122
Nordrhein-Westfalen	Düsseldorf	3	3	4	6	4	3	8	8	10	13	9	71
Nordrhein-Westfalen	Essen	9	14	8	9	12	7	7	3	4	6	14	93
Nordrhein-Westfalen	Leverkusen	7	7	9	13	9	9	7	8	3	4	14	90
Rheinland-Pfalz	Ludwigshafen	4	1	2	6	13	12	7	6	10	11	14	86
Baden-Württemberg	Heidelberg	2	5	3	3	7	3	6	10	4	9	4	56
Baden-Württemberg	Stuttgart	3	5	5	4	2	2	5	5	8	4	5	48
Baden-Württemberg	Walldorf	4	3	5	1	5	3	5	5	6	16	8	61
Bayern	Herzogenaurach	2	4	3	5	4	4	12	6	4	5	6	55
Bayern	München	26	32	40	33	40	41	44	33	32	35	53	409
Bayern	Neubiberg	2	4	3	2	2	6	5	4	5	4	9	46
Hamburg	Hamburg	2	4	2	4	4	6	4	4	9	12	12	63
Hessen	Bad Homburg	8	8	9	12	14	18	14	16	9	5	8	121
Hessen	Cologne	3	5	6	2	3	3	3	7	3	6	8	49
Total		**117**	**131**	**138**	**153**	**169**	**179**	**199**	**194**	**223**	**236**	**273**	**2012**

Figure 53: Direct trend passages distribution by regions

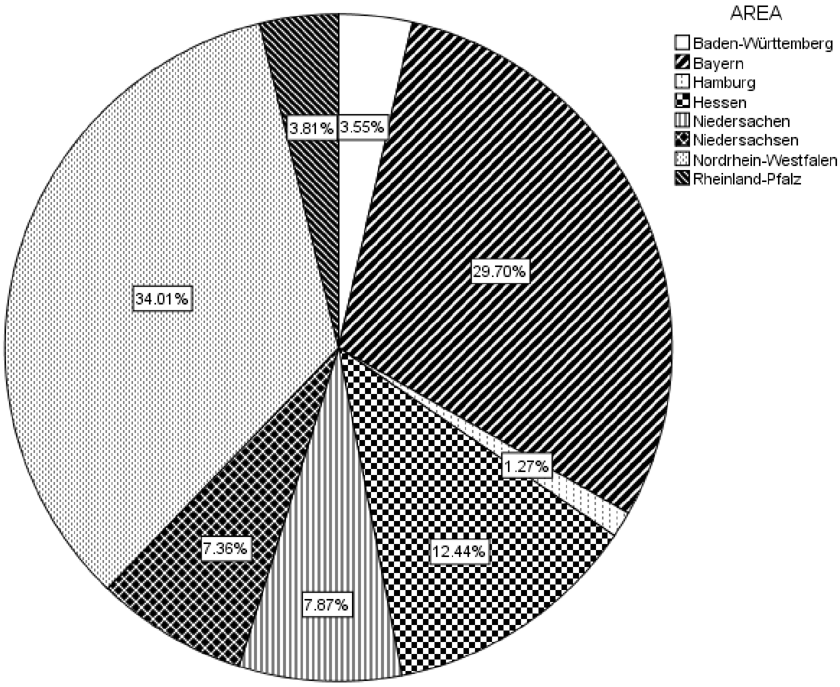


Figure 54: Indirect trend passages distribution by regions

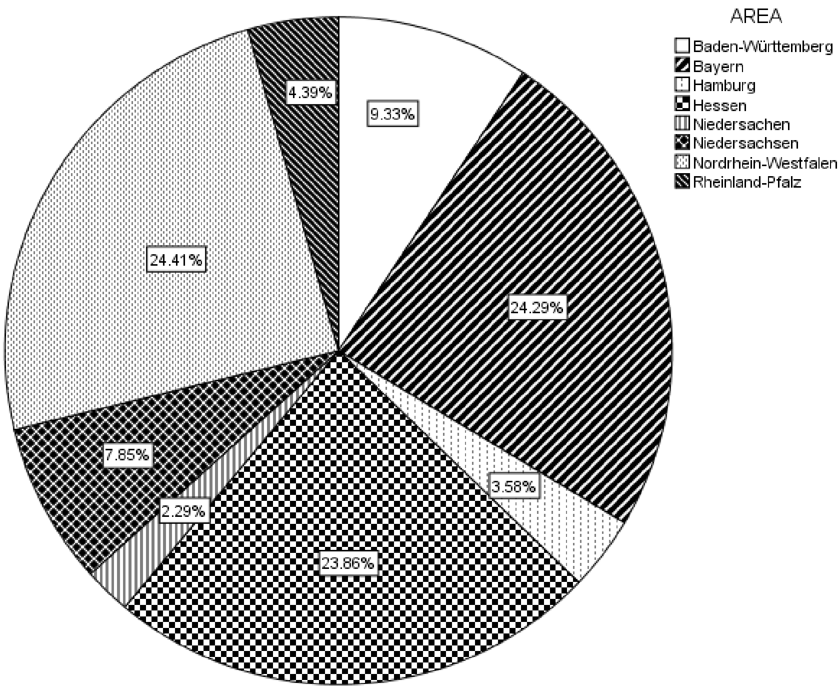


Figure 55: Direct trend passages distribution by cities

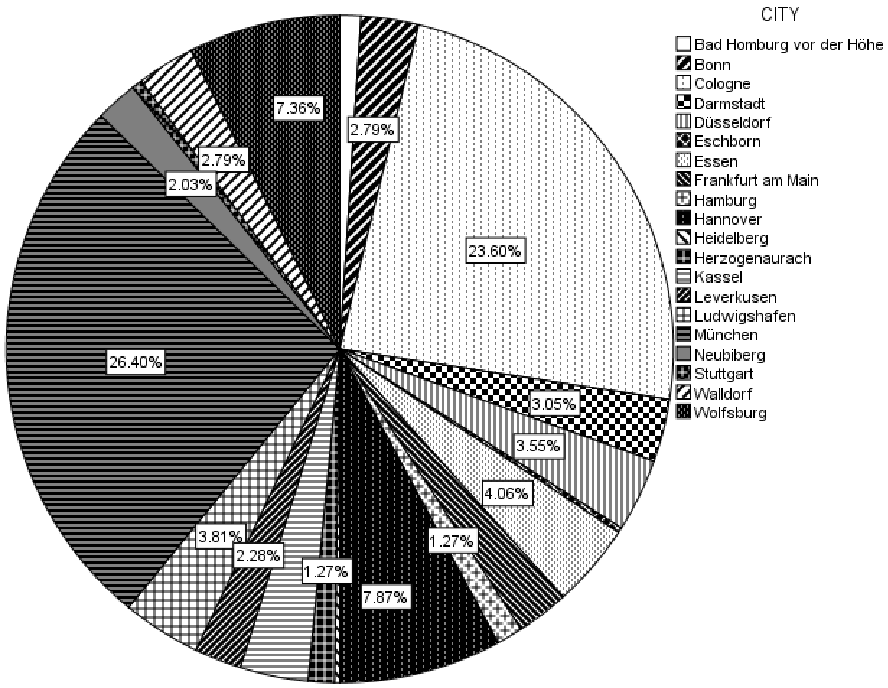
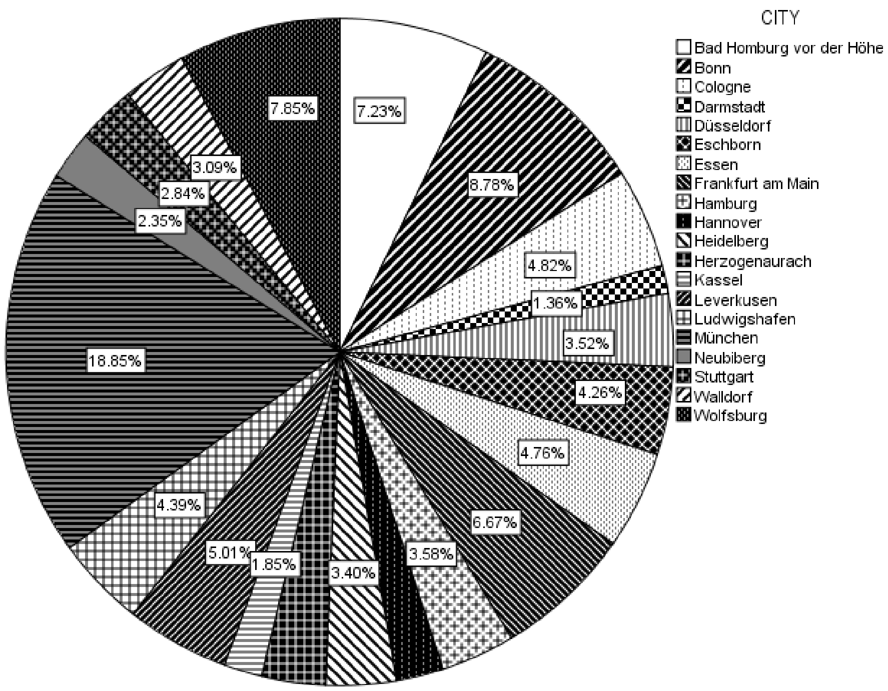


Figure 56: Indirect trend passages distribution by cities



4.1.1.5 Perceived impact of trends to corporation

Another step in the analysis was the evaluation of how corporations perceive the reported trends. In this regard, the main criteria were whether the corporations perceive the trend as a risk or an opportunity to their past, current, or future business operations or to a certain aspect that was reported. Several variables have been implemented, which contain the reported impact to the corporation or the corresponding effect in a verbal description in the variable "INFLUENCE_DESC," and that contain whether the trend is perceived as a threat or opportunity in the variable "INFLUENCE". Table 28 shows how many trends were reported as being a risk or opportunity to the business, and distinguishes whether the trend was labelled directly as a global economic trend (GET) in the period from 2004 until 2014.

Table 28: Direct and indirect TPs reported in the population (n=330)

		INFLUENCE_VALUE		
		Risk	**Opportunity**	**Total**
Indirect TP	count	821	797	1618
	% of Total	40,8%	39,6%	80,4%
Direct TP	count	53	341	394
	% of Total	2,6%	16,9%	19,6%
Total	count	874	1138	2012
	% of Total	43,4%	56,6%	100,0%

The above results reveal that indirect TPs were perceived equally as being a threat or opportunity. Of 2,012 TPs in total, 797 TPs (40%) were reported as opportunity, whereas 821 (41%) were reported as being a risk. On the contrary, the direct TPs have a significant amount of TPs (in total 341, or 17%) that were reported as opportunity. On the contrary, 53 TPs (3%) were reported as risk.

In general, the results in the overall population show that if a corporation directly uses terms like megatrend, GETs, or global trend, then it is more likely that corporations see opportunities for their business. The odds-ratio that a direct TP is perceived as an opportunity in comparison to an indirect TP is $\frac{341}{53} * \frac{821}{797} = 6.63$.

Therefore, the likelihood is 6.63 times higher that a direct TP is perceived as an opportunity in comparison to an indirect TP. On the contrary, it is less likely that a direct TP is perceived as a risk, with an odds ratio of 0.15. These results motivate the chi-square analysis on the total population of trendpassages found in the data (n=2012). The null hypothesis (H_0) is that the variables “DIRECT” and “INDIRECT”, as well as “RISK” and “OPPORTUNITY” are statistically independent from each other. The basic assumption of the chi-square test is the minimum expected cell frequency that has to be five or more. In our case, we have a minimum expected count of 171.15, which does not violate the assumption. The Pearson chi-square coefficient amounts to 179.321 and has an asymptotic significance of $p < .001$. This indicates significance relationship between the parameters, and violates $H_{0.}$

Conclusion 5: The population reveals that directly mentioned TPs are more likely to be depicted as an opportunity, rather than a risk in annual reports with an odds-ratio of 6.63.

4.1.2 Comparative analysis on applied categories

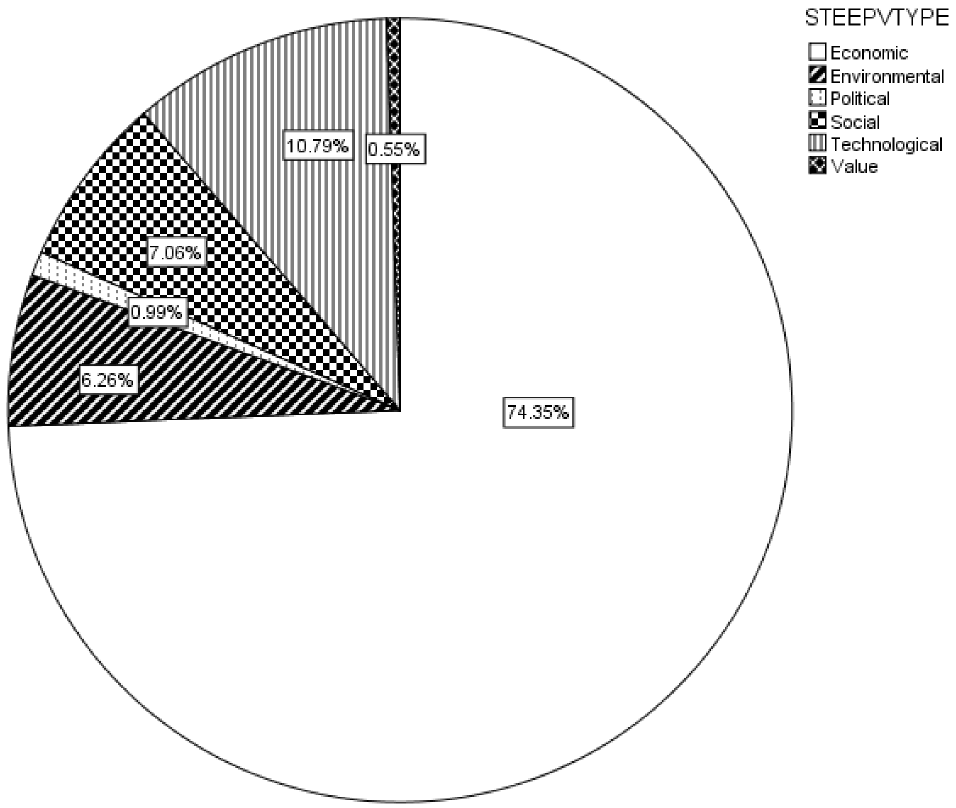
4.1.2.1 Effectiveness and efficiency of STEEPV categorization

A key part of the empirical analysis was the categorization of the extracted trend passages. The categorization follows a deductive as well as an inductive approach. The deductive approach used an existing categorization system called STEEPV, which is an acronym for social, technological, economic, environmental, political, and value. As explained by Meissner (2013, p. 46), this technique is comparable to the methodology of SWOT analysis, which stands for strength, weaknesses, opportunities, and threats. The SWOT method is a form of structured brainstorming that might involve desktop research, workshops, or expert interviews, but is more focused on scenario development. This section provides the results of deductive categorization. Table 29 and Figure 57 show the total distribution of the variable STEEPV in the period from 2004 to 2014.

Table 29: Total STEEPV distribution from 2004 to 2014

STEEPV category	Total amount	Indirect TP	Direct TP
Economic	1,498	1,219	279
Environmental	126	86	40
Political	20	20	14
Social	142	128	54
Technological	217	163	7
Value	11	4	279

Figure 57: Proportional STEEPV distribution from 2004 to 2014



A significant result of the assessment is that the category "Economic" was suitable in most trend passages (TPs) analyzed. With a total amount of 1,498, equaling 74.5%, it outnumbers all other categories. On the contrary, the category "Value" did not suit the analysis well, and only 11 TPs could be identified, equaling a total percentage rate of 0.5%. Hence, this category is negligible. For example, E.ON AG (2013, p. 4) reports that "Cleaner & better energy is the guiding strategic theme for E.ON's transformation from an integrated, primarily European energy utility into a global, specialized provider of energy solutions." This example reveals a change in the value system of the corporation towards new values, which is presented as a transformation process from a European-based company towards a global provider of energy solutions. This example could also be evaluated as economic from the STEEEPV perspective.

Another ambiguous example is presented by ThyssenKrupp AG (2014), which describes that "In addition to internal improvements, the Group's Strategic Way Forward is focused on global growth drivers. In a constantly changing environment we continuously evolve our company in order to meet the global challenge (…)." This example also belongs to the category "Value." However, this example could also be categorized as being "Economic" or "Environmental." From this perspective, it must be stated that an ex-post categorization of STEEPV is problematic. Specifically, the application of the category "Value" is difficult, as many TPs refer to economic impact. This difficulty also explains why most of the categories belong to the "Economic" category.

Another problematic category is the category "Political". Only few TPs mention the regulatory influence of political decision-making. These examples mostly reveal a risk to the current business operations. For example, Bayer presents a political trend in their annual report of 2014 in the context of strategic stakeholder management:

> It is important to approach key social and political players right from the start of a new project and to canvass their support early on and seek open dialogue. The Group has developed a guide to engaging stakeholders in strategic decision-making processes such as investment projects and launching new products. The platform that emerged from this offers tools for identifying social and political trends at an early stage and successfully incorporating them into project planning (Bayer Group, 2014, p. 83).

In this case, political trends are clearly mentioned in the text. Furthermore, the importance to business operations is demonstrated. In addition, social trends are mentioned in the same breath. Therefore, the category "Political" is not distinctively presented. In this regard, the TP was related to both trends. This example is another demonstration of the fact that an ex-post categorization of STEEPV can be ambiguous. On the contrary, the Merck Group presents a textbook example of how to present a political trend. In the annual report of 2011, Merck reports political and regulatory risk as having a negative impact to their business:

> As a global company, Merck faces political and regulatory changes in many countries and markets. In 2011, increasingly restrictive requirements were imposed in the pharmaceutical environment in terms of drug pricing, reimbursement and approval, a trend that can be seen in many countries (Merck Group, 2011, p. 86).

The categories ″Environmental″ (126 TPs in total, or 6.3%), ″Social″ (142 TPs in total, or 7.1%), and ″Technological″ (217 TPs in total, or 10.8%) are more explicit. For example, LANXESS AG (2012) mentions the megatrend "urbanization" as having an effect in the environmental category. LANXESS AG (2012, p. 29) points out that "The urbanization trend is most evident in emerging and developing economies." In the same breath, social developments are mentioned, a trend which requires expert judgement for correct categorization from an ex-post perspective. Continental AG (2009) mentions that "environment" is a megatrend. In the annual report (ARP) of 2009, the corporation (Continental AG, p. 42) reports that "need for environmentally-friendly technologies that focus on low fuel consumption and thus reduce CO2 emissions is increasing rapidly, which makes it a key growth market in the automotive sector." In this case, the company mentions environment directly, and illustrates the effect of CO2 consumption as being a business opportunity for low fuel consumption technologies. Another finding is that the category technology could be applied well to the TPs. Deutsche Telekom AG (2012, p. 140) reports that the approach of open innovation is another lever for successful technological development, as the corporation seeks "for the best ideas and the best brains outside as well as inside the company." Numerous other examples could be identified that mention the technology of innovation directly in the text. Therefore, it has to be pointed out that this category can be applied well from ex-post analysis. An example of the category of "Social" has already been given in this paragraph by Bayer Group (2014). Many other TPs were identified in the texts that mention social trends, which was beneficial for the process of categorization. Each of the TPs that refer to changes in demography, demographic development, ageing population, or that directly mention demographic changes were categorized as "Social." The next aspect of the categorization process was to identify what TPs have a direct and indirect relation to GETs. The following figures show the distribution of STEEPV according to direct and indirect mentioning.

Figure 58: Proportional STEEPV distribution of direct trends

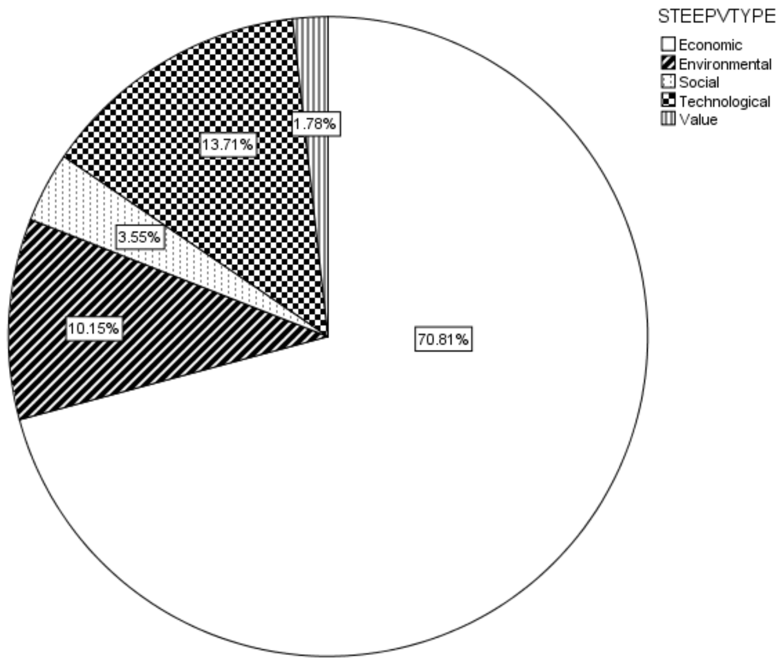
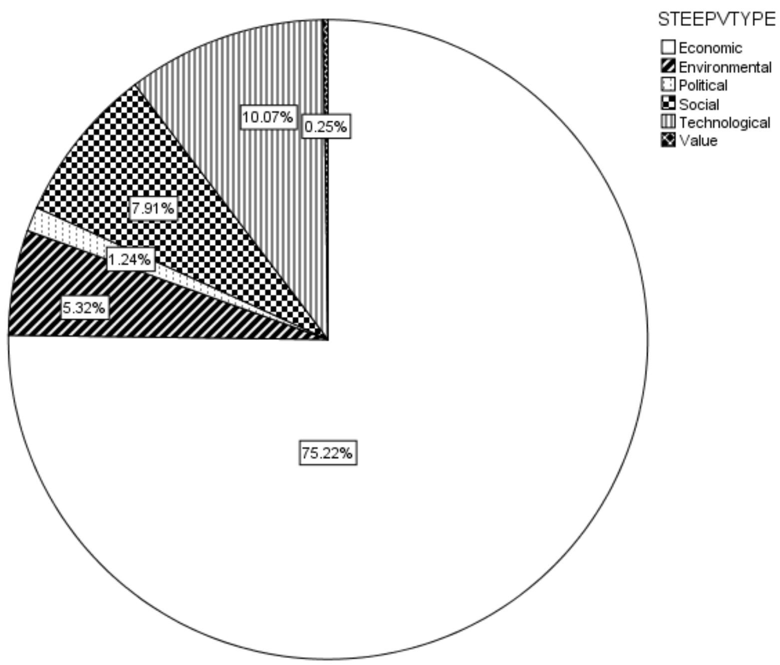


Figure 59: Proportional STEEPV distribution of indirect trends



A comparison of the absolute and the proportional distribution of STEEPV according to direct and indirect TPs reveals that the category "political" is not mentioned in the direct TPs. Furthermore, the STEEPV-category environmental is used more frequently. For example, the annual report of 2009 Siemens reports that climate change is important to business planning and corporate strategy:

> Our Environmental Portfolio may serve as an example of the way we strive to align our business activities with the aforementioned megatrends, in this case climate change. The portfolio contains technologies that reduce impacts on the environment and minimize carbon dioxide emissions responsible for climate change (Siemens AG, 2010, p. 69).

This is a paradigmatic example of a direct mentioning of this trend concerning GETs, in this case megatrends. The annual report of 2005 by Adidas contains an example of an indirect TP that has an ambiguous appeal, which is problematic for the choice of a distinct STEEPV-category:

> In the USA, GDP grew approximately 4% over the year. In the first half of the year, investment activity and private consumption increased strongly. Hurricane Katrina, high oil prices and a less optimistic job market outlook depressed consumer confidence in the third quarter. (…) Nonetheless, domestic demand trended downwards towards the end of the year and slowed overall growth (Adidas Group, 2005, p. 78).

This example mentions the Hurricane Katrina and high oil prices as being problematic to the business performance. In this case, Hurricane Katrina, and high oil prices were considered as belonging to the category ″Environment.″ In the same breath, it could be debated whether this TP might belong to the category ″Economic″ as well. This example furthermore visualizes that the categorization of STEEPV is ambiguous. Another aspect is that most TPs mention the economic effect of GETs. This could be observed in direct and in indirect TPs.

Conclusion 6: The STEEPV categorization system is applicable to the data from an ex-post perspective. The distribution of STEEPV categorization system shows low emphasis on "Political," and "Value" trends. In most cases, the category "Economic" matches the TP best from an expert point of view.

As outlined in Section 4.1.1.1, the use of trends grows annually, which is also valid for the overall utilization of STEEPV categories. However, the question in this context is whether there is a causal relation between the use of the categories by corporations or by annual years. From the cross-sectional data analysis, the following correlations could be observed (see Table 30).

Table 30: Pearson correlation between STEEPV and "Corporation_id"

STEEPV Category	Corporation_id	Significance(p-value)
Social	-.014	.292**
Technological	.118*	.179**
Economical	.077	.130**
Environmental	.071	.189**
Political	-.051	.083
Value	.003	.236**

**p < .001 (1-tailed) *P < .005 (1-tailed)

In the population (N=330) STEEPV categories correlate weakly with annual year, except in the category "Environmental." The only significant relationship between STEEPV and corporations could be found in the category "Technological." As pointed out by Miller (2004, p. 51), this statistically significant association does not mean causation, Even though it provides room for further analysis.

Figure 60: Distribution of STEEPV categories over years

Figure 60 illustrates the results from the correlation analysis and demonstrates the significant relationship between annual years and utilization of the STEEPV category system. Within the population, we can further observe a correlation between the individual STEEPV categories, as demonstrated in Table 31.

Table 31: Pearson product-moment correlations between STEEPV categories

STEEPV-Parameter	1	2	3	4	5	6
1 Social	1					
2 Technological	0.179	1				
3 Economical	0.372*	0.207	1			
4 Environmental	-0.15	0.313*	-0.083	1		
5 Political	0.368*	-0.66	0.122	-0.022	1	
6 Value	0.081	0.042	-0.110	0.302	0.123	1

**p < .001 (1-tailed) *P < .005 (1-tailed)

The Pearson Product-Moment correlation analysis for the complete timeframe of analysis shows only weak inter-correlations between the categories. This result is a good indicator that the overall population has no multicollinearity between the categories. From the longitudinal analysis point of view, the category "Economic" is continuously growing and stresses the dominance of the category within the population. Within individual years, categories correlate randomly from year to year without a real observable pattern. The strongest correlation of categories was found in 2012 between "Economical" and "Social" with Pearson Correlation of .837 (p < .001). In other years, this correlation was not significant. For example in 2007, "Economical" and "Political" correlate with .758 (p < .001).

Conclusion 7: The STEEPV categorization system is applicable to the data from an ex-post perspective. The distribution of the STEEPV categorization system shows low emphasis on "Political" and "Value" trends. Within the population, the category "Economic" matches the TPs best from an expert point of view.

4.1.2.2 Development of the ICS categorization system

The inductive categorization process (ICS) was founded on the same data used for the deductive categorization with the STEEPV (Social, technological, economic, environmental, political, values) model. In qualitative research, the inductive category formulation is an important methodology. The method is founded on the idea that a subset of material is used for category development and then applied and refined throughout the overall material assessment process (Mayring, 2008; Mayring, 2014). The material is processed in multiple steps. With each additional step of processing, the level of abstraction grows and involves reorganizing and combining or translating old into new categories. Mayring (2014) explains that at the first time a category definition is found, a category is created:

> The first time, material fitting the category definition is found, a category has to be constructed. A term or short sentence, which characterizes the material as near as possible (e.g. formulations if possible out of the material) serves as category label (Mayring, 2014, p. 81).

The next item examined can then be checked as to whether it can be subsumed under this category or whether a new category has to be created. In this study, the foundation for the categorization process is based on the whole trend passage as well as the extracted combined trend term that was stored individually in the data field "MYDB.TP_EVALUATION.NAMEDTREND". In the first step of categorization, the extracted trend terms from the trend passages were used to build a first system of categorization that was compared to the results of the STEEPV process. In this step, 780 categories were identified that categorize the total sum of TPs. In this case, the amount of trends found did not qualify for a rational categorization system, as the amount was unreasonably high. However, this result also illustrates the variety of trends that were used in the annual reports. Furthermore, it has to be mentioned that several passages had similar words, like "pension" and "pensions," or "megatrend" and "megatrends." In this case, the singular and the plural form could count for an individual category, and this was corrected by using the singular form in the first review of the data. However, the benefit from the individual extraction of the trend term provided a first overview of what categories could be applied to the material.

Interestingly 13 categories could be identified that categorize 701 trends in total, which amount to 34.8%. Table 32 lays out the topic categories with their respective frequency of occurrence and their percentages.

Table 32: Repeating trends identified for the categorization process

Industry	TPs	Percent
Pension	141	7.0
Economic trend	81	4.0
GDP growth	80	4.0
Megatrend	62	3.1
Global megatrend	55	2.7
Demographic trend	54	2.7
Market trend	52	2.6
Macroeconomic trend	47	2.3
Long-term trend	34	1.7
GET	27	1.3
Future trend	26	1.3
Business trend	21	1.0
Technology trend	21	1.0

The other 65.2% of the total number of identified categories are attributable to 1311 trends. This amounts to 767 categories. Most of these categories occur less than 18 times. In fact, most of the trends, 587 in total, occur once. In conclusion, the naming of the trends is not useful for categorization. Even though, the naming delivers a good foundation for the further inductive process, as the following examples show. A key observation is that "Pensions" is on the first place of the list. This is because annual reports consequently report about trends in pensions. Therefore, pensions are counted as a trend passage. However, this type of TPs was not counted as direct TP. One example out of these categories is "Demographic change," which occurs 18 times in the period of 2004 until 2014.

This category is similar to the category of "Demographic trends," but differs in its labeling. However, the underlying effect of the change of demographics is identical. For example, Siemens AG (2013, p. 31) describes that demographic change in conjunction with "the globalization of good flows and the rapid growth of megacities mean that the global demand is rising." The effect or described result is that the scarcity of resources leads to a higher demand for energy and material utilization. In this case, the adjustments of consumer demands are an opportunity for the corporation's sustainable business development. A similar effect could be observed in the field of healthcare that is labeled "Demographic trend", as shown in Table 32. Fresenius Medical Care AG & Co. KGaA (2012, p. 36) points out that "demographic factors contribute to the continued growth of the dialysis market. These include the ageing population and the rising incidence of diabetes and hypertensions (…)." The illustrated example is again portrayed as a business opportunity.

In addition to the trend values that were extracted from the trend passages and stored in the variable "MYDB.TP_EVALUATION.NAMEDTREND", the impact of the trend was examined for each TP. The outcome of the evaluation process was stored in "MYDB.TP_EVALUATION.INFLUENCE_DESC" as another line item to the evaluation result. In the example of "Demographic change" from Siemens AG (2013), the result or examined impact was "Business planning and risk management," because the trend was reported in conjunction with product development strategies. The other example from Fresenius Medical Care AG & Co. KGaA (2012, p. 36) that refers to demographic change was evaluated as having an effect on "Business planning and risk management." Another example is provided by HeidelbergCement Group (2012, p. 85) with the example of price trends. The HeidelbergCement Group uses this trend to describe further opportunities for the generation of more top-line, or overall gross sales growth, which is another example of a TP that was evaluated as having a positive impact to "Business planning and risk management." In total, 1,136 TPs or 56.4% were examined as having this effect. Another important influence of trends was the influence to "Technology management" (105 in total or 5.2%). For example, Merck Group (2014) reports that technology management plays an important role in their market position. In detail, Merck Group (2014, p. 67) states, "Nearly 4,000 employees around the world work for Merck researching innovations to serve long-term health and technology trends in established and emerging markets as well as in developing countries." In this case, the company referred to their regional human resource strategy, but focused more on technology and innovation. Consequently, the related variable "NAMEDTREND" was set to the value "Technology trend." Table 33 presents the 11 main influences that were attributed to 1,136 TPs.

Table 33: Top inductive categories identified by naming of trends

Industry	Total	Percent
Business planning and risk management	1136	56.4
Technology management	104	5.2
Business planning	82	4.1
Regional business planning	20	1.0
Risk management	16	0.8
Business performance	11	0.5
Innovation	8	0.4
Systematic trend research	8	0.4
Business planning	6	0.3
Rising living standards	6	0.3
Economic shift	5	0.2
Demographic change	4	0.2

In total, 562 different influences were identified. In conclusion, the above information was codified related to the extracted trend passages and served as an additional vehicle for the categorization process. The combination of trend passages in combination with the information was then used for the development of the categorization.

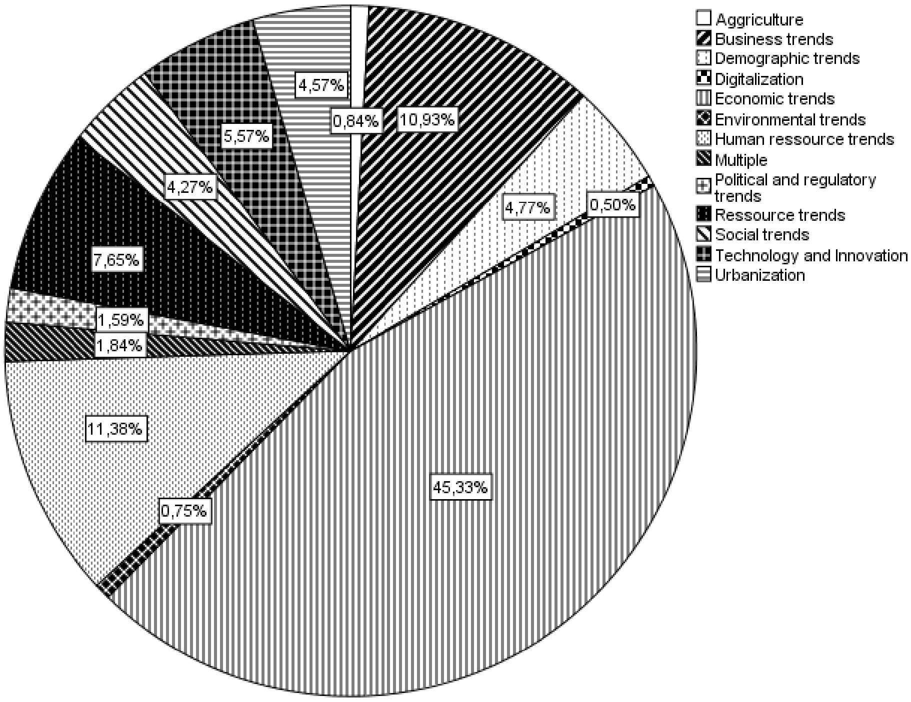
The research question concerning the inductive category "Development" was what type of trends were identified as having an impact on past and future business operations, and are therefore included in the annual reports. The aim of the categorization system should be to be able to describe how corporations perceive trends concerning the impact to their business. The first step of the inductive process was founded on the information presented in the previous section, and included trend passage and the identified trend.

As shown in Chapter 3.3, the aim of this approach was to develop the categories stepwise. The initial information and category system presented in the last section was refined after approximately 50% of the material was reviewed. In this process step, the overall context of the trend passage and its influence was included in the assessment process. In the last step, the information was then finalized. Table 34 and Figure 61 reveal the preliminary inductive categories after step 2.

Table 34: Preliminary inductive category system and distribution

Category	Frequency	Percent
Agriculture	17	0.8
Business trends	220	10.9
Demographic trends	96	4.8
Digitalization	10	0.5
Economic trends	912	45.3
Environmental trends	15	0.7
Human resource trends	229	11.4
Multiple	37	1.8
Political and regulatory trends	32	1.6
Resource trends	154	7.7
Social trends	86	4.3
Technology and Innovation	112	5.6
Urbanization	92	4.6
Total	2012	100.0

Figure 61: Distribution of the preliminary inductive category system

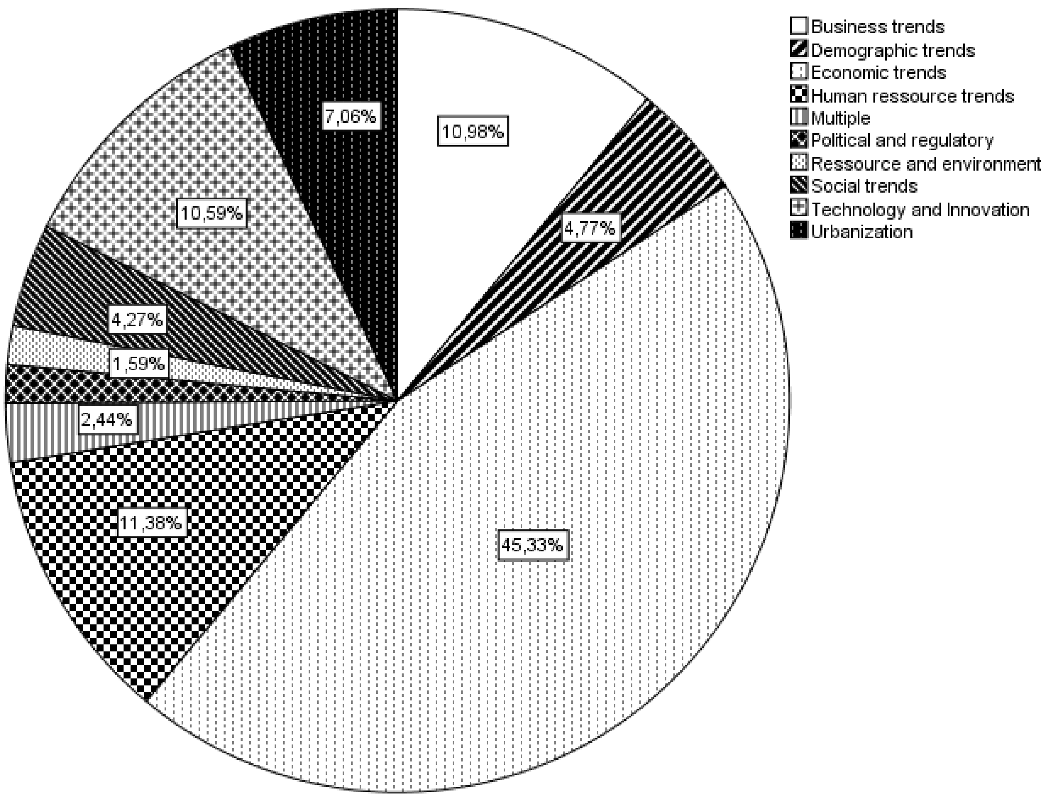


The above distribution reveals 13 categories that build the overall category system. This distribution includes direct as well as indirect TPs, because the differentiation is not important in the first place. According to the overall distribution, the economic trends still rank first place with a total of 912 identified TPs, or 45.3%. In contrast to the STEEPV category utilization, a new category, "Business trends," summarizes all relevant trends that relate to activities like trend research or that described the impact to supply chain operations. For example HeidelbergCement Group (2005, p. 20) reports that it enlarges business operations by geographical diversification. This growth is considered a business operation. Other categories like "Demographic trends" (in total 96, or 4.8%), "Resource trends" (in total 154 or 7.7%), or "Human resource trends" (229 or 11.4%) have to be considered as prominent categories, as these are used very distinctively. "Pension and salaries" is such a representative example of the "Human resource trends" category, as this category is used in nearly every annual report. In 229 examples, the term "trend" was distinctively used in conjunction with the development of pensions and salaries. For example, Deutsche Bank AG (2006, p. 52) reported that the retirement trend is important for the European pension market, and therefore important to their business. For the category resources, BMW Group (2013, p. 25) integrates the oil price trend as a core element of their business strategy. This could also be observed by several other corporations (Cf. e.g. Munich RE Group, 2006; K+S Group, 2006; Lufthansa Group, 2008). The category "Multiple" contains TPs that mention multiple trends in the same passage. Munich RE Group (2005, p. 15) reports demographic and technological trends as having an enormous impact to healthcare costs. Therefore, this type of category emphasizes that a TP contains multiple terms. On the contrary, other categories have been found that were not used frequently, but were integrated into the reporting. Such examples were "Agriculture" (17 in total, or 0.8%), "Environmental trends" (15 in total, or 0.7%), or "Digitalization" (10 in total, or 0.5%). From the point of analysis, "Agriculture" would be integrated into "Resource trends" as well as "Environmental trends." "Digitalization" would be integrated into technology and innovation. Consequently, the final category system is presented in Table 35 and Figure 62.

Table 35: Finalized inductive category system

Trendpassage	Frequency	Percent
Business trends	221	11.0
Demographic trends	96	4.8
Economic trends	912	45.3
Human resource trends	229	11.4
Multiple	49	2.4
Political and regulatory	32	1.6
Resource and environment	32	1.6
Social trends	86	4.3
Technology and innovation	213	10.6
Urbanization	142	7.1

Figure 62: Distribution of the finalized category system



In total, the finalized category system contains nine individual categories, and one category that is a combination of the other categories, called "Multiple." The distribution of the individual categories and the development process was discussed above. The following passage describes criteria of the individual categories. In this case, the relevant and required content of the TP is illustrated. Furthermore, Table 36 illustrates the overall category requirements that could be applied to other studies.

Conclusion 8: The individual trends found in annual reports qualify as a foundation to develop an individual categorization system. The ICS-finalized category system contains nine individual categories for expert analysis.

Table 36: Inductive category definitions

1. Economic trends

Category description: TP describes an economic impact to e.g. business operations, corporate strategy, competitiveness, or market conditions. The impact stems from global, nation, regional, or local markets, or from general macroeconomic conditions like GDP growth. Corporations integrate this effect and the measure or countermeasure into the dedicated TP, by mentioning e.g. Portfolio decision (Commerzbank AG, 2013), Regional business planning (BASF SE, 2010), or Business planning and risk management (Henkel AG & Co. KGaA, 2013).

Examples for trends mentioned in TPs: Banking trends (Commerzbank AG, 2014), Capital market trends (Deutsche Telekom AG, 2013), Competitor trends (Deutsche Bank AG, 2010), Dynamic globalization trends (Deutsche Bank AG, 2006), Economic trend (Deutsche Post AG, 2008), Emerging market (Adidas AG, 2006), GDP trends (Fresenius SE, 2006), Global challenges (Bayer AG, 2013), Global megatrends (K+S AG, 2010), Long-term trends (Allianz SE, 2014), Macroeconomic trends (Beiersdorf AG, 2012), Global macroeconomic trends (Deutsche Post AG, 2012), Future GETs (Volkswagen AG, 2012).

2.Business trends

Category description: TP mentions countermeasures to changes in the business environment that require (environmental) scanning, opportunities and risk management, or stakeholder management. Examples are Business and strategy trends (SAP SE, 2008), Business model (Deutsche Börse AG, 2005), Business trend (HeidelbergCement AG, 2004; Bayer AG, 2008; Continental AG, 2006), Changing trends (Adidas AG, 2009), Claims trend (Allianz SE, 2010), Complexity in supply chains (Deutsche Post AG, 2013), Cost trends (Deutsche Börse AG, 2010), Decentralization trend (RWE AG, 2014), or Future business trends (SAP SE, 2013).

Examples for trends mentioned in TPs: Strategic trends (Fresenius SE, 2014), Predictive analysis (SAP SE, 2013), Strategic risk monitoring (Allianz SE, 2005), Claims performance (Allianz SE, 2013), Risk modelling (Allianz SE, 2014), Influence to product development (Adidas AG, 2013), Changes in the risk landscape (Allianz SE, 2011), Change in business transactions (K+S AG, 2005), Business planning and risk management (Commerzbank AG, 2008), Business planning and risk management (Munich RE AG, 2006), Development of strategies (Allianz SE, 2007), Future development trends (Deutsche Börse AG, 2013), Risk assessment (Allianz SE, 2012).

3.Resource and environment trend

Category description: When TPs mention the impact of resources markets to business, or climate and environmental problems then this category is considered. E.g. Climate change and industrialization (LANXESS AG, 2012), or Waste trend (K+S AG, 2006): "Market environment Competition over the underground disposal of hazardous materials further intensified last year as a result of a fourth underground waste disposal site going into operation in Germany."

Examples for trends mentioned in TPs: Examples for trends are Agricultural megatrend (LANXESS AG, 2012), Megatrend climate change (Siemens AG, 2014), Environmental megatrend (Continental AG, 2013), Waste trend (K+S AG, 2006), Environment megatrend (Continental AG, 2010), and Global warming (Munich RE AG, 2004).

4.Demographic trends

Category description: TP mentions the effect of demographic change, or the ageing of the population as a driver for business development, such as Medical care demand (Fresenius SE, 2013), Regional business planning (Allianz SE, 2013), or Business planning (Allianz SE, 2014).

Examples for trends mentioned in TPs: Demographic development (Deutsche Lufthansa AG, 2014), Demographic trends (Fresenius Medical Care AG, 2013), Megatrends growing population (K+S AG, 2012), Megatrends growing world population (K+S AG, 2014), Long-term demographic trends (LANXESS AG, 2012), Ageing society (Allianz SE, 2006), Life expectancy (Allianz SE, 2006), Life expectations (Allianz SE, 2009), Demographic trend (Allianz SE, 2011), Growing population (K+S AG, 2008), or Demographic change (Munich RE AG, 2006), Global demographic trends (Allianz SE, 2013), and Mortality trends (Allianz SE, 2013).

5. Human resource trends

Description: Developments in Human resource management are mentioned as key trends in the TP. E.g. Salaries and Pensions, or Workforce management are mentioned as key trends for Business planning and risk management (Deutsche Börse AG, 2013).

Examples for trends mentioned in TPs: Career trends (Commerzbank AG, 2014), Salary and pension trends (Merck KGaA, 2012), Payroll trends (Volkswagen AG, 2014), Megatrend workplace trends (Beiersdorf AG, 2012), Pension risks (Beiersdorf AG, 2012), Salary trends (Deutsche Börse AG, 2012), and Teamwork trends (Deutsche Telekom AG, 2004).

6.Urbanization

Description: The development of megacities, and the continuous demand for housing in emerging economies are at the core of the TP. Business development is mentioned consequently.

Examples for trends mentioned in TPs: Urbanization (BASF SE, 2014), GETs (Volkswagen AG, 2014), Megacities and mobility (Infineon), Megatrend urbanization (LANXESS AG, 2012), and Global trends of urbanization, Increasing mobility and more (ThyssenKrupp AG, 2013)

7.Social trends

Description: Cultural and social developments that have an effect to the development of the business are mentioned in this TP. For example, Bayer (2014, p. 83) mentions that as "identifying social and political trends at an early stage and successfully incorporating them into projects (…)".

Examples for trends mentioned in TPs: Social trends (K+S AG, 2014), Social and economic megatrends (Deutsche Lufthansa AG, 2013), and Social networking (Infineon Technologies AG, 2012).

8.Political and regulatory trends

Description: TPs mention political and regulatory trends as being a risk or an opportunity to business operations. Such risks could be geopolitical risks such as the Ukraine crisis, as reported by the Deutsche Bank AG (2014). Other examples are the regulatory demand in pharmaceutical business, or in the banking business that require changes in business operations and impact risk mitigation measures.

Examples for trends mentioned in TPs: Trends in economic and regulatory environment (Bayer AG, 2007), Regulatory trend (Deutsche Börse AG, 2005), Regulatory risks and destabilized economic systems (Merck KGaA, 2011), Regulatory trends (Commerzbank AG, 2014), Macroeconomic political and social trends (Adidas AG, 2008), Political trends (Bayer AG, 2014), Regulatory and political risk (RWE AG, 2011), Monetary policies (Deutsche Bank AG, 2014), and Political and regional trends (LANXESS AG, 2014).

9.Technology and innovation

Category description: Measures of Technology and innovation are at the heart of the TP, and are often depicted as a core competency, or as a relevant measure for business success, e.g. Technology management (Deutsche Telekom AG, 2007). Trends are mentioned as the driver for innovation, or technology excellence.

Examples for trends mentioned in TPs: Digital technology trend (Deutsche Telekom AG, 2012), Open innovation (Deutsche Telekom AG, 2012), Telecommunication trends (Deutsche Telekom AG, 2014), Megatrend digitalization (E.ON SE, 2014), Innovations (Henkel AG & Co. KGaA, 2012), Technological Innovation (Fresenius Medical Care AG, 2011), Product trends (Fresenius SE, 2004), Research trends (Fresenius SE, 2005), Technological trends (Fresenius SE, 2006), Innovation (Beiersdorf AG, 2007), Innovation (Beiersdorf AG, 2011), Technology trends (BMW AG, 2011), Innovation (Continental AG, 2006), Megatrend information (Continental AG, 2009), Megatrends and innovation (Continental AG, 2010), Trends in innovation (Daimler AG, 2004), Innovation and technology (Daimler AG, 2005), Technology trends (Daimler AG, 2006), and Development trends (Daimler AG, 2007).

4.1.2.3 *Analysis of inductive category sstem (ICS)*

This sub-section discusses the use of inductive categorization system (ICS) in comparison to the STEEPV (Social, technological, economic, environmental, political, values) system. The collected data for ICS reveal that the category “Business trends” is mostly applied by the corporations Allianz SE (21) and HeidelbergCement AG (19). Munich RE AG and Allianz used “Demographic trends” most. Deutsche Post AG (62) is leading in the category “Economic trends,” followed by BASF SE (45) and Deutsche Bank (43). “Human resource trends” were important to Munich RE (22), and Continental AG (19). Lanxess AG was leading in the category of “Political and regulatory trends” (5), as well as in the categories “Social” (20), “Urbanization,” (24) “Resource” and ”Environment” (10). Leading in the category “Technology and innovation” are Bayer AG (19 TPs in total) and Volkswagen AG (19 in total). TPs with multiple trends mentioned were mainly found from the corporations Fresenius Medical Care AG (7) and Beiersdorf AG (4).

As explained by Eckstein (2012, p. 157), chi-square goodness-of-fit test validates based on a predetermined confidence level, if two categorical variables are statistically independent. The chi-square value has to be calculated based on the following equation.

Equation 14: Chi Square

$$\chi^2 = \sum_{i=1}^{I} \sum_{j=1}^{J} \frac{(n_{ij} - e_{ij})^2}{e_{ij}} \tag{14}$$

n	Observations
e	Parameter
χ^2	Chi-Square

The test was used to evaluate the relation between the variable ICS (inductive category system) and corporation_id. The null hypothesis H_0, assumes that the category ICS trend categories does not depend on a specific corporation. As explained by Backhaus (2006, p. 369), the chi-square (χ^2) is distributed approximatively with (I - 1)(J – 1) degrees of freedom under the null hypothesis. If the statistics exceeds a value of the distribution, then the null hypothesis has to be rejected, which automatically implies that the analyzed traits, groups, or in our case categorical variables are interrelated.

For the chi-square (χ^2) a value of 1057.689 was calculated, and the degrees of freedom amount to 261. With a significance of a = 0.05 and confidence level of 95% (1- 0.05=0.95) the χ^2 confidence value amounts to 224.5904. Consequently, H_0 has to be rejected with 1057.689 > 224.5904. χ^2 reveals the statistical dependency of variables, but is not able to provide information about the strength of the relation (Backhaus, 2006). This information was provided by the phi-coefficient, as depicted below.

Equation 15: Phi Coefficient

$$\Phi = \sqrt{\frac{\chi^2}{n}} \tag{15}$$

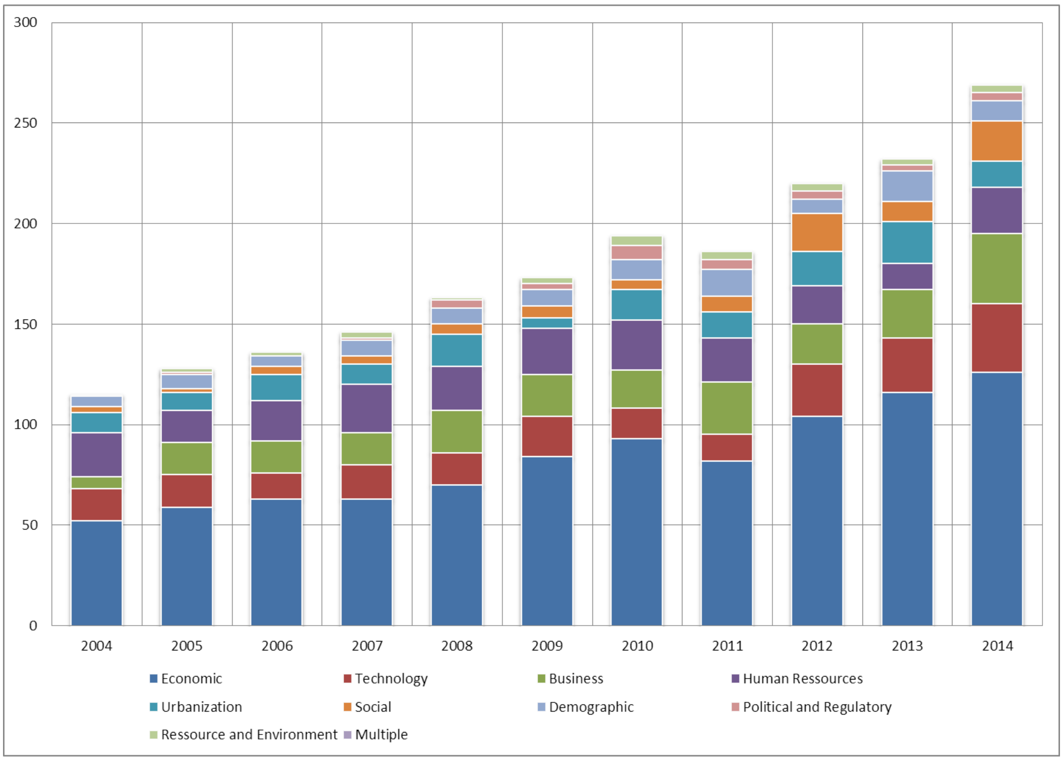
n	Testobject
Φ	Phi-Coefficient
χ^2	Teststatistics

The symmetrical analysis showed that corporations and categories associate each other, with an approximated significance or p-value of < 0.001 and Φ of .725 (Backhaus, 2006).

Conclusion 9: The frequency of specific ICS categories applied to the population depends on individual corporations. The association between the variables "ICS_Category" and "CORPORATION_ID" is moderate.

In the next step, the relation between the ICS and the annual year is analyzed in more detail. Now, as a null hypothesis it was assumed that the annual year does not influence the use of ICS categories. Before the results of the chi-square analysis are discussed, the aggregated view of ICS distributed annually is outlined (see Figure 63). In Figure 63, an overall trend towards more use of the ICS category "Economic" can be observed. This trend matches the observations of the STEEPV category analysis. However, the growth of the ICS category "Economic" is only moderate in comparison to the STEEPV system. From the visual perspective, the distribution of the categories seems to be more even, which is an indicator that the application of ICS categories does not depend on the annual year. This is a qualitative surplus of the ICS system in comparison to the STEEPV system. To further support the above argument, a chi-square analysis was performed.

Figure 63: Annual distribution of inductive categories



We assumed as a null hypothesis, H_0, that the annual year has no significant correlation with the variable "ICS_CATEGORY". For the chi-square (χ^2) a value of 107.304 was calculated, and the degrees of freedom amount to 99. With a significance of a = 0.05 and confidence level of 95% (1- 0.05=0.95) the χ^2 confidence value amounts to 77.0463. Consequently, H_0 has to be rejected with 107.304 > 77.0463. Only a weak association between the variables could be observed (phi of 0.231), which is not significant in the overall population. Therefore, the annual year has no significant influence on the application of ICS.

Conclusion 10: The ICS categories are distributed equally in the total population. In comparison to STEEPV, the category system does not depend on the annual year.

4.2 CRI IN THE CONTEXT OF ECONOMIC AND WEB-BASED INDICATORS

4.2.1 Regional analysis on web searches and tps

4.2.1.1 Regional analysis of trend responses

Google Trends data combine web search information with geographical information about which regions and cities have requested which keywords via the Google search engine. For each requested trend, the geographical data are provided in absolute index (0 to 100) that was ratio scaled in relation to regions and cities identified in the data. The result was returned for the period from 2004 to 2015. To be able to test the explanatory capacity of the data, an individual index called regional index (RI) was developed that aggregated the results on the level of regions and cities, as demonstrated below.

Equation 16: Aggregation of Regional Index per region or city

$$RI_{Region/City} = \sum_{n=1}^{Total\,Trends} RI_{Region/City}\,(TDS(n)) \tag{16}$$

The variable TDS represents the dataset with geographical information. For each region or city, a total aggregated value was calculated based on the individual entries found in each dataset of $RI_{Region/City}\,(TDS(n))$. The operation was performed for all resulting trends found. Each trend term was queried two times from the GoogleTrend database. First, data was queried without a regional constrains, and then with the regional setting to Germany. The results were one RI called "global RI" that contained the results of all countries and cities across the world, and one RI that represents the results from Germany called "local RI". These indices served to visualize the information geographically to identify if the data is useful in a different context, and to reveal if the data has explanatory capacity Keller explains that the accuracy of future events that have been materialized as an index called future factors, depends on national, regional, and global geographical aspects (Keller et al., 2015).

RI represents the geographical websearch results of regions and cities that show interest in global economic trend terms contained in annual reports. This data was integrated into an existing visualization package. As a geographical information platform, the software package "googleVis" that is implemented in R has been used. Gohil (2015) provides an idea of how to implement this package into R. This package uses an existing software package provided by Google Maps to display a map of a country, continent or region. In addition, other solutions are applicable for the implementation of MAP, such as "openstreetmap", or a geographical information system (GIS) or foresight support system (FSS). Keller et al. (2015, p. 6) identified five requirements or dimensions for a FSS, incorporating the information, collaboration, incentivization, system integrity, and support. Therefore, this solution contributes to the first dimension of FSS, which is information.

The aggregation process has been done on the level of countries (represented in Figure 64), local regions (shown in Figure 84), and cities (mapped in Figure 65 and Figure 66). Google Trends data was queried for each trend with a regional restriction to Germany (Figure 66 and Figure 67), and without a regional restriction (Figure 64 and Figure 65). Therefore, it was possible to create geographical data on the regional scale that cover only Germany, as well as on the global scale. The results are depicted in Figure 64 - Figure 67.

The intensity of the regional index is demonstrated by color shading as depicted in each of the map legends. RI indicates the interest of regions and cities that actively searched the web for trend terms that were included in the annual reports of the DAX (stock market index) corporations.

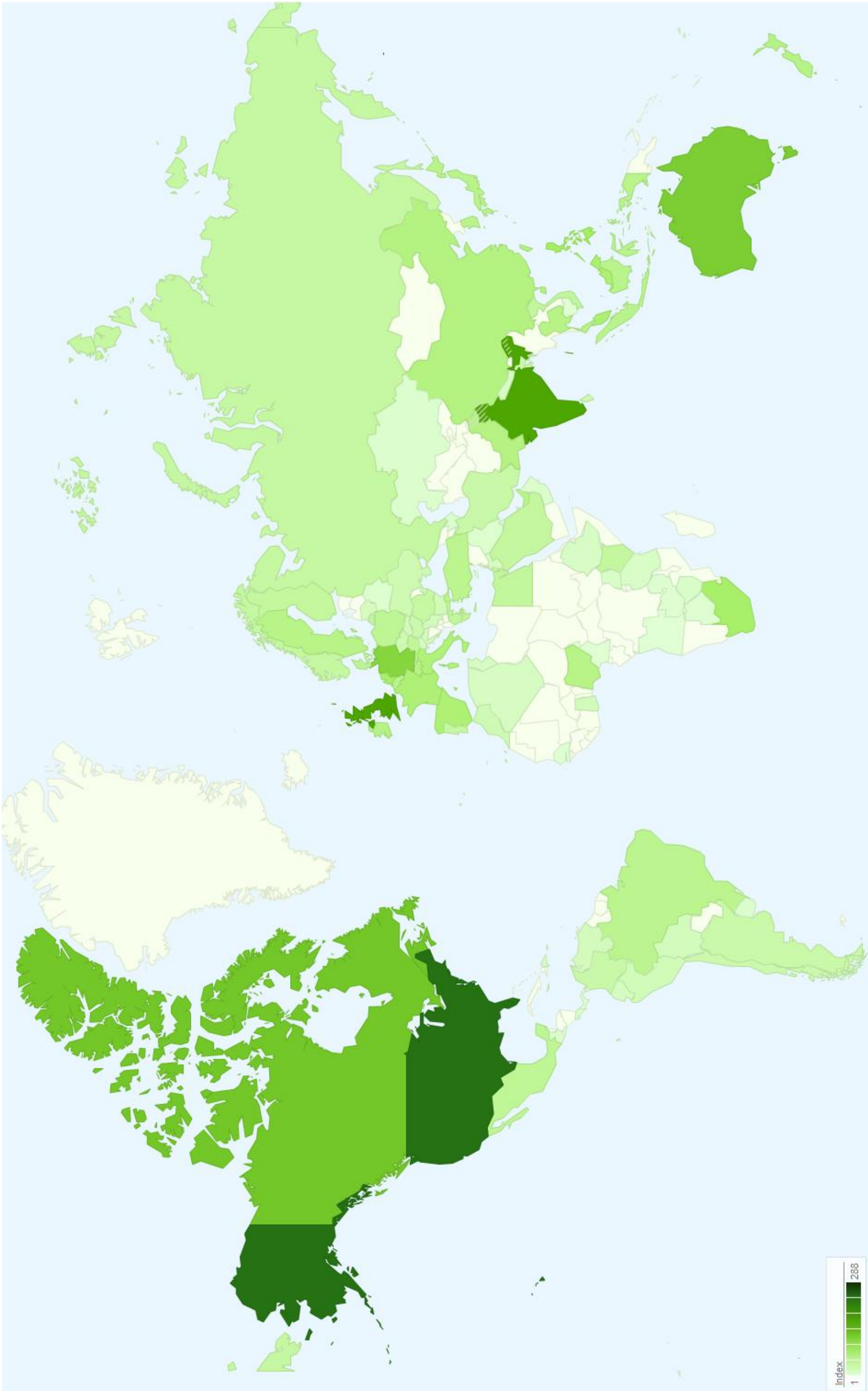


Figure 64: RI index visualized for regions (global dataset)

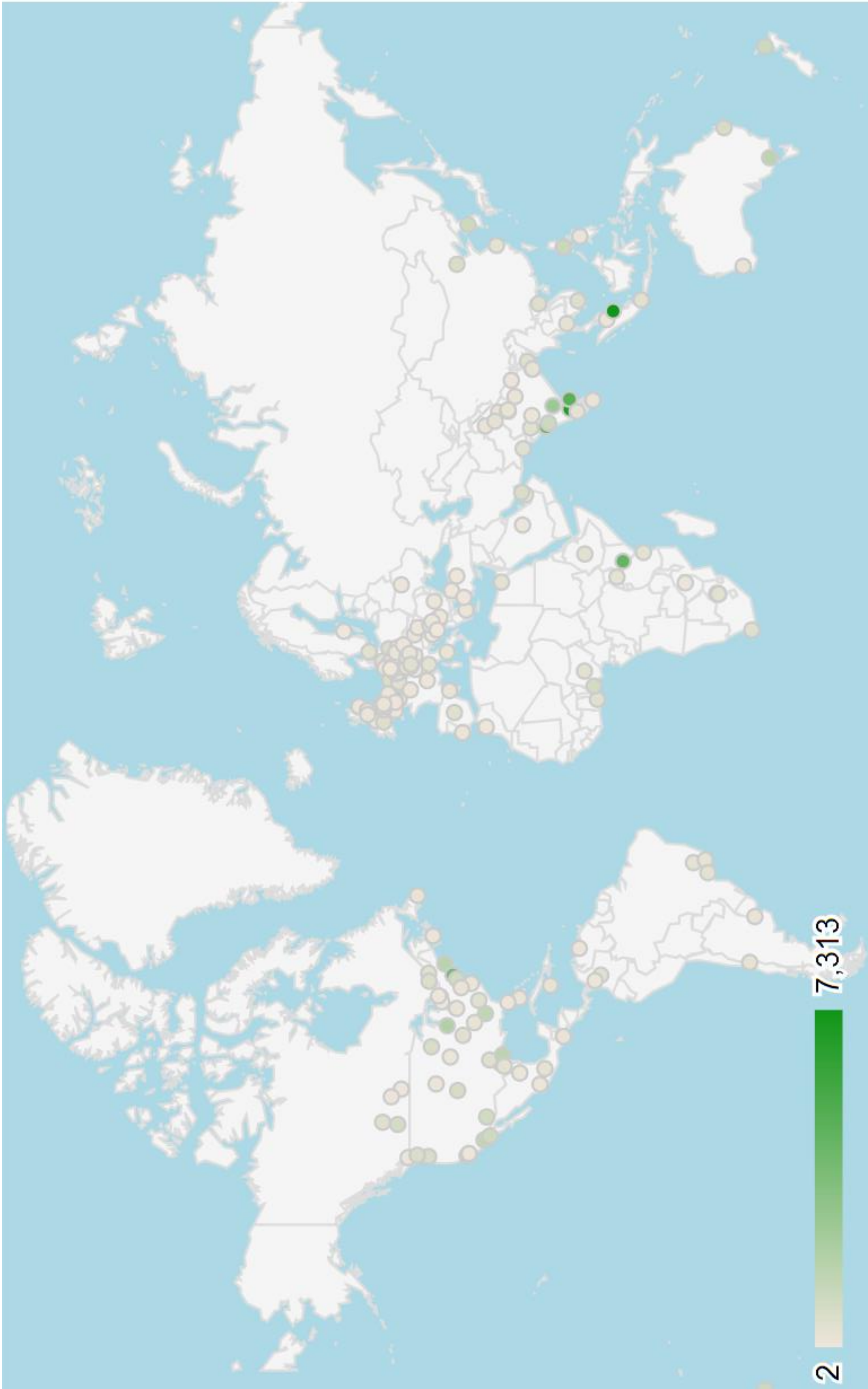


Figure 65: RI index for cities (global dataset)

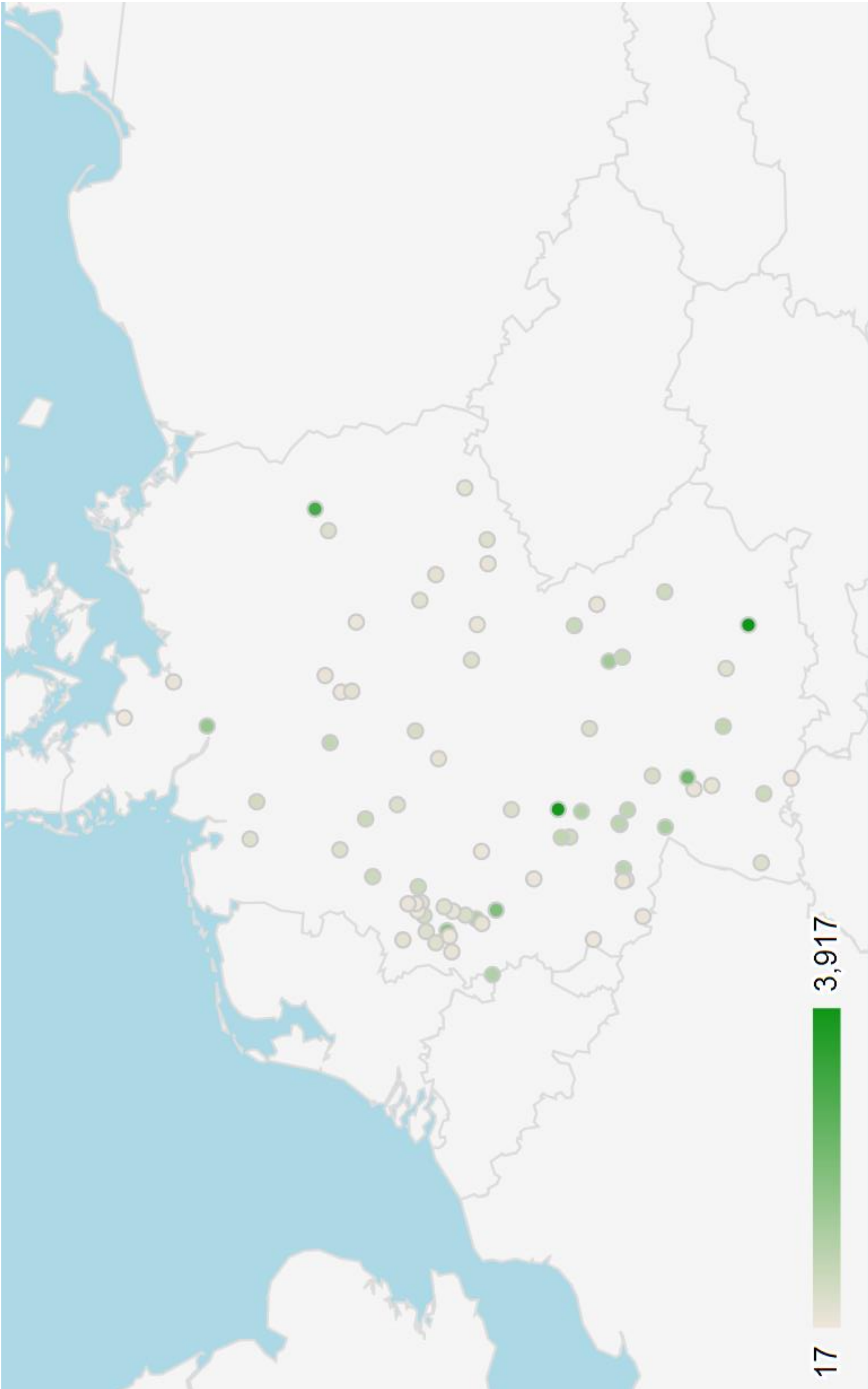


Figure 66: RI index for cities (local dataset)

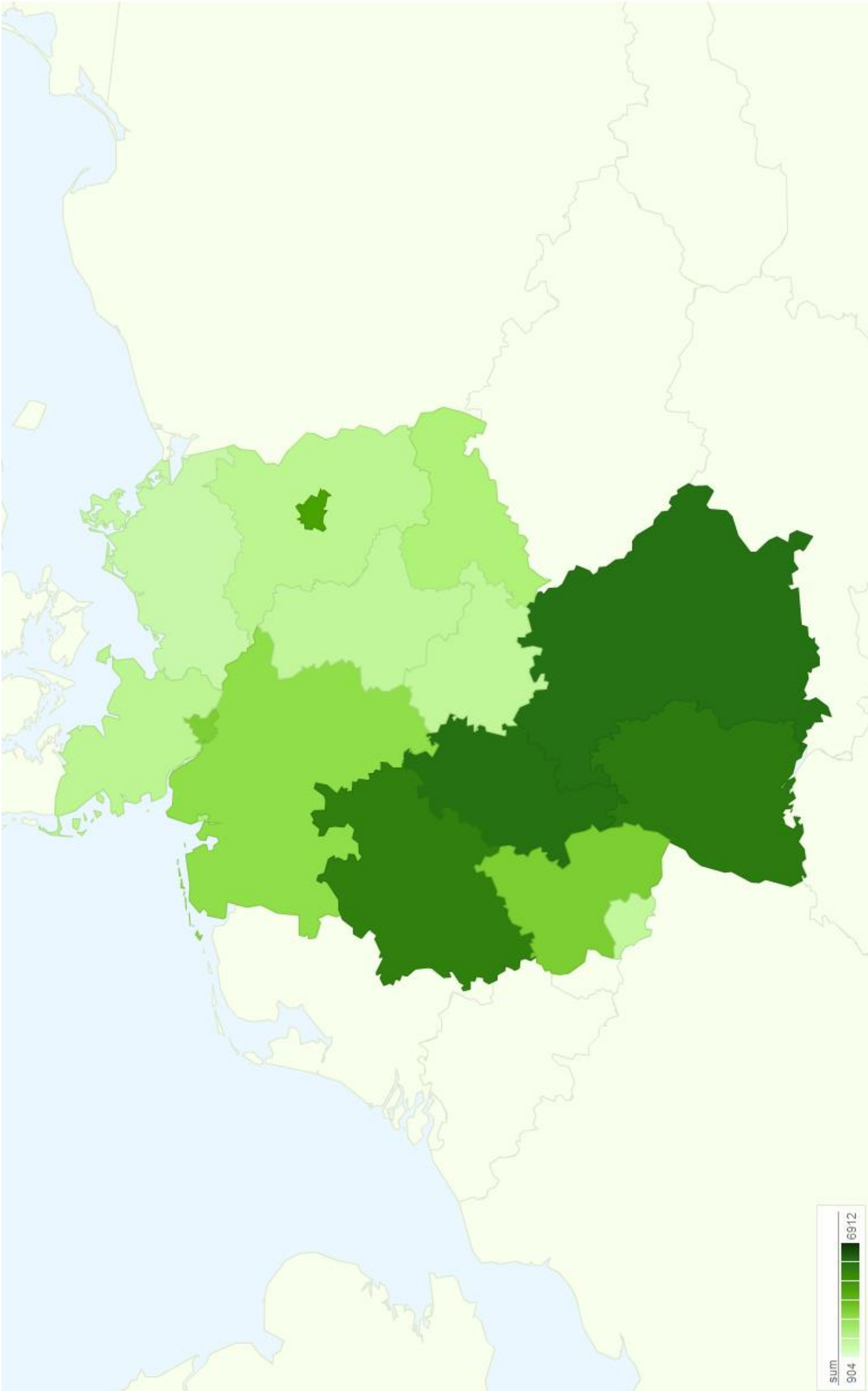


Figure 67: RI index for regions (local dataset)

The resulting RI (regional index) of the countries divides the overall results into three different classes, high, medium and low. The first class, with a high regional indicator (RI), contains countries where English is the first language, like the United States, Great Britain, Canada, or Australia. This finding illustrates also that these countries show the strongest interest in the trends mentioned in the annual reports (ARPs) of DAX (German stock index) corporations. The second-class, which is medium, contains countries like Germany, China, Switzerland, Singapore and Brazil. Surprisingly, the Philippines, Nigeria, Malaysia, Kenya, Pakistan, Spain, and the United Arab Emirates also belong to this group. Furthermore, all countries with an RI index above 1.000 could be considered to belong to this group. The last class, low, contains countries with an RI index below 1.000. Countries like Greece, Finland, Czech Republic, Poland, Argentina, Turkey, and Russia belong to this group.

Another important observation that was made on the regional level is that data acquired from Google reports the "Canton of Schaffhausen" to be a region of Germany. The "Canton of Schaffhausen" is located in the north of Switzerland. These data have to be eliminated from the original dataset. Researchers and practitioners that want to use the regional data from Google Trends need to verify the data.

This motivates to analyze the explanatory capacity of the RI indices. As demonstrated in the preliminary study, the information acquired seem to allow concluding on economic conditions such as the gross domestic product per capita (GDPpc) or the innovative capability of a certain region. In the succeeding passages, this assumption is discussed in-depth.

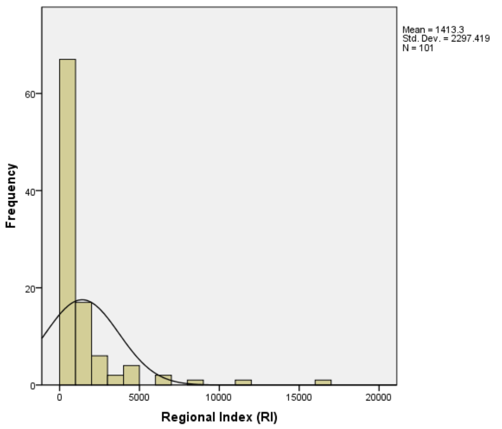
Conclusion 11: The regional indicator (RI) reveals that web searches for trends used in annual reports of German DAX corporations also occur outside of Germany.

4.2.1.2 Correlation between global RI index and GDP

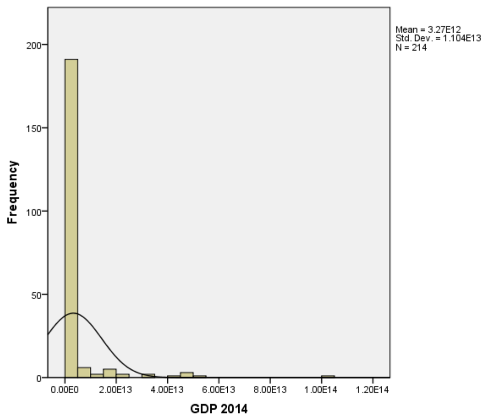
The last passage revealed that the global regional index (RI) gives the optical impression that web searches for trends used in annual reports activity occur especially in economic developed regions and cities. This passages discussed the relationship of the global regional index (RI) and (1) the gross domestic product (GDP) at purchaser's prices, and (2) RI to the gross domestic product per capita (GDPpc) by statistical correlation analysis. Figure 68 contains four histograms that illustrate the distribution of the variables.

Figure 68: Histograms of global RI and macroeconomic indices

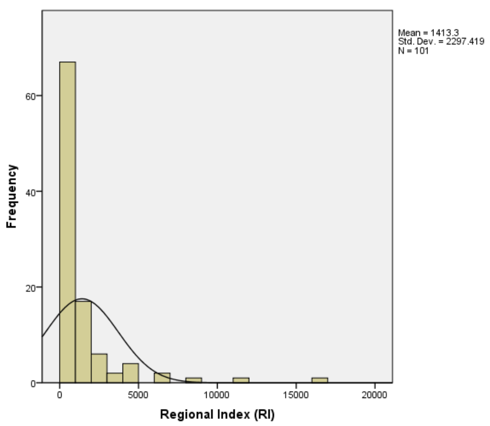
Global GDP per Capita 2014 (World Bank data)



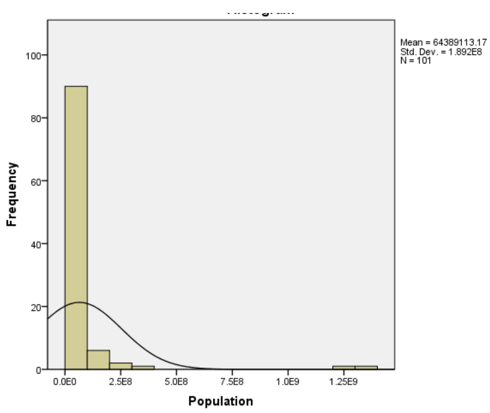
Global GDP at purchaser's prices 2014 (World Bank data)



Regional Index(RI)



Population



All variables, GDP per Capita, GDP at purchaser's price, the RI index, and the population are right-skewed distributions. The mean values of GDP and RI lie to the right of the mode of the distribution. This indicates a non-linear relationship between the variables, which requires a logarithmic transformation of the variables before further analysis is conducted. In the next step, it is tested if the global RI index has the explanatory capacity to explain the indices GDP and GDPpc.

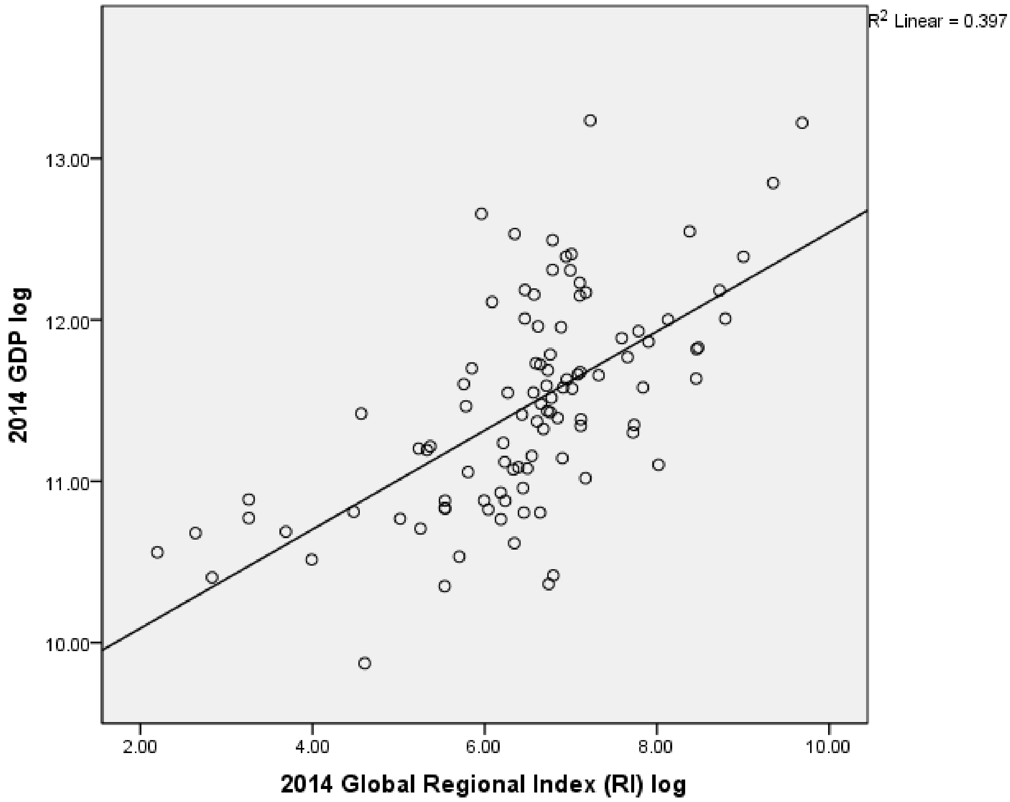
As other researchers have pointed out, web search data for future oriented search terms shows correlation with GDPpc. Preis et al. (2012) created an individual indicator based on the web search information and have revealed the correlation. In other words, the results of Preis et al. (2012) who have shown the relation between interest into future topics materialized in Google Searches and GDPpc This information should be incorporated into this discussion.

On the one hand, the data utilized represents megatrends, which are a topic from the field of foresighting. Therefore, the context of web search queries is comparable. In this case, the quality of the indicator RI should be tested. On the other hand, RI indicates in which regions and cities web searches for megatrends occur, which is an indicator for industrial activity. In this context, the indicator gives a qualitative validation if regions show in interest in the same megatrends that are publicized by German multinational corporations (MNE).

1. **Correlation between global RI index and GDP 2014**

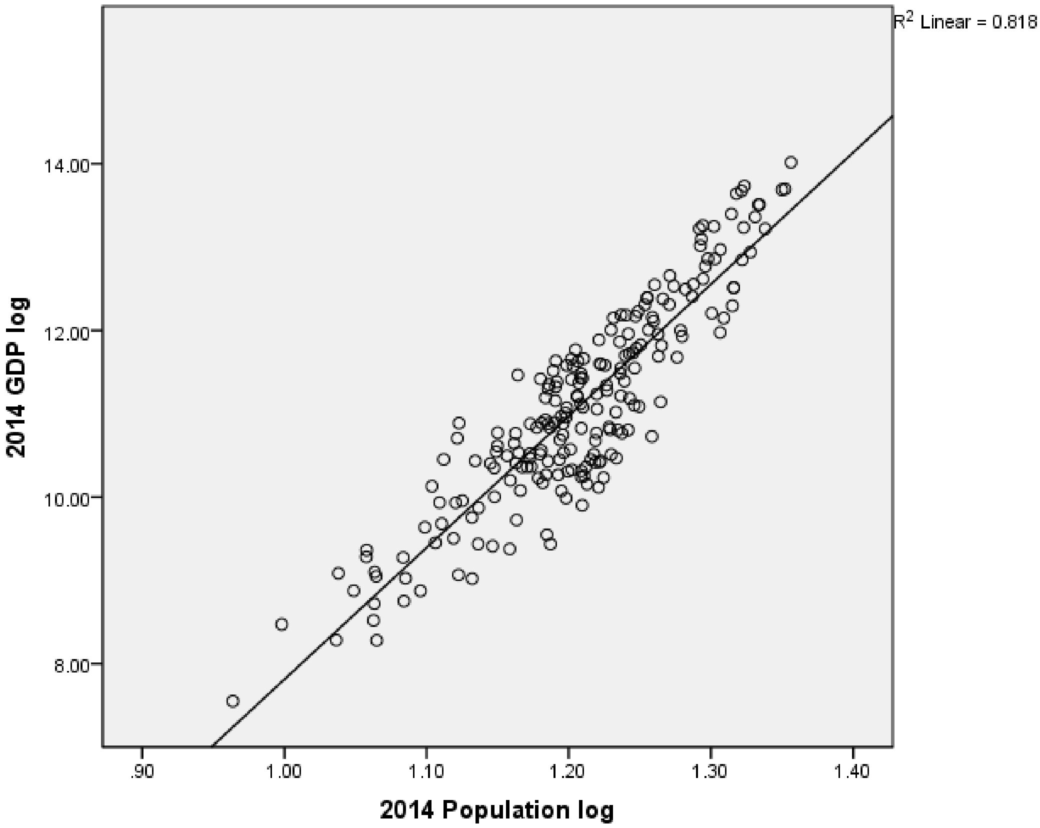
A correlation analysis shows that based on 101 total valid cases (n=101) the overall correlation between global RI and GDP amounts to .630. Even more, the significance is $p < .001$, which is a strong indicator that there is a relationship between the two variables. Figure 69 demonstrates these results by plotting the log-scaled variables.

Figure 69: 2014 GDP over global RI index (log scaled)



A regression analysis with RI index as the predictive variable and GDP as the dependent variable reveals that the model is able to explain approximately 40% of the total variance (R^2). In this case, the adjusted R^2 amounts to 0.397, which is of rather medium quality. Furthermore, as is no causal relation between the variables, and it is assumed that the correlation is rather spurious. In contrast to the variable global RI, the total population of a country has a better explanatory capacity in determining the gross domestic product (GDP). Figure 70 shows the GDP log-scaled over the population indicator log-scaled. The regression for GDP based on population as the explanatory variable has a resulting adjusted R^2 of .818.

Figure 70: Histogram of global RI index and population data

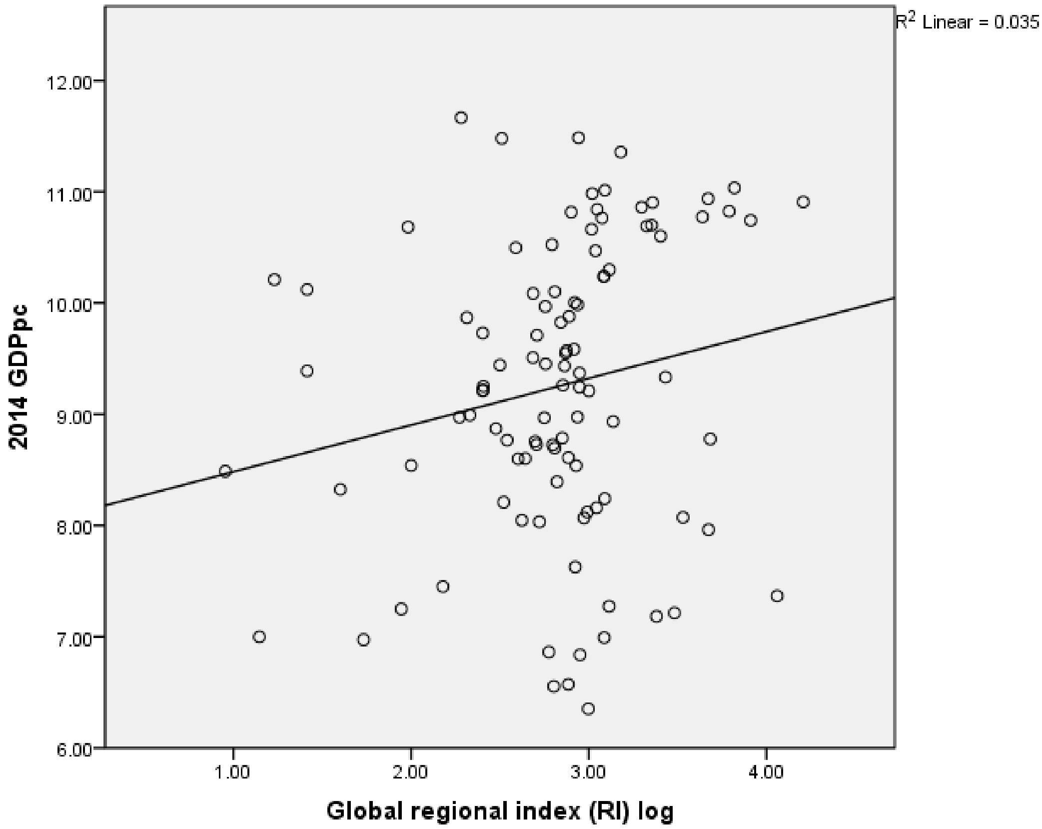


Conclusion 12: The correlation between the variable global regional index (RI) and GDP at purchaser's price seem to be spurious.

2. **Correlation between global RI index (Regions) and GDPpc 2014**

This section discusses the relation between global RI index for regions (countries) and GDPpc. The intent is to examine the relation between the Google Trends data and macroeconomic indicators more deeply. Figure 71 shows a log-scaled scatterplot of the global RI over GDPpc for 2014.

Figure 71: Global RI over GDPpc index World Bank 2014 (log scaled)



The resulting regression function for global RI and GDPpc is able to explain any development in the data. As illustrated above, the adjusted R^2 amounts to 0.035. Furthermore, the resulting regression coefficient for global RI is not even significant according to the conducted t-test. The theoretical t-value amounts to 1.985 and is based on the confidence level of 95% and a calculated degree of freedom of 99 (101 -1 -1). The value was extracted from a t-test table (cf. Backhaus, 2006, p. 630). Consequently, the variable global RI has not a significant influence in the model.

Conclusion 13: The global RI indicator is not able to explain the development of GDPpc on the level of regions and cities.

4.2.1.3 Economic analysis on local RI index and web searches

The index local RI, which is also written as RI_{Local}, founds on web searches data from Germany. The period of research is 11 years long. A set of trends instead of a single trend was used as an information basis to create the RI index. This section presents a detailed analysis of the use of trends and GDPpc (gross domestic product per capita) of 2014 provided by Destatis (Federal statistical office). Table 37 shows the data used.

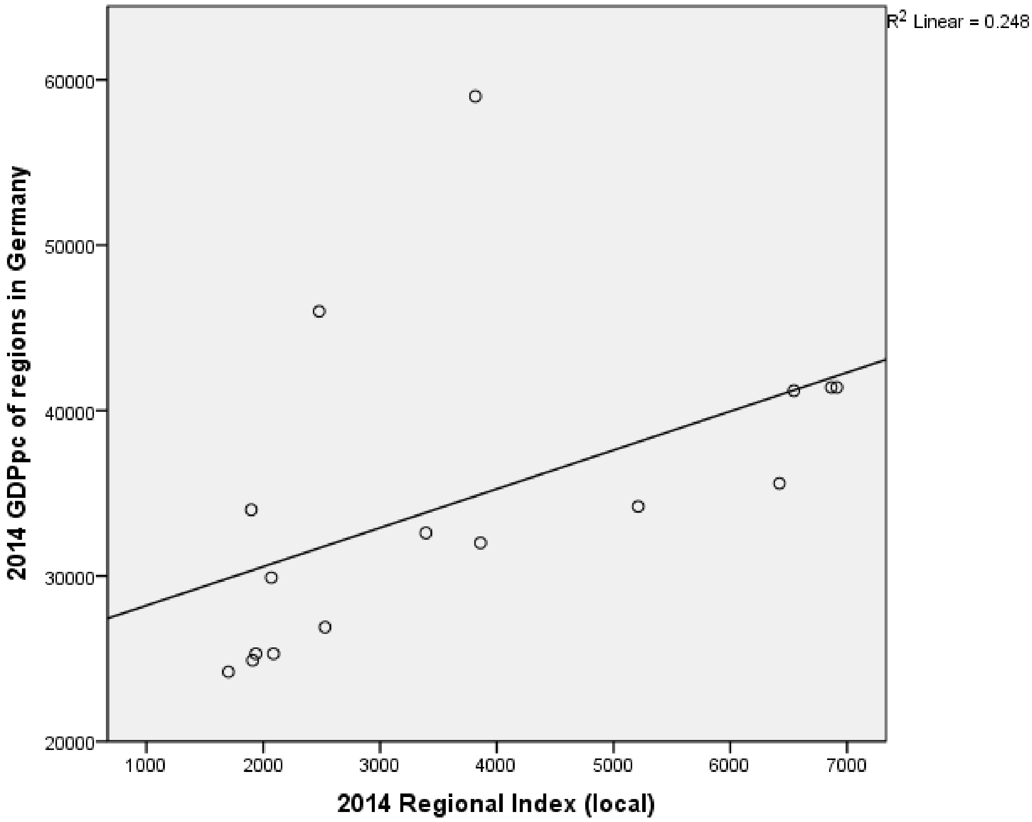
Table 37: 2014 GDPpc of regions in Germany and local RI (regions)

Rank	Region	RI local	GDPpc [EUR]
1	Bayern	6,912	41,200
2	Hessen	6,865	41,400
3	Baden-Württemberg	6,544	41,200
4	Nordrhein-Westfalen	6,420	35,600
5	Berlin	5,210	34,200
6	Rheinland-Pfalz	3,860	32,000
7	Hamburg	3,816	59,000
8	Niedersachsen	3,393	32,600
9	Sachsen	2,529	26,900
10	Bremen	2,478	46,000
11	Brandenburg	2,087	25,300
12	Schleswig-Holstein	2,069	29,900
13	Thüringen	1,936	25,300
14	Sachsen-Anhalt	1,909	24,900
15	Saarland	1,897	34,000
16	Mecklenburg-Vorpommern	1,701	24,200

The overall distribution of data reveals that the overall GDPpc varies from EUR 24,200 to EUR 59,000, which is a total range of EUR 34,800. The local regional index (RI) Trends index has a total range of 5,211, which varies from 1,701 to 6,912. Bayern has the first place in the RI index, and Mecklenburg-Vorpommern ranks last. In comparison to the analysis presented in Section 4.1.1.4., Nordrhein-

Westfalen ranked first in the utilization of direct and indirect trend passages. Figure 72 illustrates the quantitative results.

Figure 72: Local RI index (regions) over GDPpc index 2014



A bivariate analysis reveals that GDPpc and local regional RI index correlate significantly with $p < .005$ (1-tailed). The Pearson Correlation shows furthermore that both variables have a moderate correlation of .498. Motivated by these results, a linear regression analysis was conducted with GDPpc as the dependent variable, and local RI index as the independent variable. The regression model indicated an overall R^2 of .248 (adjusted R^2 of .195), which means that 24.8% of the variance could be explained by the model. The variable local RI index was significant with a significance of $p < 0.05$.

Overall, the results from the pilot study could be verified on the regional level. In this regard, it has to be mentioned that the pilot study used GDP at purchaser's prices. In addition, the local RI index is an aggregated index that has a higher quality of information compared to the indicator used in the pilot study. The results of the regression model are as follows:

Equation 17: Model results for local RI (regions) and GDPpc Germany

$$GDPpc_{Regions} = 25869.234 + 2.348\ RI_{Local,Regions} \quad (17)$$

The results of the regression model show that a change of 1,000 RI base points, leads to an increase of approximately EUR 2,500. The influence of regression coefficients (β_j), to GDPpc is tested with the t-test. The model assumed a confidence level of 95% with 16 total observations. The regression coefficients, standard errors, standardized coefficients, and t-values are shown in Table 38.

Table 38: t-test values for the local RI and GDPpc Germany

Unstandardized Coefficients		Standardized Coefficients	
B	Std. Error	Beta	t_{emp}
25869.234	4584.750		5.642
2.348	1.092	.498	2.150

The theoretical t- value t_{tab} amounts to 2.145 and is based on the confidence level of 95% and a calculated degree of freedom of 14 (16 -1 -1). The value was extracted from a t-test table (cf. Backhaus, 2006, p. 630). All coefficients are significant in the model. The confidence intervals are shown below.

Table 39: Confidence intervals for local RI and GDPpc Germany

	Lower Bound	Upper bound
b_0	16035.9	35702.5
b_1	0.00607424	4.68960

Conclusion 14: The index local RI for regions is able to make predictions about GDPpc. However, the regression model show a rather low quality with R^2 .248.

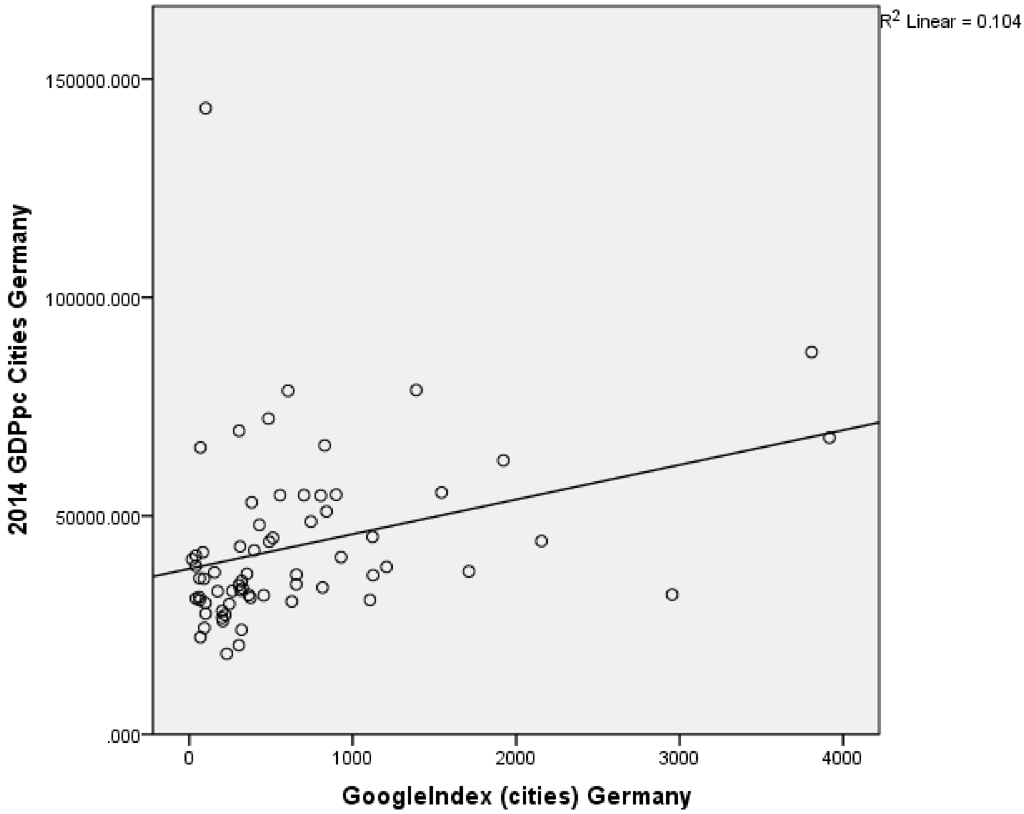
On the level of cities, 65 cities could be identified via the Google Trends request. GDPpc data was created based on data from 2013 that was increased by 1.5 percent per value. The highest RI indexes were found in Munich (3,917), Frankfurt (3,808), Berlin (2,954), Stuttgart (2,155), Bonn (1,922), and Düsseldorf (1,711). The lowest indexes were found in Kiel (17), Trier (40), Konstanz (40), Magdeburg (61), and Gelsenkirchen (63). The total range amounts to 3,900 in the index, with a mean of 569.06 and a standard deviation of 740.277. The results of the regression model based on unstandardized coefficients are illustrated below.

Equation 18: Model results for local RI (cities) and GDPpc Germany

$$GDPpc_{Cities} = 25869.234 + 2.348\ RI_{Local,Cities} \tag{18}$$

The t-test results for b0 resulted in 5.642 with a standard error of 4584.750, and 2.150 for b1 with a standard error of 1.092. Figure 73 shows the local RI index for cities over the GDPpc index for 2014. The linear regression model has an R^2 of 0.104 and an adjusted R^2 of .090. 10% of the total variance is explainable by the model.

Figure 73: Local RI index (cities) over GDPpc 2014



The theoretical t- value t_{tab} amounts to 2.145 and is based on the confidence level of 95% and a calculated degree of freedom of 14 (16 -1 -1). The value was extracted from a t-test table (cf. Backhaus, 2006, p. 630). All coefficients were significant in the calculation of the model. The confidence intervals for the coefficients are shown below.

Table 40: Confidence intervals for the regression coefficients

	Lower Bound	Upper bound
b_0	16035.9	35702.5
b_1	0.00607424	4.68960

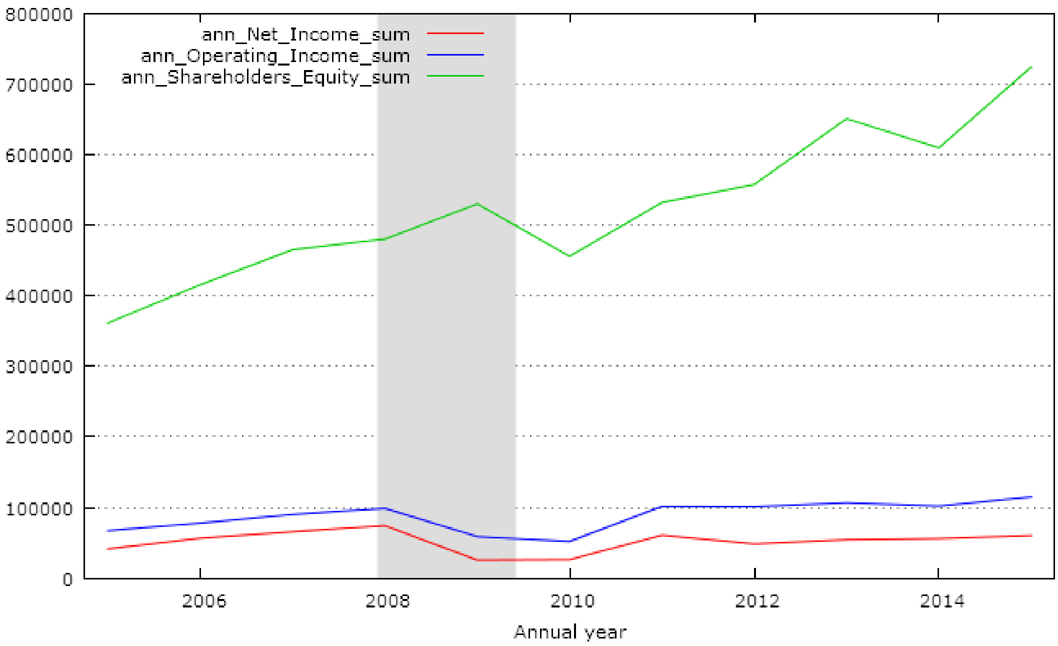
Conclusion 15: Even though there is no causal relation between the variables, local RI for cities is able to predict GDPpc partially. The regression model shows a rather low quality with R^2 of .104.

4.2.2 Explanatory model for CRI index based on financial KPIs

4.2.2.1 Impact of financial performance on corporate reporting

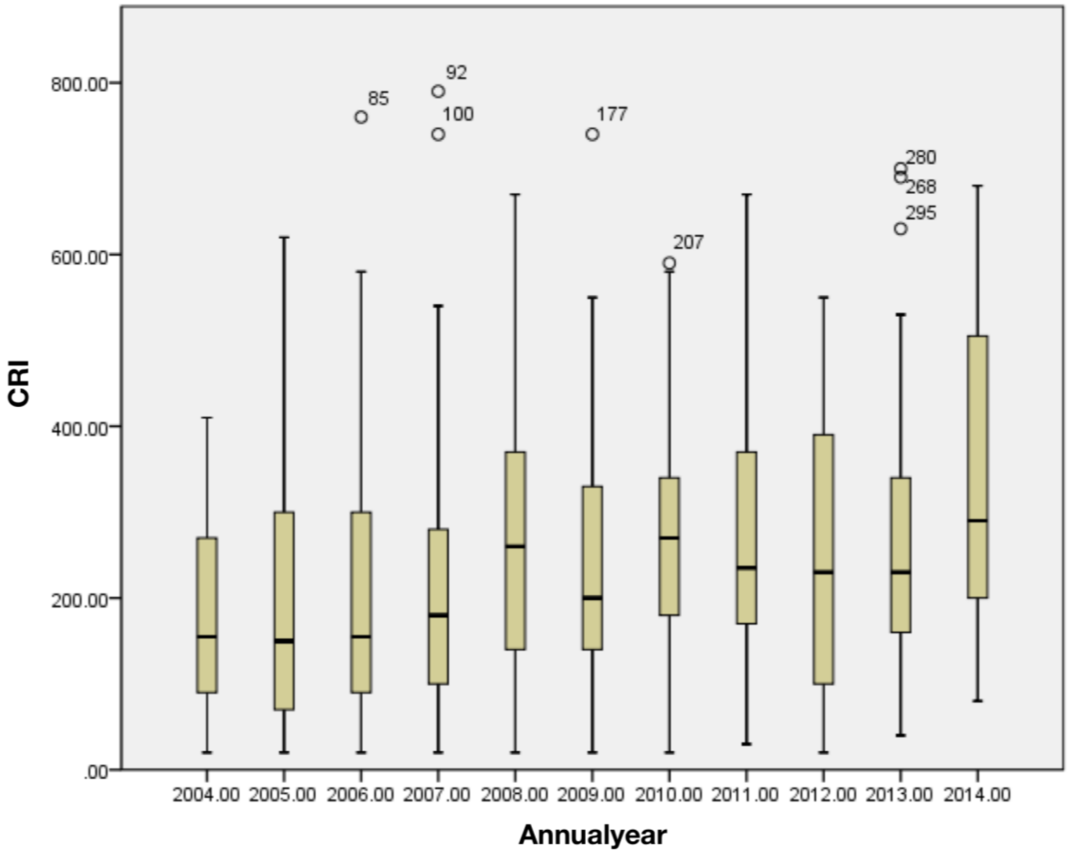
In this analysis, it is assumed that financial KPIs may have an influence on the use of trends used in the investor relation communication of blue chip corporations listed in the index DAX (German stock index). The assumption is that KPIs, such as asset-based values like “Shareholders' equity” and “Total equity,” that relate to the overall balance sheet and performance-based values that relate to the income and loss statement like “Net income” and ”Operative income” have a behavioral influence on the use of trends in annual reports. Figure 74 illustrates the development of the financial KPIs.

Figure 74: Finance KPIs in DAX in the reporting panel



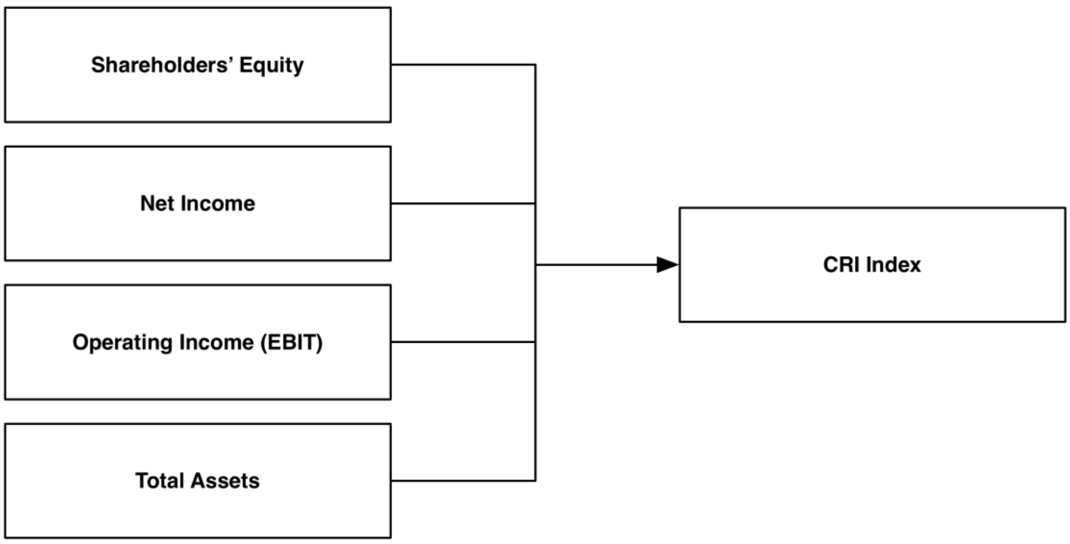
The behavioral effect should be measured with a dedicated indicator called confidence ranking index (CRI) that represents the confidence of the management in a trend used in the annual report. The assumption is that the effect can be expressed by (1) the total utilization of TPs identified as risks and opportunities, as well as by (2) the total amount of direct and indirect TPs implemented.

Figure 75: Development of the index CRI for the overall population



In Figure 75 the dependent variable of the analysis, the CRI index that combines the behavioral characteristics explained above, is illustrated as a boxplot in the overall population. This shows the starting point from the quantitative point of view. The motivation behind this analysis is an asymmetrical distribution of information in the sense that the expert that researches the influence of financial KPIs as an explanatory variable for the use of trends in annual reports has no inside information from the practitioners who created the report. In this case, the behavioral economic decision-making in investor relations is analyzed from only a quantitative point of view. Furthermore, financial KPIs are provided transparently and consistently in annual reports. In this case, the expert is able to build his decision-making based on a good set of data. Bini and Dainelli (2011) analyze the disclosure and importance of financial key performance indicators in European countries and point out that specifically the United Kingdom, followed by Germany, have a high rate of disclosure. In addition, the authors (Bini and Dainelli, 2011, p. 83) point out that "Managers, probably, pay more attention to FKPI disclosure quality because they are aware of the relevance of this information for stakeholders." Other researchers, like Chang et al. (2014), investigate the topic of disclosure in Australian corporations and highlight the importance of active communication with existing and potential investors in regard to profitability and ensuring capital investments. The information acquired should now be used to test whether the relationship between the usages of trends in annual reporting has a relation to the financial KPIs acquired. A multivariate regression model between trends and financial KPIs was developed. In Figure 76, the underlying assumptions are codified into a conceptual model.

Figure 76: Influence on the utilization of risks



The financial KPIs are tested against the earlier developed (behavioral) confidence indicator CRI index. The indicator utilizes the complete data of the panel and treats it as one coherent cross-sectional sample. To realize this perspective of analysis, two different statistical approaches of linear regression are applied, which are the multivariate analysis for the analysis from the cross-sectional point of view, and the generalized estimation equation approach that represents the panel's point of view. Table 41 gives an overview of the pearson product-moment correlation of the financial KPIs and the index CRI.

Table 41: Pearson product-moment correlations financial KPIs and CRI

Model parameters	**1**	**2**	**3**	**4**	**5**
1 CRI	1				
2 Net income	0.062	1			
3 Operating income	0.30	0.758**	1		
4 Shareholders' equity	0.079	0.511**	0.621**	1	
5 Total assets	0.154**	0.217**	0.215**	0.456**	1

**p < .001 (1-tailed) *P < .005 (1-tailed)

A starting point of the empirical analysis of this model is the correlation of analysis between the variables, as depicted above. It is important to note that a regression analysis cannot verify this causality and is able only to deliver further arguments for the discussion (Eckstein, 2012). However, the Pearson product-moment correlation reveals first insights into the data, as depicted above. The correlation between the financial KPIs, but also between CRI and total assets motivates the development of the linear regression models.

Conclusion 16: Financial KPIs for each corporation are provided consistently in the overall population (n=330). The correlation between the CRI index and the financial indicators provide a foundation for the development of linear regression models from the cross-sectional and the LTA point of view.

4.2.2.2 Multivariate model for CRI index and financial KPIs

This section discusses the cause and effect relationship between the model and especially the use of trends represented with the confidence ranking index (CRI) and financial values are illustrated.[22] Driven by the idea that financial KPIs have an influence on the CRI index, the complete panel was investigated for linearity. The dependent variable CRI index is a metric variable and justifies regression analysis, which purpose is as Kuhne (2015, p. 5) points out to support or to reject a hypothesis. A correlation analysis shows that for each annual report "Net income," "Total assets," "Operating income," and "Shareholders' equity" correlate with CRI index. Especially the indicators "Shareholders' equity" and "Operating income" correlate well with CRI index with $p < 0.01$. The estimated regression function is shown below.

Equation 19: Estimated regression function

$$CRI_{Annualreport} = b_0 + b_1 OI_{Annualreport} + b_2 SE_{Annualreport}$$
$$= 197.804 + 0.11\ OI_{Annualreport} + 0.02\ SE_{Annualreport} \quad (19)$$

$OI_{Annualreport}$	Operating income for a specific annual report
$SE_{Annualreport}$	Shareholders equity for a specific annual report

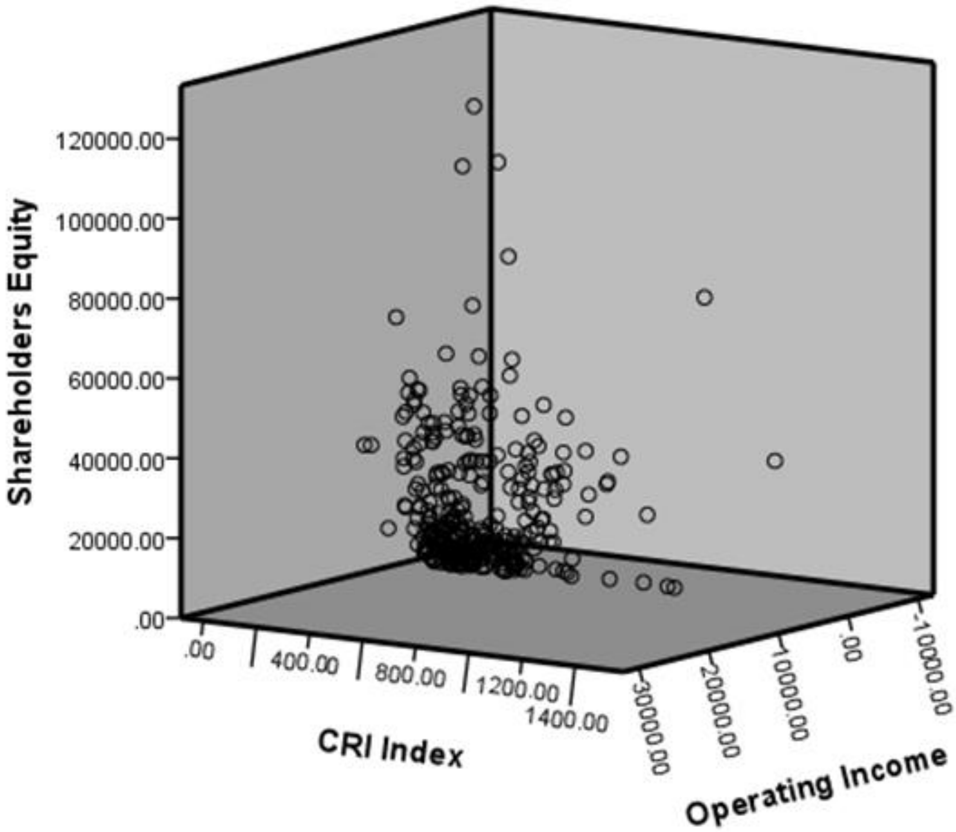
To test our model, we had to assume for H_0 that all regression coefficients are zero. That means that there is no relation between the dependent and independent variables. Our F-Test with $F(18.689, 2)$ resulted in $p < 0.01$, which means that H_0 has to be rejected. Therefore, the data shows a significant relationship between the variables. The t-test ($H_0{:}\,\beta_j = 0$) was also applied to validate the regression coefficients.

[22] The resulting dataset is enclosed in the appendix under A.4. Annual report evaluation dataset.

With a predefined significance level of 95%, all regression coefficients are statistically significant in our equation, with 2.726 for OI ($p < 0.01$) and 2.710 for SE ($p < 0.01$). In this regard, it needs to be pointed out that the other financial KPIs, "Net income" and "Total assets" were tested as well. The resulting quality of the variables in terms of significance was too low.

The 3D plot in Figure 77 displays the distribution of the model variables. As demonstrated in the Pearson product-moment correlations in section 4.2.2.1., "Shareholders' equity" and "Operating income" correlate moderately with 0.621 ($p < 0.001$), which is observable in the 3D plot.

Figure 77: 3D scatter plot of model variables



The developed model has an R Square of .103 and adjusted R square of .097. Approximately 10 % of the total variation is explainable by the model. However, this result is rather unsatisfying, and is not the result for the overall analysis. At this point, we take away that the model is a conceptual step in the exploratory research approach. Anyhow, we had to test the premises of the linearity. If the parameters are unbiased and efficient, then these are called best linear unbiased estimators (BLUE). To test multicollinearity, we analyzed the correlation between shareholder equity and operating income. High levels of correlation among independent variables can effect regression results. This collinearity is -0.621, which is acceptable. Next, the regression coefficients, standard errors, standardized coefficients were calculated.

Table 42: t-test values for the regression coefficients

	Unstandardized Coefficients		Standardized Coefficients	
	B	Std. Error	Beta	t
(Constant)	197.804	15.520		12.745
Operating Income	.011	.004	.180	2.695
Shareholders' Equity	.002	.001	.176	2.625

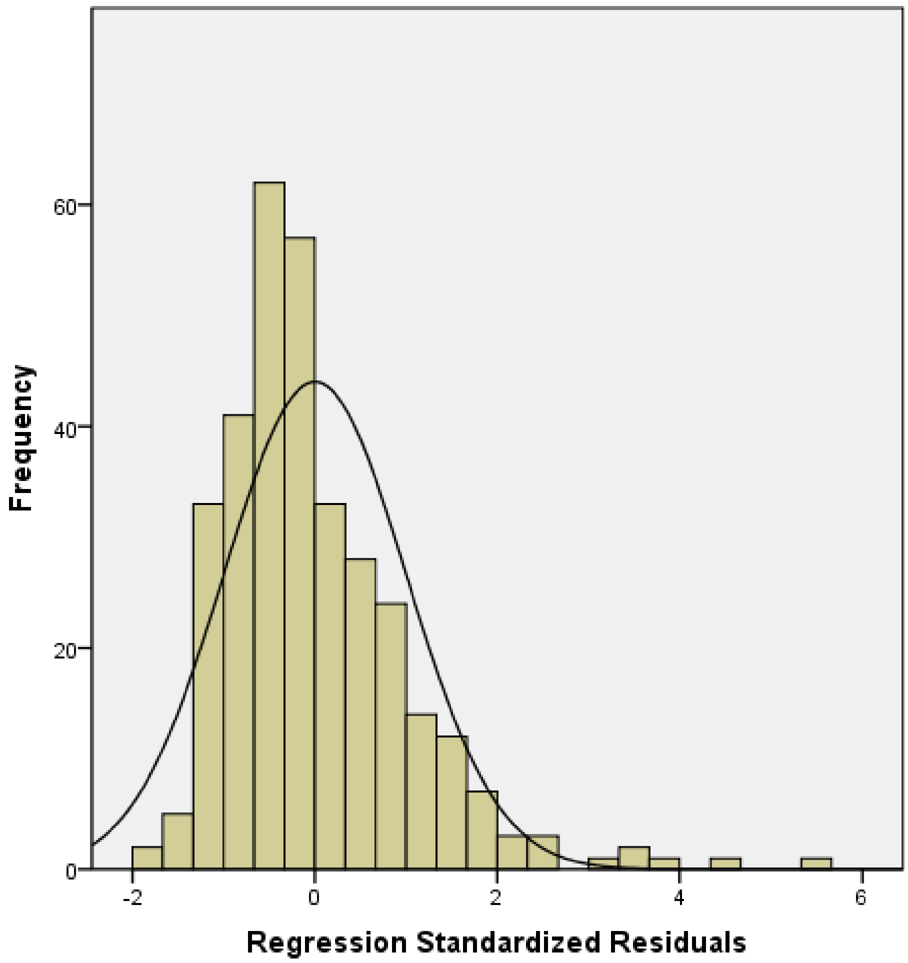
The influence of standardized regression coefficients (b_j), to GDPpc was tested with the t-test, as shown in Table 42. The model assumed a confidence level of 95% with 330 total observations. The confidence interval is depicted in Table 23.

Table 43: Confidence intervals for the regression coefficients

	Lower Bound	Upper bound
(Constant)	167.273	228.335
Operating Income	0.00305283	0.0195611
Shareholders' Equity	0.000501068	0.00349797

The following histogram (Figure 78) shows the residue distribution. Even though we treated the overall data as a consistent cross-sectional dataset, we calculated the Durbin-Watson coefficient to test auto-collinearity in the data. The Durbin Watson value is 1.952, with an assumed α of 0.25 and 330 observations.

Figure 78: Histogram of the CRI index



The statistical table for Durbin-Watson reveals threshold values with a lower bound of 1.81335 and an upper bound of 1.82550. In our case, we have no auto-collinearity, because the Durbin-Watson value is within the boundaries of the statistical values of 1.81355 < 1.952 < 4-1.82550 = 2.1745.

The residuals are distributed equally around 0, with a few outliers. We expect standardized deviations with +/- 3 around 0. The statistical analysis revealed that the standardized residuals are distributed from -1.859 (minimum) to 5.476 (maximum). The overall population comprises six outliers that also add to the rather weak results of the regression. To validate the quality of the model without the outliers, the initial data set was adjusted. After recalculating the model with a corrected dataset, that does not include the outliers, the quality of the model described with R-square could be raised to 0.116 and R-square adjusted to 0.11. Furthermore, the correlation between the regression coefficient is corrected to -.605. This correction has to be rated as a minimal improvement to the initial data. Overall, the depicted distribution is acceptable, and stresses that the residuals are normally distributed with a few outliers, which are acceptable.

Another premise for a linear regression model is that disturbance variables need to have a constant variance. This condition is also called homoscedasticity. This test could also be performed inspecting the distribution of the standardized residuals (by plotting the standardized residuals over the estimated values). The model shows homoscedasticity, because no geometric pattern could be observed in the distribution of the residuals.

Conclusion 17: The developed regression model for CRI based on the financial KPIs for the cross-sectional population is valid from the statistical point of view. Approximately 10 % of the total variation in the overall population is explainable by the model. The results of the model are integrated into the exploratory research.

4.2.2.3 GEE Model for CRI index and financial KPIs

The analysis of the acquired data from the longitudinal analysis or panel perspective motivates a change of the statistical model towards generalized estimating equation (GEE) (Chiou and Muller, 2005). The GEE model that was introduced by Liang and Zeger (Feddag et al., 2003; Zorn, 2001; Ballinger, 2004; Fitzmaurice, 2009). Fitzmaurice (2009) provides an overview of the history of longitudinal data models and points out that (maximum) likelihood-based approaches have been abandoned altogether in favor of semi-parametric methods (e.g. GEE approaches). Based on the concepts of Ballinger (2004, p.140), the design of the appropriate GEE model follows the following steps:

1. Identify the model parameter(s) of interest;
2. Specify any interaction terms of interest (cause and effect relationship);
3. Specify the variables that indicate the clustering of the dependent variable responses in the data (e.g., by case, by annual year, by behavioral group, by organizational unit, by trial, or by measurement);
4. Specify the link function that will "linearize" the regression equation;
5. Identify the distribution of the dependent variable and specify it in the model (normal distribution, logistic distribution, passion distribution);
6. Specify the structure of the correlation of within-subject responses (the "working" correlation matrix);
7. Identify and request the appropriate test statistics to be generated.

The benefits of GEE models compared to ordinary least square (OLS) are that regression estimates from OLS models cannot cope with inconstant variances and abnormally distributed error terms (Ballinger, 2004). Ballinger (2004, p. 131) explains that a key of the GEE model is the "Link transformation" function that that "will allow the dependent variable to be expressed as a vector of parameter estimates (β)." The general form of the link transformation function is depicted below (see Equation 20).

Equation 20: Link transformation function

$$g(\mu_i) = x_i{}'\beta = \sum_{k}^{n} x_{ik}\beta_k \tag{20}$$

x_i' Covariate matrix

β Unknown vector of regression coefficients

$g(\mu_i)$ Known link function with $\mu_i$responses

The link transformation function depends on the distribution of the underlying dependent variable, which can vary from normal distribution, binominal distribution, passion distribution for counted data, negative binominal distribution, gamma distribution, and multinomial distribution (Ballinger, (2004). It must be stated here that the option to integrate different distributions into the GEE models is one of the key benefits over linear regression models. Based upon the link function and the distribution of the dependent variable, the structure of the correlation of within-subject responses needs to be specified, described as specifying the working correlation matrix (Ballinger, 2004). Consequently, correlation among data within a longitudinal or clustered structure that stems from repeated measures, or as in our case, due to the acquisition of annual reports and web-based search data at separated points in time, can be integrated by the application of GEE. Wang (2014) provides an overview of the different models and correlation structures utilized in GEE models and points out that the quality of the model depends on the selection of the working correlation structures, sample size and power calculation, and "the issue of informative cluster size." Chiou and Muller (2005, p. 534) explain that the concept of the working correlation matrix is founded on the assumption that the variance function is a function of the means in GEE models and that the "correlation of the repeated measurements is considered through a common "working correlation matrix." In other words, researchers can integrate their knowledge of cluster wise interdependencies into the model through the working correlation matrix (Zorn, 2001, p. 474). To choose the optimal working correlation structure for our model, we can choose from independent, exchangeable, k-dependent, autoregressive AR(1), Toeplitz, and unstructured (cf. Wang 2014, p.3). Wang (2014) points out that a misspecification of the working correlation structure in GEE leads to inefficiencies in the GEE model due to a lack of finite-sample performance. Chiou and Muller (2005, p. 534) explain that this is not necessarily a feature of GEE.

The question arises of how an ideal working correlation matrix for the GEE model can be designed. In OLS models, these inefficiencies can be handled based on the Akaike information criterion. As GEE do not depend on the maximum likelihood estimation, Pan (2001) developed a test based on the Akaike's information criterion and created an independent model information criterion (QIC) measure referred to as quasi-likelihood, which provides the researcher a tool to select and appropriate correlation structure. Zorn (2001) explains:

> While standard maximum-likelihood analysis specification of the full conditional distribution of the dependent variable, quasi-likelihood requires only that we postulate the relationship between the expected value of the outcome variable and the covariates and between the conditional mean and variance of the response variable (Zorn, 2001, p. 471).

The benefits of the quasi-likelihood methodology are implemented in a large number of statistical software packages, and as pointed out by Pan (2001, p. 12), this method "allows one to use any general working correlation structure to estimate the variables in GEE." This method is consequently applied in this study. Ballinger (2004) refers to Rotznitzky and Jewell (1990) to explain that test statistics analogous to repeated analysis of variance (ANOVA) tests allow one to test hypotheses "regarding parameter estimates in a method analogous to those used in testing coefficients from normal-errors regression methods." Zorn (2001) refers to the work of Diggle (cf. Diggle et al., 1994; Diggle, 2013) and points out that regression coefficients are:

> When regression coefficients are the scientific focus […] one should invest the lion's share of time in modelling the mean structure, while using a reasonable approximation to the covariance. The robustness of the inference about ß can be checked by fitting a final model using different covariance assumptions and comparing the two sets of estimates and their robust standard errors (Diggle, 2013, p. 140).

The goodness of fit test shows the capacity of GEE in the longitudinal approach, even though it is seen critical in the literature (c.f. Pan, 2002). Based upon the recipe of specifying a GEE model, we identified the model parameters of interest, the interaction, and the variables (see step 1-3). Analogous to the previous OLS model, this model comprises CRI (confidence ranking index) as the dependent variable, and "Operating income" and "Shareholder equity" as intendent variables. The continuous variable CRI index was distributed normally. The categorical variable "ANNUALYEAR" was available for each dataset of the panel, and was then treated as a fixed factor. A premise in performing GEE is to evaluate the differences between the panels by conducting a repeated analysis of variance (ANOVA), based on the following hypotheses.

$$H_0:\ \mu_1 = \mu_1 = \mu_2 = \cdots = \mu_j \tag{21}$$

$$H_1:\ \mu_1 \neq \mu_1 \neq \mu_2 \neq \cdots \neq \mu_j$$

Table 44 reveals the results of the ANOVA that tests the differences between the groups of variables. The basic premise our null hypothesis is that there are no differences between the individual mean values of our parameters (H_0: $\mu_1 = \ldots = \mu_n$) for at least two values of μ_j.

Table 44: Univariate analysis for the panel analysis

Variable	df	F-Value	Significance (Sig)	Partial Eta Squared
Intercept	1	179.361	.000***	.361
Operating income	1	8.766	.003**	.027
Shareholders' equity	1	3.615	.058	.011
Annual year	10	2.733	.003**	.079

*p < .05. **p < .01. ***p < .001.

The ANOVA results indicated that the corrected model qualified for further analysis ($F=5.558$, $p < .001$). H_0 needs to be rejected. With an R^2 of 0.174 and an adjusted R^2 of .143, the model already showed an improvement in comparison to the cross-sectional model (see section 4.2.1.2). The intercept has the strongest ability to describe the variances in the model (Partial Eta Squared of .361). The newly introduced variable “Annual year” was able to describe .079 or 8% of the variance of the dependent variable. However, the variable “Shareholders’ equity” did not qualify as a significant variable for our model, based on the α-value of .05. However, a linear regression reveals that the overall quality of the model justifies the inclusion of the variable “Shareholders’ equity.” The estimation of the model variables in a statistical software revealed that “Shareholders’ equity” has a significance of $p < .05$. This significance led to the assumption that the overall quality of the final GEE model is best determined by preparing two models and running two independent analyses, as demonstrated in Table 45.

Table 45: Model comparison for finalizing GEE model decision

	Model 1		Model 2	
Variables	**Wald Chi-square**	**Sig.**	**Wald Chi-square**	**Sig.**
(Constant)	89.602	.000***	111.541	.000***
Operating income	4.265	.039*	6.561	.010**
Shareholders’ equity	1.240	.265	-	-
Annual year	41.425	.000***	39.394	.000***

*p < .05. **p < .01. ***p < .001.

The variable “Shareholders’ equity” has no influence in our model. This is an important difference from the results of the linear regression performed. In this case, it is important to notice that the working correlation matrix above was set to independent. Before the optimal working correlation matrix was specified, the variables were determined based on a GEE model in comparison to the linear regression model with the variable ANNUALYEAR modeled as a dummy variable for each year, as illustrated in the Table 46.

Table 46: Comparison of GEE to OLS (n=30)

	Ordinary least squares, normal distribution		GEE , normal distribution, independent correlation	
Variable	**Unstandardized coefficient**	**Standard error**	**Unstandardized coefficient**	**Standard error**
(Intercept)	341.713***	37.026	341.713***	46.15
[ANNUALYEAR=2004.00]	-202.909***	49.523	-202.909***	42.1505
[ANNUALYEAR=2005.00]	-200.701***	49.413	-200.701***	50.8956
[ANNUALYEAR=2006.00]	-186.690***	49.322	-186.690***	52.5062
[ANNUALYEAR=2007.00]	-169.689***	49.278	-169.689***	47.4322
[ANNUALYEAR=2008.00]	-97.739*	49.629	-97.739*	43.0525
[ANNUALYEAR=2009.00]	-76.768	49.729	-76.768	55.3283
[ANNUALYEAR=2010.00]	-110.990*	49.268	-110.990*	48.4354
[ANNUALYEAR=2011.00]	-121.538*	49.268	-121.538*	50.1678
[ANNUALYEAR=2012.00]	-126.218**	49.269	-126.218*	54.5394
[ANNUALYEAR=2013.00]	-95.618*	49.255	-95.618*	46.0085
[ANNUALYEAR=2014.00]	-		-	-
Operating Income	0.17**	.003	.017**	.0067
Quasi likelihood under independence model criterion (QIC)	-		11568150.842	
Corrected quasi likelihood under independence model criterion (QICC)	-		11568144.150	

*p < .05. **p < .01. ***p < .001.

Both models delivered the same results for the unstandardized coefficients. However, the GEE model shows better characteristics as it delivers the same results with less variables used. The QIC and the QICC value as displayed in the above table were also accounted, because these values represent the value of information. A high value represents a high value of information. This also allows a comparison of different models. Both values illustrate that the model has a high information value. In Table 47, different working correlations are compared.

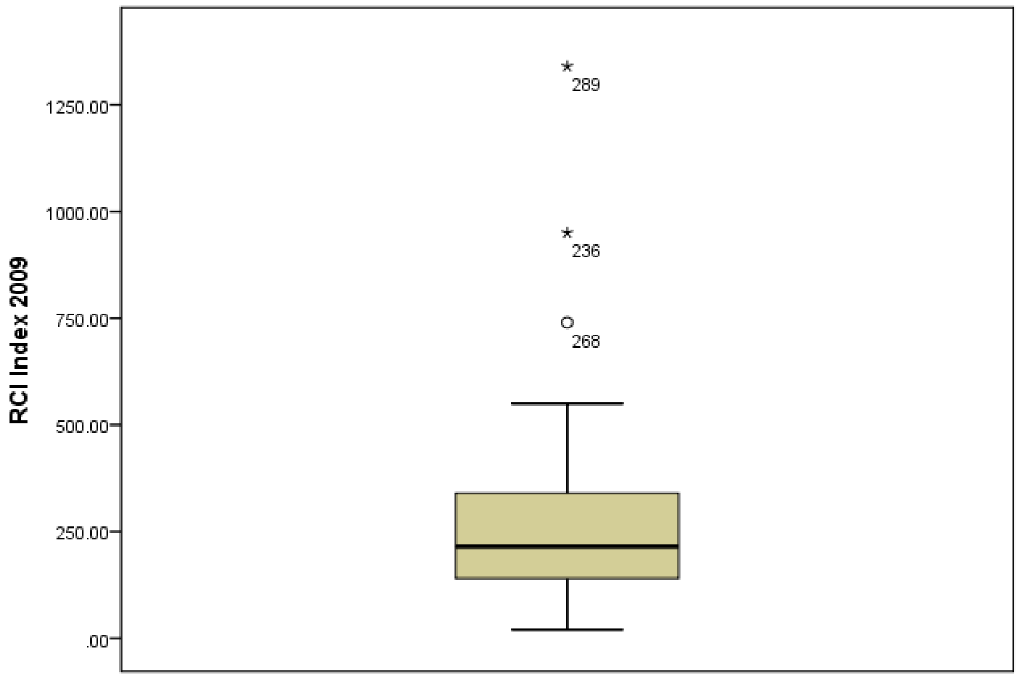
Table 47: GEE Model comparison with different working correlations

	GEE , normal distribution, independent correlation		GEE , normal distribution, one-period autoregressive correlation		GEE , normal distribution, exchangable correlation	
Parameter	**Unstandarized coeffcient**	**Standard error**	**Unstandarized coeffcient**	**Standard error**	**Unstandarized coeffcient**	**Standard error**
(Intercept)	341.713***	46.15	369.346***	52.6176	380.178***	51.5643
[ANNUALYEAR=2004.00]	-202.909***	42.1505	-214.399***	45.1097	-218.903***	44.8624
[ANNUALYEAR=2005.00]	-200.701***	50.8956	-209.625***	52.3386	-213.123***	52.0572
[ANNUALYEAR=2006.00]	-186.690***	52.5062	-192.686***	54.8113	-195.036***	54.8945
[ANNUALYEAR=2007.00]	-169.689***	47.4322	-173.590***	49.3375	-175.119***	49.5945
[ANNUALYEAR=2008.00]	-97.739*	43.0525	-111.256*	43.6584	-116.554**	42.8695
[ANNUALYEAR=2009.00]	-76.768	55.3283	-91.948	52.3509	-97.899	51.4111
[ANNUALYEAR=2010.00]	-110.990*	48.4354	-114.206*	49.3693	-115.467*	49.1766
[ANNUALYEAR=2011.00]	-121.538*	50.1678	-124.804*	50.8946	-126.084*	50.4195
[ANNUALYEAR=2012.00]	-126.218*	54.5394	-128.221*	52.9204	-129.007*	51.9249
[ANNUALYEAR=2013.00]	-95.618*	46.0085	-98.711*	46.4266	-99.923*	45.8866
[ANNUALYEAR=2014.00]	-	-	-	.	-	.
Operating income	.017**	.0067	.010**	.0052	.007	.0050
Quasi-likelihood under independence model criterion (QIC)	11568150.842		11743605.358		11908123.541	
Corrected Quasi-likelihood under independence model criterion (QICC)	11568144.150		11743601.872		11908120.031	

*p < .05. **p < .01. ***p < .001.

Table 47 illustrates the results of the working correlation comparison of (1) independent correlation, (2) one-period autoregressive correlation, and (3) exchangeable correlation. From the viewpoint of quality, the QIC and the QICC parameters reveal that the independent correlation provides the best model fit. On the contrary, the exchangeable correlation structure lacks quality. Specifically, "Operating income" is not significant. The unstandardized coefficients are comparable in the model. However, in structure (3) the influence of the constant that is depicted as intercept is most significant, with 380, compared to structure (1) with 341 and structure (2) with 369. To conclude, the variable "ANNUAL_YEAR" has the biggest influence on the CRI index. Especially in comparison to the financial KPI "Operating income" that was implemented in the model, the variable "ANNUAL_YEAR" and the influence of the intercept, have to be considered huge. In Figure 79, the boxplot shows the CRI in 2009, with two outliers marked by stars.

Figure 79: Boxplot CRI index in 2009



The standard errors determined by each model are also comparable, and show no significant differences. The quality of coefficient determined by structure (2) is comparable to the quality of the structure (1). From the point of data quality, all covariates are fixed factors in the model. Consequently, models determined by GEE methods do not vary completely from the linear regression model developed earlier, although the parameter shareholders' equity does not fit the GEE model. The parameters estimated by GEE are significant (α = 0.05), despite the value for 2009. The final step in the overall comparison involves a comparison of the working correlation matrix for structure (1) to (3), which is depicted in Table 48.

Table 48: Working correlation structure comparison

Structure 1	2004	2005	(…)	2013	2014
2004	1	0		0	0
2005	0	1		0	0
(…)			(…)		
2013	0	0		1	0.535
2014	0	0		0	1
Structure 2	**2004**	**2005**	**(…)**	**2013**	**2014**
2004	1	0.525		0.004	0.002
2005	0.535	1		0.007	0.004
(…)			(…)		
2013	0.004	0.007		1	0.535
2014	0.002	0.004		0.535	1
Structure 3	**2004**	**2005**	**(…)**	**2013**	**2014**
2004	1	0.287		0.287	0.287
2005	0.287	1		0.287	0.287
(…)			(…)		
2013	0.287	0.287		1	0.287
2014	0.287	0.287		0.287	1

Conclusion 18: The above results stress the superiority of the unstructured model. It is less restrictive, and shows absolutely no correlation between the annual years. However, the logical interdependence of annual years could be modeled with the autoregressive structure to provide enough quality from the statistical point of view.

4.2.3 Model improvement of explanatory model with web search data

4.2.3.1 Automated correlation analysis for model improvement

The preliminary study revealed that the term "megatrends" used in annual reports (ARPs) in the period from 2008 to 2012 is also represented in the data revealed from Google Trends. Furthermore, the response data of Google Trends revealed that web searches for the term occur in economically strong regions. This result underlines the assumption that if DAX (German stock index) corporations are motivated to research specific trend terms with Google Trends, then the Google Trends data represent this interest. However, the individual interests of specific corporations cannot be determined. Only information about the regional occurrence of a specific trend search can be obtained. Furthermore, the timely relation between the occurrences of web searches might also deliver further hints about the development of trends (Preis et al., 2012).

The previously developed linear regression and generalized estimating equations (GEEs) model assumed that financial KPIs affect the utilization of trends in annual reports. The analysis treated the codified data as (a) cross-sectional data and (b) as panel data. The motivation in this section is that web searches have an impact on the use of trends in annual reports. The analysis of trend passages (TPs) from annual reports delivered a large set of trends that were mentioned directly and indirectly. As shown in the last section, these trends were assumed to be of special interest to the individual corporation. On the contrary, the preliminary analysis utilized only the term “megatrend” in conjunction with Google Trends to identify what regions in Germany are mostly interested in future-related terms. In this case, the assumption was that “megatrend” is especially interesting to corporations that have internal or external foresight capabilities. Furthermore, it was assumed that regions that have a high GDP are especially interested in future-oriented topics. The developed confidence ranking index (CRI) is a tool that can be employed to investigate the relation between economic profitability and the use of trends. The CRI index that was developed to rate the use of trends in annual reports is now used in conjunction with Google Trends to reveal possible correlations, which might result in improvement potential for trend analysis. In this case, the analysis takes two research strains.

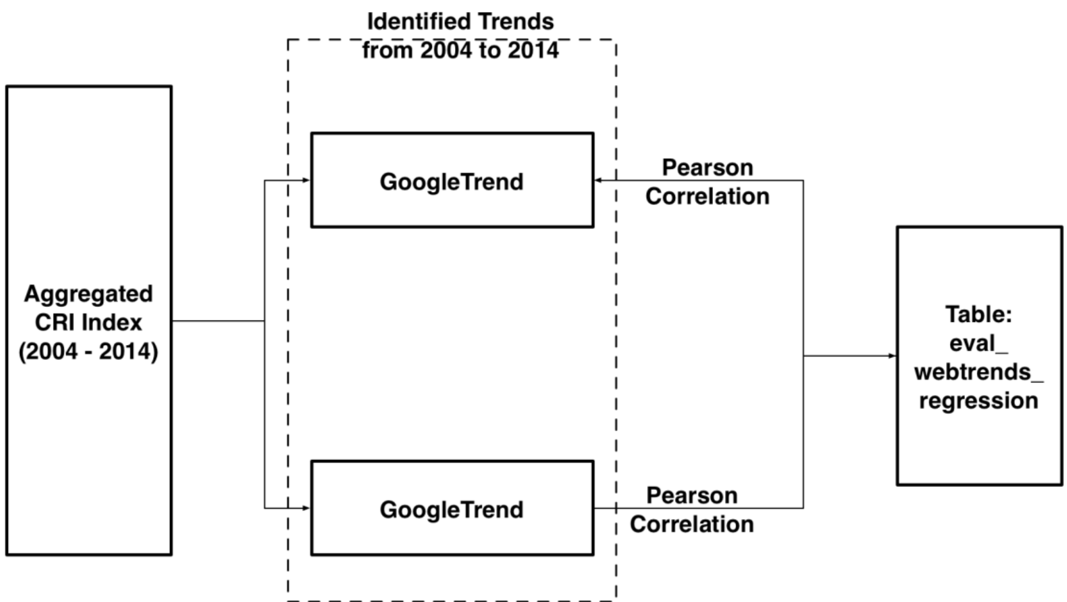
The first research strain treats the CRI-codified data as cross-sectional data, and the second research strain treats the overall data as a coherent panel. The first approach requires an aggregation of the CRI indices on the level of annual year, as depicted below.

Equation 22: Aggregation of CRI per year

$$CRI_{DAX,Year} = \sum_{n=1}^{30} CRI_{Report,Year}\,(i) \tag{22}$$

For each annual report, the individual CRI indices are summarized. The result is a total CRI index. The result is a total CRI index for the overall cross-sectional data that represents a time series from 2004 to 2014. The CRI index and the individual Google Trends indices are now analyzed for correlation in the cross-sectional data, as shown in the Figure 80.

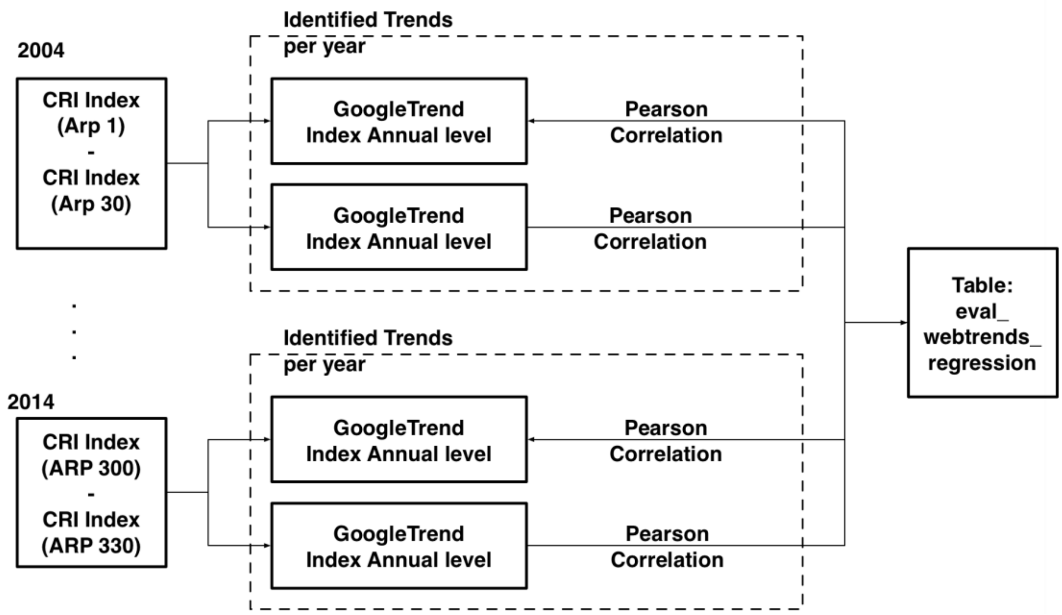
Figure 80: Cross sectional correlation analysis of CRI and Google Trends



First, a Pearson correlation test was conducted that revealed whether there is a significant correlation test between the values of the CRI index and the Google Trends trend results. The correlation test assumes as a null hypothesis, H_0 that an identified trend does not correlate with the CRI index of the annual report. If this assumption is violated, then the trend is considered to correlate with the CRI index. This condition qualifies the trend as being relevant to the corporation. The results are stored in the table "eval_webtrends_regression". Second, n-linear regressions for each Trend have been created in R.

Next, the overall data is treated again as a panel. Based upon this approach, the correlations between the annual years could also be integrated into the analysis. Only the trends of a specific year are used in the analysis to test the correlation, and to estimate the regression model in R. Based on the results of the annual year, a vector with n-trends can be created. The individual vector is then utilized for a panel analysis. The process of data aggregation is illustrated in Figure 81.

Figure 81: Panel correlation analysis of CRI and Google Trends



4.2.3.2 *Model improvement based on web search trends*

The foundation for the cross-sectional analysis is a set of 914 trends that were used to extract trend data from Google, with the R script Google Trends that is depicted in the appendix. Depending on the predefined regional setting, a different amount of datasets was returned. The global settings returned 315 datasets in total. With the regional settings that were set to Germany, 36 dataset were returned. Table 49 illustrates the results including the information on which year a trend refers to according to their use in the annual report.

Table 49: Google Trends results segregated into global and local

Characteristic	Global	Germany
Total trends queried	914	914
Return in relation to the year of utilization		
2004	22	2
2005	21	7
2006	17	1
2007	28	3
2008	21	1
2009	22	2
2010	20	2
2011	17	2
2012	36	7
2013	47	4
2014	64	5
Total trends	**315**	**36**

The returned information was now transformed into a mean annual result to be comparable to the confidence ranking index (CRI) (see section 4.2.2.1). Each mean result and the CRI index values stored the database "mydb" in the table mydb.dax_aggregation_reports were implemented into a linear regression model. Furthermore, a Pearson correlation analysis was performed to identify the correlation between the Google Trends index on the annual basis, and the CRI index. In total, 35 Pearson correlations were calculated and 251 linear regression models were created. Table 50 reveals the results of the Pearson correlation analysis in total and in percentage for global and local settings, which refer to Germany. In both cases, the degrees of freedom amount to nine.

Table 50: Results of pearson correlation analysis

Characteristic	**Global**	**Germany**
Significance of Pearson correlation (2 tailed)		
High significance [a]	87 (28%)	6 (17%)
Significance [b]	122 (39%)	19 (53%)
No significance	106 (34%)	11 (31%)
Range of Correlation		
Maximum positive [a b]	0.92	0.76
Minimum positive [a b]	0.60	0.60
Maximum negative [a b]	-0.63	-0.62
Minimum negative [a b]	-0.86	-0.86

[a] $p < 0.01$.

[b] $p < 0.05$.

The underlying assumption of the Pearson correlation analysis, or the null hypothesis (H_0: p = 0), was that there is no correlation in the population of the CRI index and the individual annual Google Trends index. The alternative hypothesis (H_1: p ≠ 0) is automatically valid when the null hypothesis was violated. If this assumption was violated, then we have to assume.

In total, 209 examples were identified on the global level that violated the null hypothesis. Of these, 42 trends correlated negatively with the CRI index, and 167 had a positive correlation. The determined Pearson correlation coefficient was calculated for each trend found in the period of analysis from 2004 to 2014. Each trend refers to a specific mean Google Trends index of 11 years. On the global level, 67% correlate significantly with the CRI index (209 trends in total). The Pearson correlation coefficient range indicates a medium to high correlation on the positive and the negative scale for results that have significance better than $p < 0.05$. On the local level, that is the results only from Germany, over 70% have a significant correlation (25 trends). The correlation is in the bandwidth of 0.60 to 0.76, and 0.62 to 0.86 in the negative area. As demonstrated above, 209 Google Trends correlate well with the CRI index on the global level. Respectively, 25 Google Trends correlate well the CRI index on the local level.

The correlation analysis indicates which trends are important for DAX (German stock index) corporations. Consequently, these trends should be of special interest. Furthermore, it could be revealed that trends with a negative correlation towards the CRI index also show a negative trend in the annual Google Index. That means that these terms are less queried by the public. In this regard, the term "public" includes all participants that have access to Google, which can be households, governments, and corporations. From this perspective, trends that have a positive significant correlation with the aggregated CRI index should be examined if they could be an explanation for a cause and effect relationship of trend utilization in DAX reports. For each of the Google Trends trend indices that have a significant correlation with CRI, a linear regression model was created in R.

The assumption for each linear regression model created is that the explanatory or independent variable, in our case the annual Google Trends index, and the outcome or dependent variables the annual CRI are linearly related. That means that the population mean of the dependent variable can be modeled with a linear equation. This procedure was also realized in R. In this context, the coefficient, the intercept, R-square, R-square adjusted, the F Value, and the significance level of the intercept and the coefficient were determined to evaluate the quality of the models created. Furthermore, this information should be used to test what model is best to determine the effect to the overall RCA index. The quality of these models was evaluated based on the R-square and the R-square adjusted index, as shown in Table 51.

Table 51: Quality of OLS models based on Google Trends

Characteristic	Global	Germany
R Square (Maximum)	0.8400	0.7200
R Square (Minimum) [b]	0.3666	0.3681
Adjusted R Square (Maximum)	0.8394	0.7166

The data reveals a total span of R-square with 0.4884 for models that are based on Google Trends index with a global setting. On the local scale, a bandwidth for an R-square of 0.3769 and for the adjusted R Square of 0.4367 was revealed. The following tables show some examples of the linear regression models for the variable CRI calculated for the determination of the CRI index with Google Trends indices for global and local datasets. In addition, each regression model was calculated on the global and local dataset. Table 52 and Table 53 show an excerpt of all resulting regression models for CRI that were calculated with the developed algorithm based on the global and local dataset. The table includes the unstandardized regression coefficients, t-test values for the regression coefficients, R^2 and f-test values for quality assessment.

Table 52: CRI regression models based on global GoogleTrend data (excerpt)

	Unstandardized coefficients		T-Values		Goodness-of-Fit	
Trendname	**Intercept**	**Coefficient**	**Intercept**	**Coefficient**	**R-Square**	**Fvalue**
General trend	-67.68968	0.01184	-5.07256	7.29958	0.84	53.28390
Longterm development	-64.82091	0.01270	-4.50210	7.26126	0.84	52.72587
Integrate megatrends	89.11503	-0.00349	17.22120	-5.54703	0.75	30.76957
Growing population	-34.34445	0.00722	-3.13906	5.42918	0.74	29.47605
RFID	100.12891	-0.00802	7.73884	-5.10169	0.71	26.02721
Innovation trends	-44.25070	0.00884	-3.09660	5.09004	0.71	25.90851
Internet of Things	-50.22441	0.00771	-3.95653	4.99533	0.71	24.95330
Pensions	-32.67641	0.00777	-2.54795	4.98308	0.70	24.83107
Corporate responsibility	83.09645	-0.00317	15.43576	-4.84974	0.69	23.51999
Digitalization	-35.44406	0.00785	-2.65560	4.83798	0.69	23.40607
Transparency	48.45547	-0.00270	10.48990	-4.81478	0.69	23.18212
Growing demand for water	91.28391	-0.00660	8.04486	-4.78535	0.69	22.89957
Customer trends	-29.19829	0.00694	-2.41832	4.72665	0.68	22.34125
Trends	89.86811	-0.00368	13.99518	-4.71368	0.68	22.21880
Salary	104.76457	-0.00657	8.95630	-4.62401	0.67	21.38151
Consolidation	55.78578	-0.00398	7.82480	-4.59118	0.67	21.07893
Environment	89.17981	-0.00546	9.09108	-4.57772	0.67	20.95553
Internationalization	80.83953	-0.00654	6.78734	-4.52038	0.66	20.43386
Strategic development	-67.81154	0.01271	-2.92956	4.51833	0.66	20.41530
Technology	106.21937	-0.00742	7.73315	-4.44732	0.65	19.77869

Table 53: CRI regression models based on local GoogleTrend data (excerpt)

	Unstandardized coefficients		T-Values		Goodness-of-Fit	
Trendname	**Intercept**	**Coefficient**	**Intercept**	**Coefficient**	**R-Square**	**Fvalue**
Social Media	107.51805	-0.00737	9.09522	-5.12793	0.72	26.29564
Salary	-40.94896	0.01026	-2.48247	5.11925	0.72	26.20677
Mobility	107.11563	-0.00734	9.07108	-5.11519	0.72	26.16520
RFID	75.09056	-0.00554	7.59938	-4.61216	0.67	21.27198
Compliance	-31.11337	0.00894	-1.90967	4.51514	0.66	20.38646
Communication	78.72792	-0.00485	8.71002	-4.41905	0.65	19.52799
Innovations	-40.74110	0.00847	-2.50115	4.27977	0.63	18.31646
Information technology	93.20680	-0.00729	5.69153	-3.66445	0.55	13.42821
Outsourcing	83.40365	-0.00675	5.44494	-3.62887	0.55	13.16872
Corporate social responsibility	-52.30970	0.01279	-1.80344	3.62831	0.55	13.16466
Globalization	-14.93921	0.00329	-1.98040	3.58794	0.54	12.87331
Environment	77.20839	-0.00444	7.52934	-3.56659	0.54	12.72055
Sustainability	-56.03555	0.01101	-2.07701	3.35907	0.51	11.28333
Research and development	-45.57646	0.00879	-2.04418	3.24563	0.49	10.53413
Restructuring	-55.45580	0.01107	-1.97567	3.24438	0.49	10.52601
Risk assessment	-41.93137	0.01010	-1.60994	3.18997	0.48	10.17593
KPIs	-61.73327	0.00966	-2.40239	3.09273	0.46	9.56495
Internet of Things	-27.84954	0.00388	-2.65232	3.03970	0.45	9.23975
GDP growth	-44.35529	0.00801	-2.01788	2.99825	0.44	8.98948
Cost trends	-28.48469	0.01035	-0.99367	2.97161	0.44	8.83046

Risk management	-39.14722	0.00851	-1.59079	2.84409	0.41	8.08887
Climate Change	-24.88829	0.00653	-1.31296	2.83263	0.41	8.02379
Megatrend	-50.90274	0.00929	-1.87021	2.80766	0.41	7.88294
Life expectancy	-62.99944	0.01172	-1.79975	2.75557	0.40	7.59317
Business Strategy	-49.44116	0.00958	-1.71845	2.74129	0.39	7.51467
Methods	46.15446	-0.00271	5.67627	-2.74076	0.39	7.51178
Business model	-60.47064	0.00986	-2.02277	2.71448	0.39	7.36839
Social media	-61.59723	0.01160	-1.67351	2.59346	0.36	6.72603
Remote services	-63.14198	0.01158	-1.65661	2.49942	0.34	6.24711
Trends	50.17651	0.00211	7.18651	2.48491	0.34	6.17478
New trends	-57.32206	0.00980	-1.74495	2.45493	0.33	6.02670
Normalization	-60.89993	0.01145	-1.56062	2.41478	0.33	5.83115
Technology	62.19142	-0.00304	5.97597	-2.39988	0.32	5.75942
Supply chain	3.48843	0.00119	0.83854	2.34635	0.31	5.50537
Internationalization	-55.22052	0.00976	-1.60315	2.33146	0.31	5.43572
Transparency	-1.69270	0.00223	-0.21095	2.29020	0.30	5.24500
Social networking	-32.50574	0.00815	-1.09525	2.26041	0.29	5.10943
Sustainable development	-27.60787	0.00870	-0.86311	2.23705	0.29	5.00440
Energy	39.10270	0.00343	2.93216	2.11949	0.26	4.49225
Innovation	59.48255	-0.00036	7.17828	-0.35344	-0.10	0.12492
Pensions	29.18896	0.00097	1.15758	0.31566	-0.10	0.09964
Safety	56.14582	0.00011	6.02723	0.09422	-0.11	0.00888
Water	6.02090	-0.00001	5.36794	-0.04568	-0.11	0.00209

The above results are now used to verify whether the linear regression model developed in the previous section could be improved by integrating the trend indicator into the developed equation (see 4.2.2.2). For the implementation process, five trends with the best-adjusted R-square indicator on the global and on the local level were included into the cross-sectional regression analysis. First, we reflect on the quality of model developed on the cross-sectional data. The model includes shareholders' equity and operating income as independent variables, and CRI as the dependent variable. The R-square value of this model was 0.103 and the adjusted R-square amounted to 0.097. In comparison, the linear regression models that utilize the Google Trends index outperform the model based on financial key performance indicators (KPIs). Another aspect is that the data is closer to the regression line created with the Google Trends index models. However, we cannot assume that web searches are the only influence on the use of trends in annual reports. Now, let us assume that the additional information gained from the analysis with Google Trends improves the initially developed model in section 4.2.1.2. Consequently, the estimated regression function is extended with one Google Trends index, as depicted in Equation 23.

Equation 23: Estimated regression function for CRI and Google Trends

$$CRI_{DAX,Year} = b_0 + b_1 OI_{DAX,Year} + b_2 SE_{DAX,Year} + b_3\ GT \tag{23}$$

$OI_{DAX,Year}$	$\sum_{n=1}^{30} CRI_{Report,Year}\ (i)$
$SE_{DAX,Year}$	$\sum_{n=1}^{30} CRI_{Report,Year}\ (i)$
GT	Google trend Index

The Google Trend variable contains annual data for a specific trend that was gained from the analysis above. Here, ten trends were implemented into the regression function, and results for the analysis were calculated to identify possible improvement potential.

Table 54: Improvement of OLS model of CRI index

	Unstandarized coefficient beta				Standarized coefficient beta					
Trendname	**I**	**OI**	**SE**	**GT**	**I**	**OI**	**SE**	**GT**	**R-Square**	**Adjusted R-square**
Regional settings: Local										
Social media	341.297 [a]	.011 [a]	.002 [b]	-2.795 [a]		.176 [a]	.140 [b]	-.218 [a]	0.149	0.141
RFID	314.569 [a]	.011 [a]	.002 [b]	-3.593 [a]		.182 [a]	.141 [b]	-.217 [a]	0.149	0.141
Information technology	282.088 [a]	0.11 [a]	.002 [b]	-2.249 [a]		.179 [a]	.146 [b]	-.194 [a]	.139	.131
Outsourcing	274.519 [a]	.011 [a]	.002 [b]	-2.418 [a]		.179 [a]	.147 [b]	-.194 [a]	.139	.131
Environment	353.453 [a]	.011 [a]	.002 [b]	-3.600 [a]		.180 [a]	.147 [b]	-.191 [a]	.138	.130
Regional settings: Global										
Innovation trends	142.108 [a]	.011 [a]	.002 [b]	2.367 [a]		.175 [a]	.144 [b]	.222 [a]	.151	.143
Corporate responsibility	571.945 [a]	.011 [a]	.002 [b]	-6.359 [a]		.177 [a]	.142 [b]	-.217 [a]	.148	.141
Internationalization	288.819 [a]	.011 [a]	.002 [b]	-2.971 [a]		.181 [a]	.142 [b]	-.213 [a]	.147	.139
Oil market trends	321.059 [a]	.011 [a]	.002 [b]	-2.819 [a]		.180 [a]	.142 [b]	-.208 [a]	.145	.137
Strategic trends	155.472 [a]	.011 [a]	.002 [b]	1.718 [a]		.175 [a]	.148 [b]	.200 [a]	.141	.134

[a] $p < 0.01$.

[b] $p < 0.05$.

I: Intercept / coefficient

OI: Operating income

Five trends from the regression based on local and five trends from the global Google Trends index were selected for additional regression analysis. The assumption was if the additional variable improves the initial model developed on the cross-sectional data foundation, then the overall R Squared and adjusted R Squared value should demonstrate an improvement. The overall results show that the regression coefficients calculated based on Google Trend data have the strongest influence on CRI. All implemented trends improved the results of the initial model by an improvement of R^2. However, the improvement has to be rated as having a rather minimal effect on the initial model. In the group of trends that were acquired with the regional settings (Germany), the trend with the highest Pearson correlation to the CRI index "Social media" improved the R-square index of the model by .046 or 44%.

In detail, the independent variables in the linear regression model are able to explain 14% of the variation in the CRI index. In the examples above, the Google Trends index based on the term "Environment" improved the model by 26%. In the examples with the global settings, the Google Trends index based on the term "Innovation trends" improved the model by .40 or 39%. "Strategic trends" led to an improvement of .31 or 30%. The improvements visualized in percentage points indicate strong improvement. In addition, the resulting coefficients (standardized and unstandardized) indicate a huge influence of the newly implemented variable to the overall ordinary least square (OLS) regression model. In each model demonstrated in the Table 54, the Google Trends index influences CRI significantly. Of course, this is not true for all trend models calculated. However, this result stands out. Furthermore, in all of the demonstrated models, shareholders' equity had the lowest influence and the lowest significance with $p < 0.05$.

Conclusion 19: The implementation of variables based on Google Trend into existing regression models, in our case CRI index based on financial KPIs, was able to deliver improvement. The improvement amounts to an additional 5% of explanatory capacity of the total variance.

4.2.3.3 GEE model for CRI index operating income and web searches

In contrast to the cross-sectional analysis, implementing and analyzing the impact of the Google Trends trend index for annual reports (ARPs) on the panel level requires several steps of preparation. First, the obtained annualized Google Trends data needs to be related to the aggregated confidence ranking index (CRI) on the level of the ARPs. To achieve this connection, trend passages (TP) in the annual reports (ARP) need a logical connection to the global and local Google Trends data. As demonstrated in section 4.2.2.3, the individual CRI index resides on the level of the ARP. Afterwards, this information needs to be aggregated in the form of a summarized index, which can then be used for panel analysis. For this purpose, two variables that represent the addition of each index of the local and global Google Trends index have been implemented, as depicted below.

Equation 24: Aggregation of GoogleTrend data per annual report

$$GT_{ARP} = \sum_{n=1}^{Total\ Trends} GT_{TP}(n) \tag{24}$$

These indices represent the total value of trends that was acquired from the Google Trend data. It follows the logic that was applied to the other indices created. The index was created based on the global dataset and on the local dataset. Each of the trends used in the ARPs and the Google Trends index depend on the year of publication. Therefore, the individual trend in the ARP relates to a dedicated value in the annual Google Trends time series of the keyword queried. In some cases, the trends used in the ARPs are not represented in the Google Trends data. In this case, the data is represented with a value of 0 in the database.

The above steps complete the preparation process, and the local and global Google Trends variables are now incorporated into the GEE model that was already developed and utilized in section 4.2.1.3. The generalized estimating equation (GEE) model for the CRI index now depends on the shareholders' equity, the global and the local Google Trends variables. Analogous to section 4.2.1.3, a GEE model that is founded on the same variables and adds the Google Trends indices to the overall model is specified. The ANCOVA test indicates validity of the model and motivates further development ($F=9.119$ $p < .001$). With an R^2 of .426 and adjusted R^2 of .379, the new configuration looks promising in comparison to the model developed in section 4.2.1.3. Levene's test of equality indicates that the error variance is equal across all groups ($p < .01$). Table 55 illustrates the results of the ANCOVA analysis.

Table 55: ANCOVA for extended panel with global and local index

Variable	Degrees of freedom (df)	F-Value	Sig.	Partial Eta Squared
(Constant)	13	57.653	.000***	.242
Operating Income	1	6.420	.000***	.043
Global GT index	1	43.338	.000***	.234
Local GT index	1	4.890	.340	.003
Annual year	10	1.828	.049*	.056

*p < .05. **p < .01. ***p < .001.

As shown above, the constant qualifies mostly to describe the variances in the model (Partial Eta Squared of .242). The newly introduced global Google Trends index also demonstrates explanatory capacity (Partial Eta Squared of .234). As a reminder, this index represents the Google Trends search results to the term of trend used within the dedicated company annual report of a specific year. On the contrary, the local Google Trends index performs worse in comparison to the global index. This index is not even significant within the model. The above results are based on the total amount of annual reports published (n=330). For 161 APRs, no local Google Trends index is created, which explains the low significance of the index, due to the dominance of the Google Trends index. However, a second ANCOVA analysis reveals that the model based on the local Google Trends index produces significant results, with local Google Trends index significant in the model ($p < 0.001$). These results are depicted in Table 56.

Table 56: ANCOVA comparison with global and local index

Parameter	Model 1 Based on global GT Index	Model 2 Based on local GT index
df	12	12
Sig.	.000	.000
F-Value	20.895	9.923
Partial Eta Squared	0.442	.273
R^2	0.442	.273
Adjusted R^2	0.421	.246

As shown in the above comparison, the global Google Trends Index model outperforms the local Google Trends model based on the ANCOVA analysis and on a comparison of the R^2 values and the partial ETA squared. The results of Model 1 motivate the further development. According to section 4.2.1.3., we specify the model and identify the best working correlation structure by testing different model types. As variables we include "corporation_id" (n=30), which represents the ARPs in the individual year. Within-subject effect is determined by "Annual_year." Table 57 illustrates the results of the working-correlation structure comparison between (1) independent, (2) one-period Autoregressive, and (3) exchangeable.

Table 57: GEE model comparison with different working correlations

Parameter	GEE , Normal distribution, Independent correlation		GEE , Normal distribution, one-period autoregressive correlation		GEE, normal distribution, exchangeable correlation	
	Unstandardized coefficient	**Standard error**	**Unstandardized coefficient**	**Standard error**	**Unstandardized coefficient**	**Standard error**
(Intercept)	201.962***	32.2955	229.513***	33.7547	223.801***	33.8474
[ANNUALYEAR=2004.00]	-102.898*	41.3220	-119.762**	41.8252	-113.890**	38.3359
[ANNUALYEAR=2005.00]	-144.190***	40.7059	-154.556***	41.0512	-151.762***	37.4642
[ANNUALYEAR=2006.00]	-101.356*	40.9496	-114.434**	41.3038	-108.603**	37.7558
[ANNUALYEAR=2007.00]	-87.602*	40.8722	-99.539*	41.1762	-93.529*	37.6284
[ANNUALYEAR=2008.00]	-59.202	40.7485	-68.830	41.0864	-68.525	37.5682
[ANNUALYEAR=2009.00]	-14.996	41.0108	-28.195	41.3230	-26.310	37.9653
[ANNUALYEAR=2010.00]	-61.069	40.5325	-68.619	40.3188	-65.146	37.1754
[ANNUALYEAR=2011.00]	-59.933	40.6351	-69.009	39.6868	-64.570	37.3111
[ANNUALYEAR=2012.00]	-59.317	40.6769	-68.642	37.7426	-63.489	37.3548
[ANNUALYEAR=2013.00]	-59.954	40.4355	-65.622*	31.7781	-63.312	37.0455
[ANNUALYEAR=2014.00]						
Operating income	.010***	.0027	.009**	.0033	.007*	.0032
Global Google Trends index	.902***	.0719	.786***	.0777	.861***	.0780
Quasi-likelihood under independence model criterion (QIC)	7729839.568		7814574.816		7792790.547	
Corrected Quasi-likelihood under independence model criterion (QICC)	7729834.230		7814571.401		7792785.744	

*p < .05. **p < .01. ***p < .001.

The comparison between the working correlation structures indicates similar results to the analysis in section 4.2.1.3. Even though the major difference is depicted in the quality indicators QIC and QICC, which lie closer together in this case. Another difference is the statistical significance of the variable "ANNUAL_YEAR." In the above models, the variable "ANNUAL_YEAR" is less dominant, which results in the fact that only few parameters are statistically significant. The fiscal years 2004, 2005, and 2006 are especially significant. In these years, the indicator "global Google Trends" is less dominant in contrast to "ANNUAL_YEAR." In detail, several datasets provided by Google Trends could be identified that have no significant value until the year 2011. The data quality may lack in these years, producing unsatisfying results for the long-term analysis. However, the effect is well compensated for due to the influence of the parameter "Annual year." The next step in the quality assessment is the analysis of the working correlation structures, as shown in Table 58.

Table 58: Working correlation structure comparison

Structure 1	**2004**	**2005**	**(…)**	**2013**	**2014**
2004	1	0		0	0
2005	0	1		0	0
(…)			(…)		
2013	0	0		1	0.535
2014	0	0		0	1
Structure 2	**2004**	**2005**	**(…)**	**2013**	**2014**
2004	1	0.393		0.000	0.000
2005	0.393	1		0.001	0.000
(…)			(…)		
2013	0.000	0.001		1	0.393
2014	0.000	0.000		0.393	1
Structure 3	**2004**	**2005**	**(…)**	**2013**	**2014**
2004	1	0.170		0.170	0.170
2005	0.170	1		0.170	0.170
(…)			(…)		
2013	0.170	0.170		1	0.170
2014	0.170	0.170		0.170	1

The independent depicted as Structure (1) does not model the interaction between the different times of observations, and shows no correlation between the "Annual years." Structure (2) indicates a decreasing correlation between the annual years. Structure (3) stays constant with a factor of .0170.

Conclusion 20: The "global Google Trends" index provides an ideal ground for the optimization of the previously developed GEE model. The generalized estimated equation based on one-period autoregressive correlation fits the conceptual model best.

5 DISCUSSION AND CONCLUSION

5.1 RESEARCH CONCLUSION

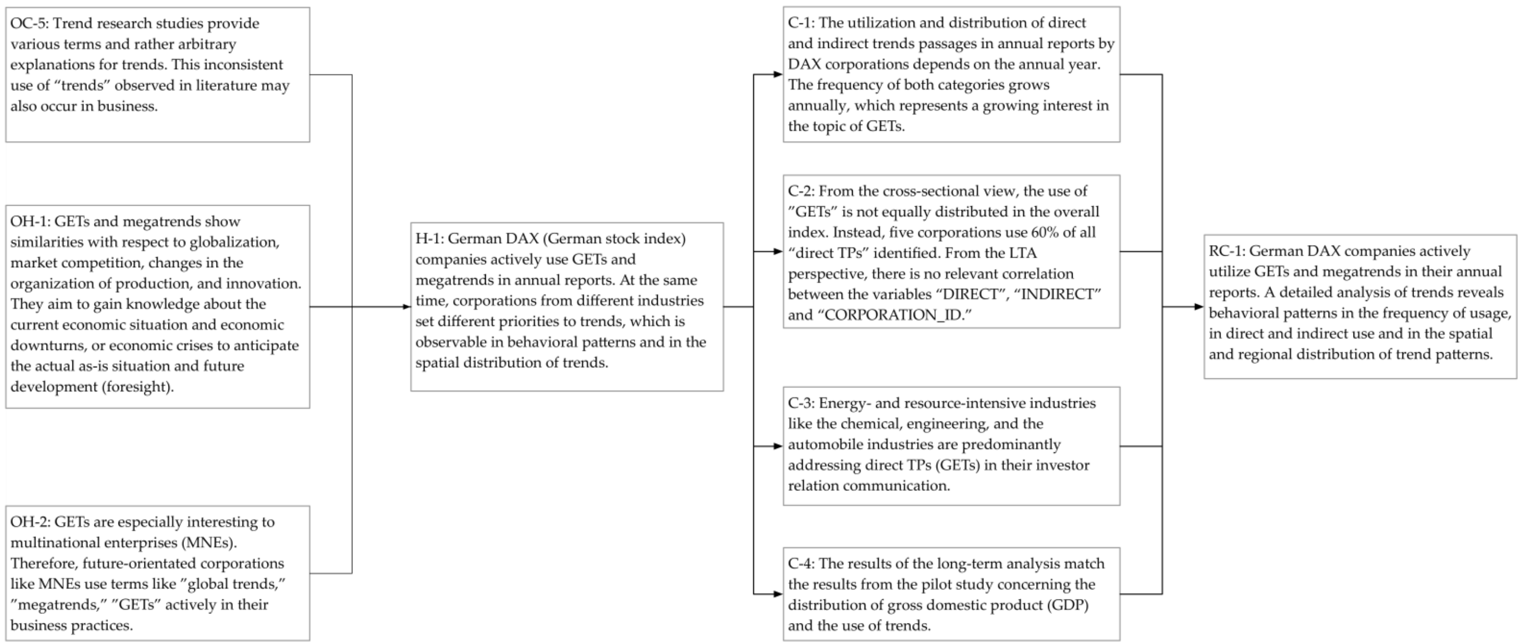
In section 3.3.1.1, hypotheses that built the foundation for the empirical research were created based upon the results of the literature review in Chapter 2, and on the results of the pilot study. Due to the numbering system that was implemented for operationalizable conclusions (OC), operationalizable hypotheses (OH), hypotheses (H), and conclusions (C), the overall argumentation process is illustrated graphically in this section. This section draws inferences from analysis to literature. The discussion is founded on the hypotheses created in section 3.3.1.1, which have a relation to the literature review and the pilot study.

1. General utilization of GETs in investor relation

The analysis revealed that Megatrends or global economic trends (GETs) showed a continuous growth in popularity in the period of analysis from 2004 to 2014. Among all multinational enterprises (MNEs) within a country, some MNEs are prone to utilize trends in their investor relation communication. This assertion was empirically researched in section 4.1.1, and resulted in three conclusions. The research based on Hypothesis 1 resulted in the conclusion that the use of trends in the DAX (German stock index) corporations has grown since 2004. Five corporations use 60% of all direct trend passages (TPs) in the overall population. The spatial distribution of regions and cities reveal that some regions in Germany are more prone to utilizing trends. In addition, the results emphasize the insights gained from the pilot study. In addition, energy-intensive industries are more prone to use TPs in their investor relations, as shown in Figure 52

Research conclusion 1: German DAX companies actively utilize GETs and megatrends in their annual reports. A detailed analysis of trends reveals behavioral patterns in the frequency of usage, in direct and indirect use and in the spatial and regional distribution of trend patterns.

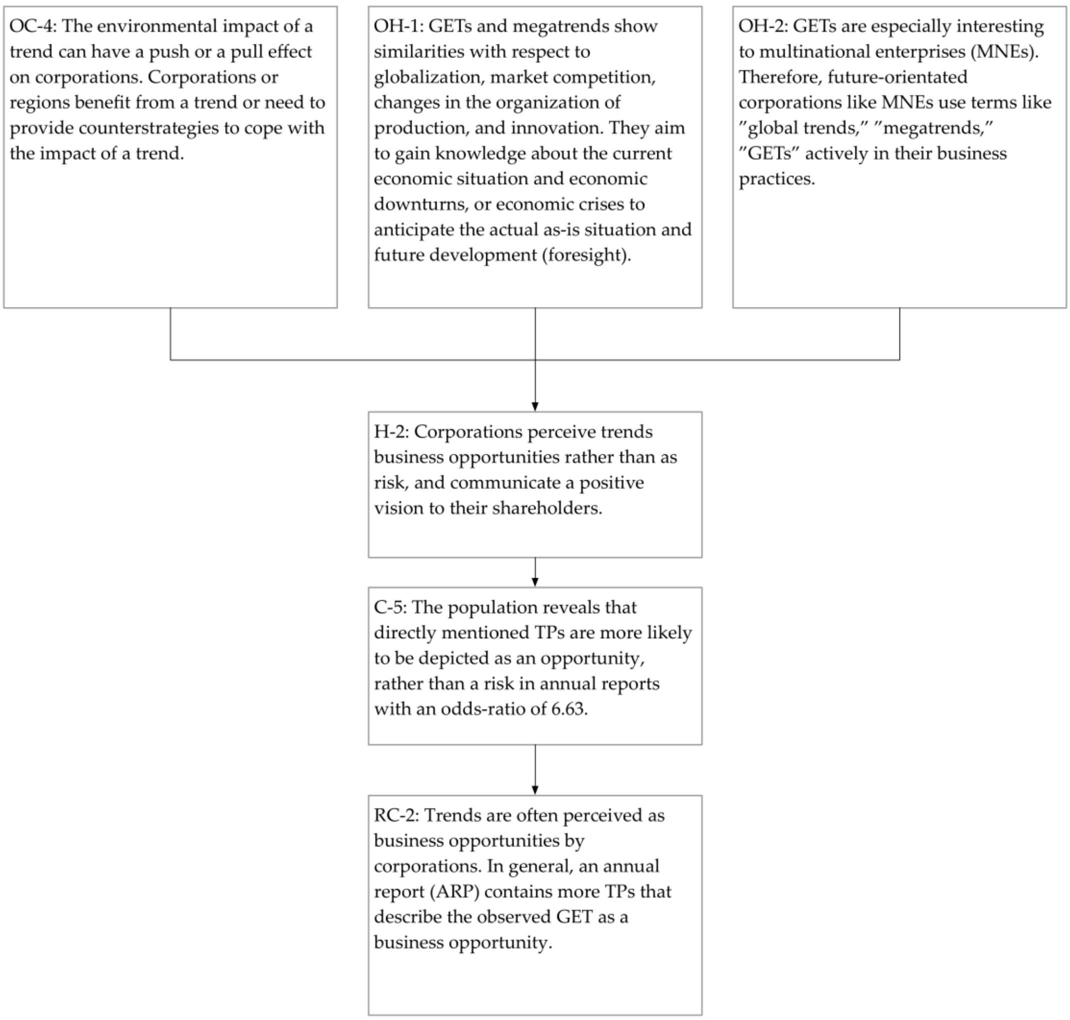
Figure 82: Argumentation map for hypothesis 1



2. Opportunitic communication behavior of GETs in investor relation

At the heart of the analysis was the hypothesis that corporations portray global economic trends mostly as business opportunites in annual reports. The key supportive argument for Hypothesis 2 was delivered by the chi-square analysis. The data reveals an odds-ratio of 6.63 that direct TPs are perceived as an opportunity, rather than a risk. The chi-square analysis reveals a strong association between the variables. Overall, it can be concluded that the data acquired support the hypothesis, which leads to the following research conclusion.

Figure 83: Argumentation map for hypothesis 2



Therefore, trends are most oftently perceived as a business opportunity by German blue chips corporations. The overall argumentation chain is depicted in **Fehler! Verweisquelle konnte nicht gefunden werden.**. The chi-square analysis eveals a strong association between the variables. Overall, it can be concluded that the data acquired support the hypothesis, which leads to the following research conclusion.

Research conclusion 2: Trends are often perceived as business opportunities by corporations. In general, an annual report (ARP) contains more TPs that describe the observed GET as a business opportunity.

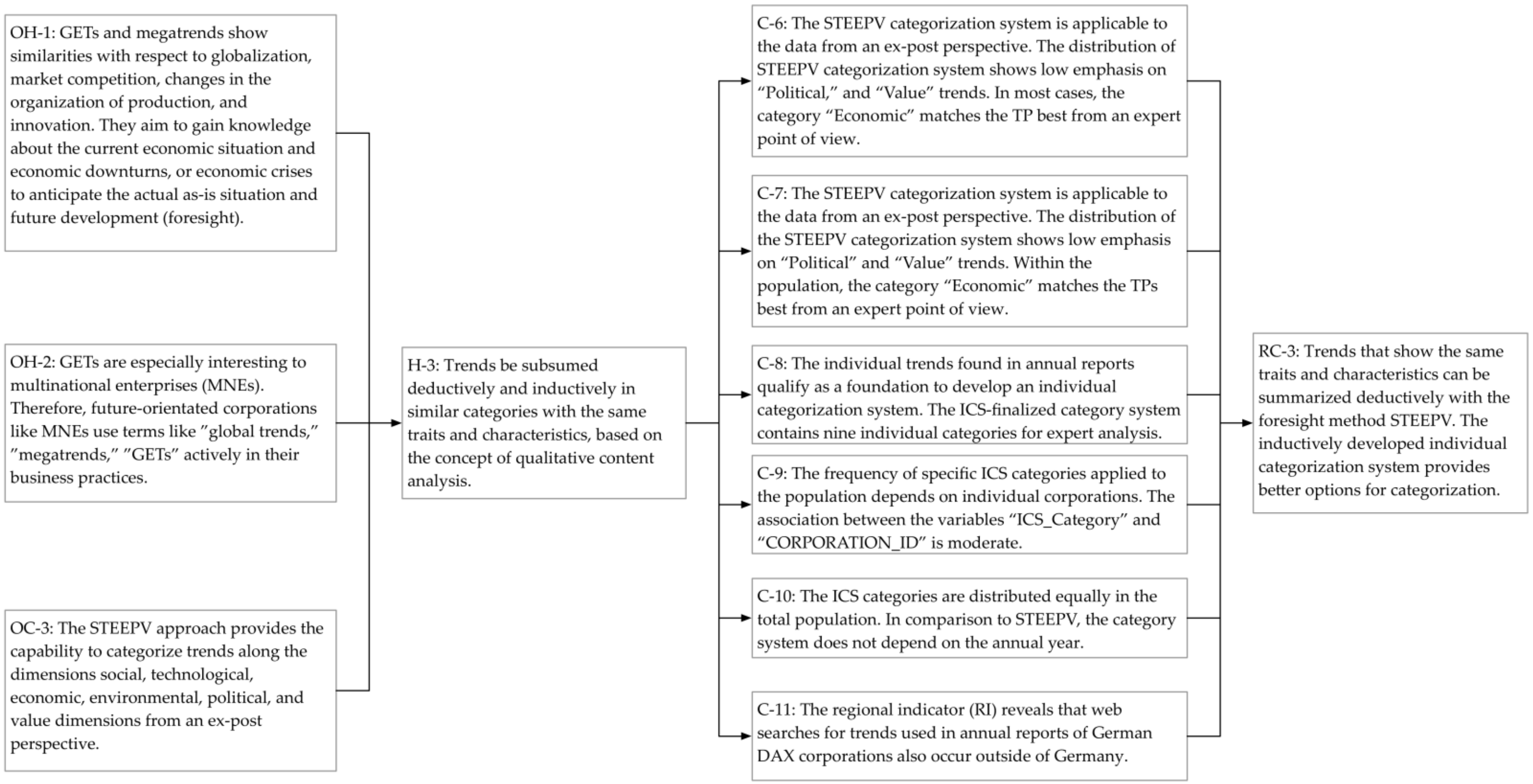
3. Categorization of trends

Based on the literature reviews, and partially motivated by the research of the pilot study, the empirical analysis investigated the categorization of trends. Hypothesis 3 assumed that trends that show the same characteristics could be summarized into similar categories based on an existing categorization system. Furthermore, it was assumed that an individual categorization system is able to outperform an existing categorization system in terms of effectiveness and efficiency.

As illustrated in Figure 84, six conclusion were drawn that deliver strong support for Hypothesis 4. In general, STEEPV is applicable to the data and delivers results for the overall data. However, the results indicate that the system is not optimal for the categorization process. An individual categorization system called ICS was developed based on qualitative content analysis. A comparative analysis between the two systems shows that the ICS system for categorization outperforms the STEEPV.

Research conclusion 3: Trends that show the same traits and characteristics can be summarized deductively with the foresight method STEEPV. The inductively developed individual categorization system provides better options for categorization.

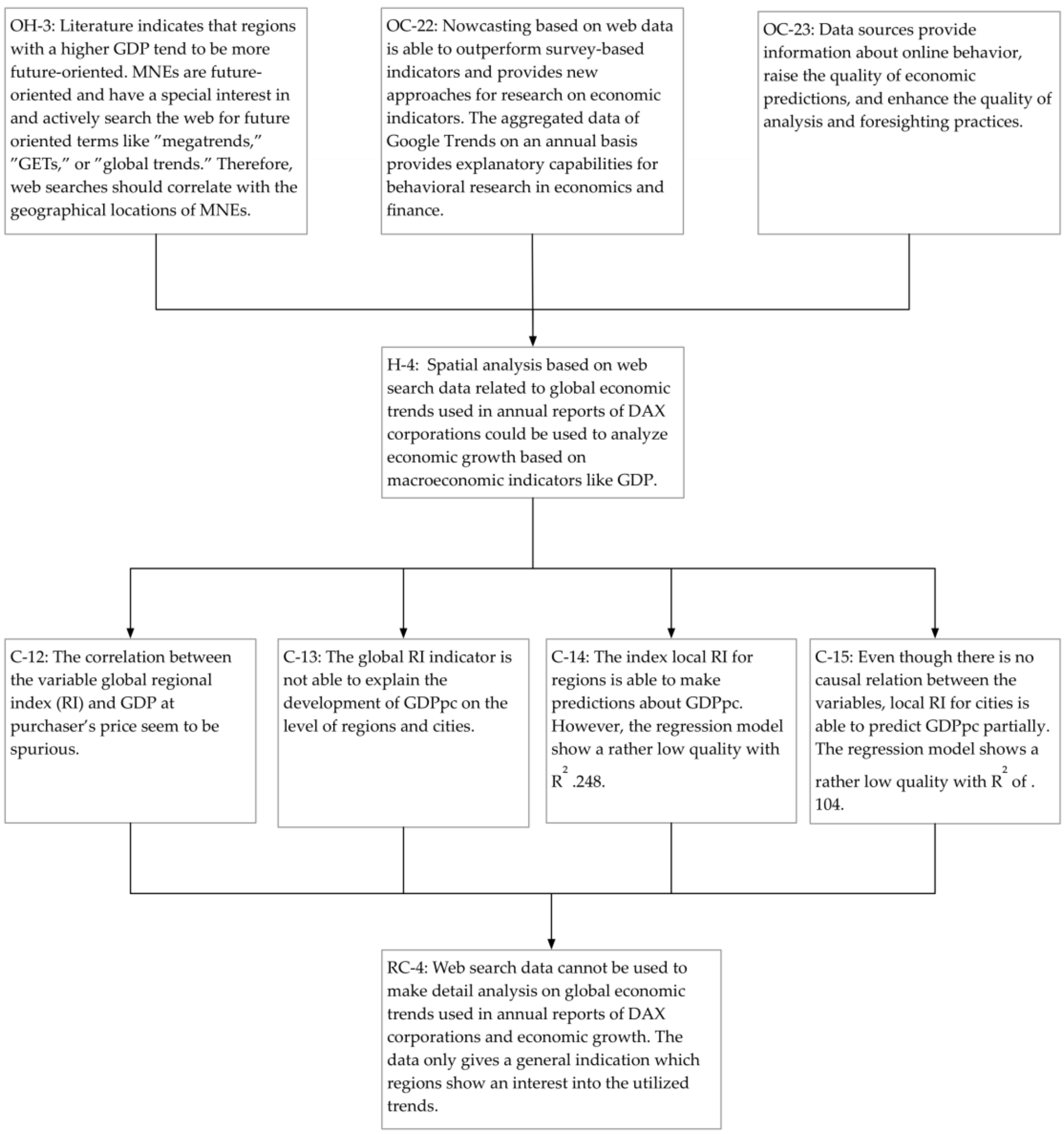
Figure 84: Argumentation map for hypothesis 3



4. Spatial analysis based on web search data

Hypothesis 4 assumed that the spatial information provided by web search trends are applicable to foresight activities and even foster the capabilities and quality of FSSs, or GISs. The core hypothesis was founded mainly on the results of the pilot study. However, the empirical analysis had different results as the pilot study. The reults of the analysis are shown in Figure 85.

Figure 85: Argumentation map for hypothesis 4



The developed indicator RI index was used to research the spatial information on a global and regional level. This concept was founded partially on the results of the pilot study and the insights gained from literature review. In general, the gained insights support the initial hypothesis only partially. The regional indicator (RI) reveals that web searches for trends used in annual reports of German DAX corporations also occur outside of Germany, and especially in economically well suited regions. In detail, the correlation between global RI index and GDP at purchaser's price in 2014 has to be perceived as being a spurious correlation. In comparison, a population-based indicator has a far better explanatory capacity, which was demonstrated during the analysis. The empirical analysis used the RI index, which is an aggregated index that has a higher quality of information compared to the indicator used in the pilot study. The analysis on the correlation of gross domestic product per capita (GDPpc) showed that the global RI indicator was not able to explain the development of GDPpc on the level of regions and cities. Only the index local RI is partially able to make predictions about GDPpc. The regression model show a rather low quality with R^2 .248 for the analysis on regions, and an ever bader quality on the level of cities with R^2 of .104.

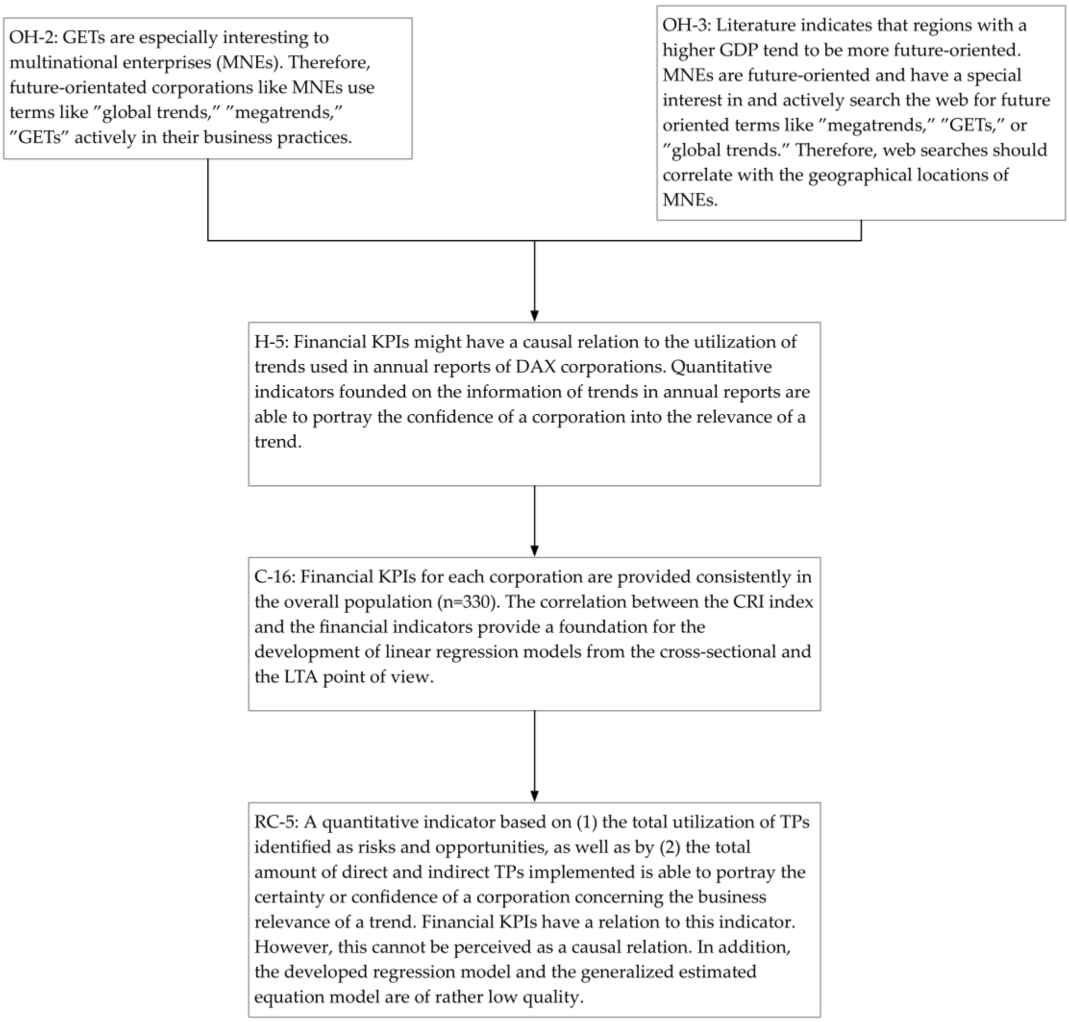
As a sidenote, Google Trends data does not deliver a coherent global dataset that visualizes the use of trends, due to governmental restrictions (e.g. China and Russia's). On the other hand, the geographical settings implemented in Google Trend might require modification. It was observed that data acquired indicated that Google reports the "Canton of Schaffhausen" to be a region of Germany. The "Canton of Schaffhausen" is located in the north of Switzerland. Future researchers need to investigate carefully the results delivered by Google Trends.

Research conclusion 4: Web search data cannot be used to make detail analysis on global economic trends used in annual reports of DAX corporations and economic growth. The data only gives a general indication which regions show an interest into the utilized trends.

5. Relation of financial indicators and CRI (confidence ranking index)

To further investigate into the behavioral aspects of the use of trends in investor relations, and to further apply the gained longitudinal data, the thesis assumed that financial KPIs have an influence on the use of trends. This concept was mainly motivated by the results of the pilot study, which investigated only the interdependence between GDP and web search indicators. The argumentation is depicted in Figure 86.

Figure 86: Argumentation map for hypothesis 5



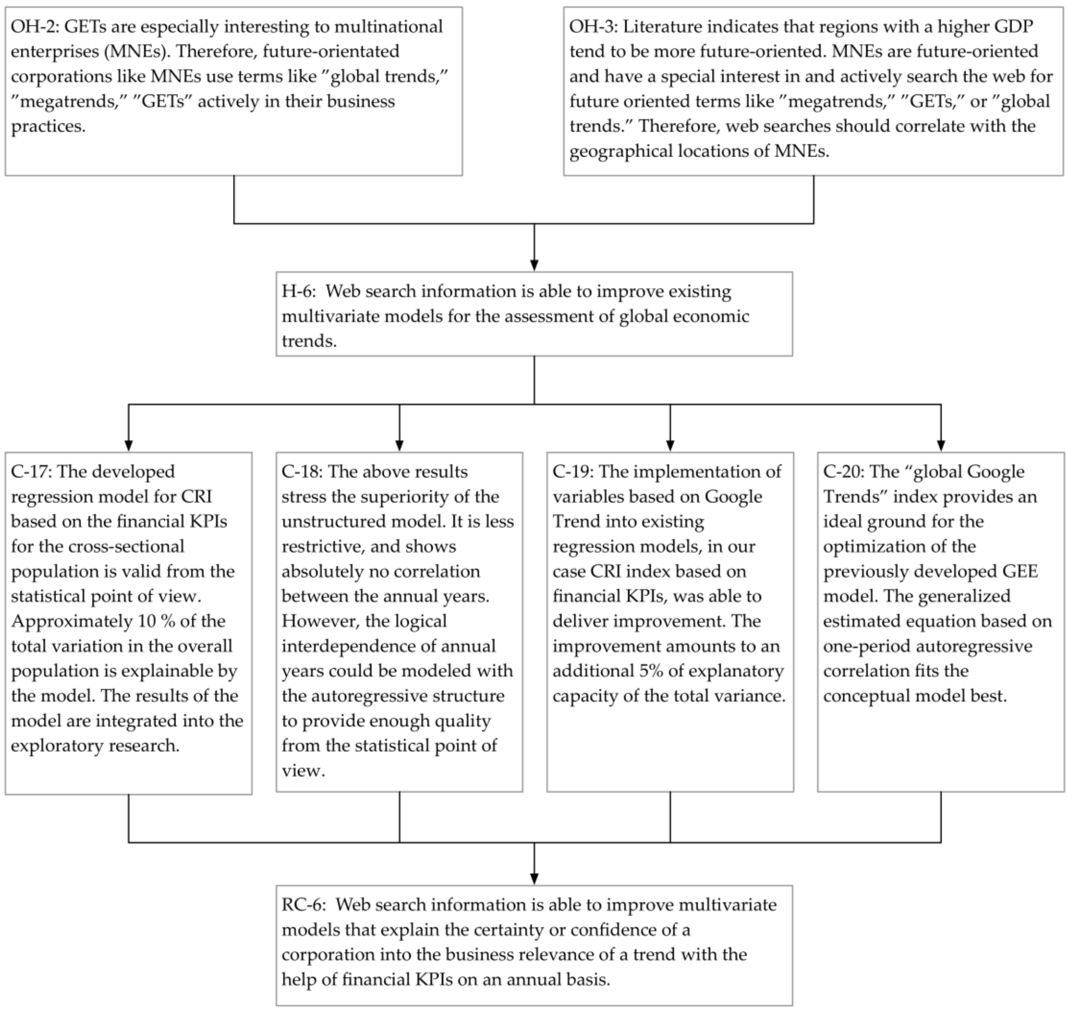
The confidence of corporations into a certain trend was codified into an indicator based on (1) the total use of TPs identified as risks and opportunities, as well as by (2) the total amount of direct and indirect TPs implemented, which was codified in the index CRI. An initial correlation analysis motivated the development of the regression models. From the cross-sectional point of view, the conceptual multivariate model has an R-square of .103 and an adjusted R-square of .097, which is rather unsatisfying, and is not the result for the overall analysis. At this point, we take away that the developed ordinary least squares (OLS) model is a conceptual step in the exploratory research approach. The panel data model based on GEE delivered better results, because it is able to model the annual interrelation between the different points of measurement. The exploratory research approach feeds from both results as it provides logical adjustments in the course of research.

Research conclusion 5: A quantitative indicator based on (1) the total utilization of TPs identified as risks and opportunities, as well as by (2) the total amount of direct and indirect TPs implemented is able to portray the certainty or confidence of a corporation concerning the business relevance of a trend. Financial KPIs have a relation to this indicator. However, this cannot be perceived as a causal relation. In addition, the developed regression model and the generalized estimated equation model are of rather low quality.

6. Optimization of regression models with web search data

The next step of the analysis focused on the improvement of the previously developed linear regression and GEE model that assumed that financial KPIs have an impact on the use on trends in annual reports. In this case, it was assumed that web search data is able to improve the quality of both models. This assumption led to three conclusions, as illustrated in Figure 87.

Figure 87: Argumentation map for hypothesis 6



In this context, web search data was added to the overall data as an explanatory variable. An automated linear regression and correlation analysis developed in R identified the trends that fit best for the linear regression model. These trends were used to optimize the model. The analysis revealed that an overall improvement of 44% of the multivariate model could be achieved by the integration of web trends. The application of web search data to the GEE model delivered even better results. These results delivered strong support for the initial hypothesis, leading to the following conclusion.

Research conclusion 6: Web search information is able to improve multivariate models that explain the certainty or confidence of a corporation into the business relevance of a trend with the help of financial KPIs on an annual basis.

5.2 THEORETICAL CONTRIBUTIONS

This thesis contributes to different strains of theoretic development in the field of economics. In detail, recent discussion about the low value of information that is provided by terms such as megatrends illustrates the criticism that stems from foresight practitioners, as revealed by reviewing articles from the magazine *Technological Forecasting and Social Change*. By reviewing studies on trends from industry practitioners such as consulting companies and governmental institutions, it was demonstrated that trend terms like “global economic trends (GETs)” and ”megatrends” were used arbitrarily. The strong subjective character of these studies leads to the assumption that especially the terminology ”megatrend” has no value, and should be replaced by a compound term like “environmental trend” or ”GET.” From this perspective, an empirical analysis was conducted to examine further the use of trends in the context of German blue chips companies. In this context, the annual reports published by these corporations were used as an indicator and consequently researched from the period of 2004 to 2014. The primary data obtained in the empirical analysis of the thesis support the theoretical argumentation.

Theory on foresighting provides tools for the analysis of trends from the ex-ante perspective for the development of scenarios or for conducting expert panels such as Delphi studies. In addition, foresight provides tools for the classification of trends such as STEEPV (Social, technological, economic, environmental, political, values). However, no tools are provided to categorize trends from an ex-post perspective. The thesis developed an individual approach to the categorization of trends used in financial publications, in this case annual reports. The categorization system ICS is able to outperform the STEEPV and is an additional component in the toolset of foresighting that was portrayed in the literature review. Furthermore, the tool provides the capability to research trends in financial publications such as annual reports. Future practitioners could apply this system to annual reports from other international stock market indices.

A growing body of literature has investigated Google Trends and pointed out that the data of search queries provided by Google are an ideal foundation for econometrical analysis (cf. e.g. Askitas and Zimmermann, 2009; Choi and Varian, 2012; Vosen and Schmidt, 2011; Dimche and Davcev, 2014). The SVI (Searching volume index) provides a measure to show the importance of a certain keyword used for web searches (Dimche and Davcev, 2014, p. 34). So far, there has been little to no work that researches GETs with Google Trends. This was investigated more deeply by applying the methodologies of mixed-method research, which combine qualitative analysis with quantitative analysis. The literature highlights that this form of research is growing in popularity. The mixed-methods approach is an ideal tool for the research of GETs in combination with web searches. The results in this thesis contribute to the applications of mixed methods. In the field of behavioral research founded statistical models, the thesis provided a unique approach to optimize the quality of multivariate models for cross-sectional analysis of a population and for the analysis of panels based on generalized estimated equations. By implementing web search data into linear regression and generalized estimation equation models, the overall performance of the models was improved. To integrate and to prepare the web search data, several steps of data preparation needed to be applied to the data and have been demonstrated in the empirical design of the research study. This approach is directed to provide other researchers further help on developing individual trend methodologies.

5.3 CONTRIBUTION TO MANAGEMENT PRACTICE

Recent research based on economic indicators and web search data found that regions with a higher GDP are more future-orientated (Preis et al., 2012). This idea was further examined in the study, and indicated that the web search information can only be used partially based on the concept implemented in the analysis. However, management practitioners should use this approach to verify if a trend is important to a potential audience that is interested in the annual report of the corporation. The study also revelaed an arbitry use of trends by corporations, consulting corporations, and public institutions. In this case, the developed methodology can be used to identify the best-fitted terminology for a phenomenon that should be conmmunicated as a trend to a public audience.

The aggregation of different trend terms provides the possibility to create maps of interest that can be used for detailed analysis. This set of interests is also portrayed as map of interests that visualize the global use of trends geographically. In this case, the results that the thesis contributes are usable for management practitioners that use web-based search data in econometrical models. The trend research component that collects data from Google Trends and does correlation analysis is also usable in a different context. The initial design of the database and the statistical function realized in R were designed to be utilizable and implementable into other software solutions like foresight support systems or geographical information systems. Data from Google Trends reveals valuable insights into the discussion of GETs, and provides further ground for enhancements in the field of corporate and regional forecasting models. The source code that was created in this thesis helps practitioners to create individual maps of interest for trends found in annual reports. This methodology is not restricted to the analysis of trends in annual reports. In addition, other types of trends can be included in the algorithm to create geographical maps that visualize the interest of web users. Furthermore, the integration of this information into FSS is perceived as a value-adding step in the process of nowcasting.

5.4 LIMITATIONS OF RESEARCH

The scope of the study has several limitations, which provide other researchers the opportunity to contribute to this field. One limitation stems from the design of the multivariate models developed in the thesis. The concept was only to integrate disclosed financial data and available web search data into the development of the explanatory models on the use of trends in annual reports. Due to the longitudinal design of the study, it was assumed that a survey-based approach could not deliver valuable results, as the responsible experts that decided on the use of trends in each individual year could not be obtained. This limitation was not problematic for the analysis conducted. Especially from an ex-post perspective, it has to be assumed that survey results are biased as well and do not reveal the underlying decision-making processes at point of creation.

Quantitative indicators implemented into the statistical models provide a benefit in the behavioral analysis. A possible step of improvement would be to develop a one-step forecast based on the regression models developed, and to compare these results with a survey that aims to obtain data about confidence in the use of trends in annual reports from industry practitioners. This step would add more quality to the developed regression model. Another limitation stems from the quality of web search data obtained. In this case, geographical information was not able to provide qualitative information on a global level about the use of trends. The governmental restrictions on the use of Google Trends in big economies like China and Russia reduces the explanatory quality of web search trends on a global scale. However, the obtained regional information about cross-border interest in web search trends emphasizes the work of globalization researchers such as Ghemawat or Hiltunen, who point out that even if megatrends are present in numerous geographical locations they are not always global, especially given that globalization is questioned concerning its global appeal. At the same time, the above statement also reflects the limitation of the analysis that stemed from the data that was provided by Google Trends. Future researches will also face this limitation, and should consider additional data soures for their analysis.

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Volkswagen AG (2013). Annual Report 2013. Retrieved at: http://www.volkswagenag.com/content/vwcorp/info_center/en/publications/2014/03/Y_2013_e.bin.html/binarystorageitem/file/GB+2013_e.pdf.

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APPENDIX

A.1. DAX ANNUAL REPORTS 2004 – 2014

Table 59: DAX annual reports from the fiscal period from 2004 to 2014

Corporation	Annual Reports (Protected pdf-files marked with (x))	Date of publication
Adidas AG	Adidas Group, 2004 (x)	March 9, 2004
	Adidas Group, 2005	March 2, 2005
	Adidas Group, 2006	March 7, 2006
	Adidas Group, 2007 (x)	March 5, 2007
	Adidas Group, 2008 (x)	March 3, 2008
	Adidas Group, 2009 (x)	March 4, 2009
	Adidas Group, 2010 (x)	March 3, 2010
	Adidas Group, 2011 (x)	March 2, 2011
	Adidas Group, 2012	March 7, 2013
	Adidas Group, 2013	March 5, 2014
	Adidas Group, 2014 (x)	March 5, 2015
Allianz SE	Allianz Group, 2004 (x)	March 17, 2005
	Allianz Group, 2005 (x)	March 16, 2006
	Allianz Group, 2006	March 16, 2007
	Allianz Group, 2007	March 20, 2008
	Allianz Group, 2008	March 13, 2009
	Allianz Group, 2009	March 19, 2010
	Allianz Group, 2010	March 18, 2011
	Allianz Group, 2011	March 23, 2012
	Allianz Group, 2012 (x)	March 15, 2013
	Allianz Group, 2013	March 14, 2014
	Allianz Group, 2014	May 6, 2015
BASF SE	BASF Group, 2004 (x)	March 9, 2005
	BASF Group, 2005 (x)	February 28, 2006
	BASF Group, 2006 (x)	February 21, 2007
	BASF Group, 2007 (x)	February 21, 2008
	BASF Group, 2008	February 21, 2009
	BASF Group, 2009 (x)	February 24, 2010
	BASF Group, 2010 (x)	February 24, 2011
	BASF Group, 2011 (x)	February 24, 2012
	BASF Group, 2012 (x)	February 26, 2013
	BASF Group, 2013	February 25, 2014
	BASF Group, 2014	February 27, 2015
Bayer AG	Bayer Group, 2004	March 15, 2005
	Bayer Group, 2005	March 6, 2006
	Bayer Group, 2006	March 15, 2007
	Bayer Group, 2007	February 28, 2008
	Bayer Group, 2008	March 3, 2009
	Bayer Group, 2009	February 26, 2010
	Bayer Group, 2010	February 28, 2011
	Bayer Group, 2011	February 28, 2012
	Bayer Group, 2012	February 28, 2013
	Bayer Group, 2013	February 8, 2014
	Bayer Group, 2014	February 26, 2015

Corporation	Annual Reports (Protected pdf-files marked with (x))	Date of publication
Beiersdorf AG	Beiersdorf AG, 2004	March 7, 2005
(Listed since 2008)	Beiersdorf AG, 2005	March 2, 2006
	Beiersdorf AG, 2006	March 5, 2007
	Beiersdorf AG, 2007	February 28, 2008
	Beiersdorf AG, 2008	March 3, 2009
	Beiersdorf AG, 2009 (x)	March 4, 2010
	Beiersdorf AG, 2010 (x)	March 3, 2011
	Beiersdorf AG, 2011 (x)	March 1, 2012
	Beiersdorf AG, 2012 (x)	March 5, 2013
	Beiersdorf AG, 2013	March 4, 2014
	Beiersdorf AG, 2014	February 13, 2015
BMW AG	BMW Group, 2004	March 14, 2005
	BMW Group, 2005	March 13, 2006
	BMW Group, 2006	March 13, 2007
	BMW Group, 2007	March 17, 2008
	BMW Group, 2008	March 18, 2009
	BMW Group, 2009	March 17, 2010
	BMW Group, 2010	March 14, 2011
	BMW Group, 2011	March 12, 2012
	BMW Group, 2012	March 14, 2013
	BMW Group, 2013	March 5, 2014
	BMW Group, 2014	March 18, 2015
Commerzbank AG	Commerzbank Group, 2004 (x)	March 14, 2005
	Commerzbank Group, 2005 (x)	March 29, 2006
	Commerzbank Group, 2006 (x)	March 28, 2007
	Commerzbank Group, 2007 (x)	March 28, 2008
	Commerzbank Group, 2008 (x)	March 27, 2009
	Commerzbank Group, 2009 (x)	March 24, 2010
	Commerzbank Group, 2010 (x)	March 29, 2011
	Commerzbank Group, 2011 (x)	March 29, 2012
	Commerzbank Group, 2012 (x)	February 23, 2013
	Commerzbank Group, 2013 (x)	March 21, 2014
	Commerzbank Group, 2014 (x)	March 18, 2015
Continental AG	Continental AG, 2004	March 21, 2005
	Continental AG, 2005	March 27, 2006
	Continental AG, 2006	March 26, 2007
	Continental AG, 2007	March 24, 2008
	Continental AG, 2008	March 23, 2009
	Continental AG, 2009	March 22, 2010
	Continental AG, 2010	March 21, 2011
	Continental AG, 2011	March 26, 2012
	Continental AG, 2012	March 25, 2013
	Continental AG, 2013	March 24, 2014
	Continental AG, 2014	March 23, 2015
Daimler AG	Daimler AG, 2004	February 15, 2005
	Daimler AG, 2005	February 16, 2006
	Daimler AG, 2006	February 14, 2007
	Daimler AG, 2007	February 14, 2008
	Daimler AG, 2008	February 17, 2009
	Daimler AG, 2009	February 18, 2010
	Daimler AG, 2010	February 16, 2011
	Daimler AG, 2011	February 14, 2012

Corporation	Annual Reports (Protected pdf-files marked with (x))	Date of publication
	Daimler AG, 2012	February 25, 2013
	Daimler AG, 2013	February 21, 2014
	Daimler AG, 2014	February 17, 2015
Deutsche Bank AG	Deutsche Bank AG, 2004	March 24, 2005
	Deutsche Bank AG, 2005	March 23, 2006
	Deutsche Bank AG, 2006	March 27, 2007
	Deutsche Bank AG, 2007	March 26, 2008
	Deutsche Bank AG, 2008	March 24, 2009
	Deutsche Bank AG, 2009	March 16, 2010
	Deutsche Bank AG, 2010	March 15, 2011
	Deutsche Bank AG, 2011	March 20, 2012
	Deutsche Bank AG, 2012	March 21, 2013
	Deutsche Bank AG, 2013	March 20, 2014
	Deutsche Bank AG, 2014	March 24, 2015
Deutsche Börse AG	Deutsche Börse Group, 2004 (x)	April 04, 2005
	Deutsche Börse Group, 2005 (x)	March 31, 2006
	Deutsche Börse Group, 2006 (x)	March 20, 2007
	Deutsche Börse Group, 2007 (x)	March 28, 2008
	Deutsche Börse Group, 2008 (x)	March 27, 2009
	Deutsche Börse Group, 2009 (x)	March 29, 2010
	Deutsche Börse Group, 2010 (x)	March 23, 2011
	Deutsche Börse Group, 2011 (x)	March 15, 2012
	Deutsche Börse Group, 2012 (x)	February 19, 2013
	Deutsche Börse Group, 2013 (x)	February 19, 2014
	Deutsche Börse Group, 2014 (x)	February 18, 2015
Deutsche Lufthansa AG	Lufthansa Group, 2004	23 March, 2005
	Lufthansa Group, 2005 (x)	23 March, 2006
	Lufthansa Group, 2006 (x)	8 March, 2007
	Lufthansa Group, 2007 (x)	12 March, 2008
	Lufthansa Group, 2008	11 March, 2009
	Lufthansa Group, 2009	11 March, 2010
	Lufthansa Group, 2010	17 March, 2011
	Lufthansa Group, 2011	15 March, 2012
	Lufthansa Group, 2012	March 15, 2013
	Lufthansa Group, 2013	March 14, 2014
	Lufthansa Group, 2014	March 12, 2015
Deutsche Post AG	Deutsche Post AG, 2004 (x)	March 17, 2005
	Deutsche Post AG, 2005	March 9, 2006
	Deutsche Post AG, 2006 (x)	March 13, 2007
	Deutsche Post AG, 2007 (x)	March 4, 2008
	Deutsche Post AG, 2008	February 25, 2009
	Deutsche Post AG, 2009	February 19, 2010
	Deutsche Post AG, 2010	February 18, 2011
	Deutsche Post AG, 2011	February 17, 2012
	Deutsche Post AG, 2012	March 12, 2013
	Deutsche Post AG, 2013	March 25, 2014
	Deutsche Post AG, 2014	March 12, 2015
Deutsche Telekom AG	Deutsche Telekom AG, 2004	March 15, 2005
	Deutsche Telekom AG, 2005	March 2, 2006
	Deutsche Telekom AG, 2006	Mar 01, 2007
	Deutsche Telekom AG, 2007	February 11, 2008
	Deutsche Telekom AG, 2008	February 26, 2009

Corporation	Annual Reports (Protected pdf-files marked with (x))	Date of publication
	Deutsche Telekom AG, 2009 (x)	February 8, 2010
	Deutsche Telekom AG, 2010 (x)	February 25, 2011
	Deutsche Telekom AG, 2011 (x)	Feb 23, 2012
	Deutsche Telekom AG, 2012 (x)	February 28, 2013
	Deutsche Telekom AG, 2013	March 6, 2014
	Deutsche Telekom AG, 2014 (x)	February 26, 2015
E.ON SE	E.ON AG, 2004 (x)	March 10, 2005
	E.ON AG, 2005 (x)	March 9, 2006
	E.ON AG, 2006 (x)	March 7, 2007
	E.ON AG, 2007 (x)	March 6, 2008
	E.ON AG, 2008 (x)	March 10, 2009
	E.ON AG, 2009 (x)	March 10, 2010
	E.ON AG, 2010 (x)	March 9, 2011
	E.ON AG, 2011 (x)	March 14, 2012
	E.ON AG, 2012	March 13, 2013
	E.ON AG, 2013	March 12, 2014
	E.ON AG, 2014	March 11, 2015
Fresenius Medical Care AG	Fresenius Medical Care AG & Co. KGaA, 2004	March 16, 2005
	Fresenius Medical Care AG & Co. KGaA, 2005	March 16, 2006
	Fresenius Medical Care AG & Co. KGaA, 2006	March 3, 2007
	Fresenius Medical Care AG & Co. KGaA, 2007	March 13, 2008
	Fresenius Medical Care AG & Co. KGaA, 2008	March 12, 2009
	Fresenius Medical Care AG & Co. KGaA, 2009	March 11, 2010
	Fresenius Medical Care AG & Co. KGaA, 2010	March 10, 2011
	Fresenius Medical Care AG & Co. KGaA, 2011	March 8, 2012
	Fresenius Medical Care AG & Co. KGaA, 2012 (x)	February 26, 2013
	Fresenius Medical Care AG & Co. KGaA, 2013 (x)	February 25, 2014
	Fresenius Medical Care AG & Co. KGaA, 2014 (x)	February 25, 2015
Fresenius SE	Fresenius SE & Co. KGaA, 2004 (x)	March 18, 2005
	Fresenius SE & Co. KGaA, 2005 (x)	March 17, 2006
	Fresenius SE & Co. KGaA, 2006 (x)	March 16, 2007
	Fresenius SE & Co. KGaA, 2007 (x)	March 10, 2008
	Fresenius SE & Co. KGaA, 2008 (x)	March 13, 2009
	Fresenius SE & Co. KGaA, 2009 (x)	March 12, 2010
	Fresenius SE & Co. KGaA, 2010 (x)	March 11, 2011
	Fresenius SE & Co. KGaA, 2011 (x)	February 22, 2012
	Fresenius SE & Co. KGaA, 2012 (x)	March 19, 2013
	Fresenius SE & Co. KGaA, 2013 (x)	March 20, 2014
	Fresenius SE & Co. KGaA, 2014 (x)	March 19, 2015
HeidelbergCement AG	HeidelbergCement Group, 2004 (x)	March 18, 2005
	HeidelbergCement Group, 2005 (x)	March 17, 2006
	HeidelbergCement Group, 2006 (x)	March 21, 2007
	HeidelbergCement Group, 2007	March 14, 2008
	HeidelbergCement Group, 2008	March 17, 2009
	HeidelbergCement Group, 2009 (x)	March 17, 2010
	HeidelbergCement Group, 2010 (x)	March 16, 2011
	HeidelbergCement Group, 2011 (x)	March 15, 2012
	HeidelbergCement Group, 2012	March 14, 2013
	HeidelbergCement Group, 2013	March 19, 2014
	HeidelbergCement Group, 2014	March 19, 2015
Henkel AG & Co. KGaA	Henkel AG & Co. KGaA, 2004 (x)	February 15, 2005
	Henkel AG & Co. KGaA, 2005	February 21, 2006

Corporation	Annual Reports (Protected pdf-files marked with (x))	Date of publication
	Henkel AG & Co. KGaA, 2006 (x)	February 27, 2007
	Henkel AG & Co. KGaA, 2007 (x)	February 27, 2008
	Henkel AG & Co. KGaA, 2008 (x)	February 25, 2009
	Henkel AG & Co. KGaA, 2009	February 25, 2010
	Henkel AG & Co. KGaA, 2010	February 24, 2011
	Henkel AG & Co. KGaA, 2011	March 8, 2012
	Henkel AG & Co. KGaA, 2012	March 3, 2013
	Henkel AG & Co. KGaA, 2013	February 20, 2014
	Henkel AG & Co. KGaA, 2014	March 4, 2015
Infineon Technologies AG	Infineon Technologies AG, 2004	December 10, 2004
	Infineon Technologies AG, 2005	December 7, 2005
	Infineon Technologies AG, 2006	December 18, 2006
	Infineon Technologies AG, 2007 (x)	December 13, 2007
	Infineon Technologies AG, 2008	January 26, 2009
	Infineon Technologies AG, 2009	December 8, 2009
	Infineon Technologies AG, 2010	December 22, 2010
	Infineon Technologies AG, 2011	December 20, 2011
	Infineon Technologies AG, 2012 (x)	November 13, 2012
	Infineon Technologies AG, 2013 (x)	November 30, 2013
	Infineon Technologies AG, 2014 (x)	November 27, 2014
K+S AG	K+S Group, 2004 (x)	February 28, 2005
	K+S Group, 2005 (x)	February 27, 2006
	K+S Group, 2006	March 2, 2007
	K+S Group, 2007	March 13, 2008
	K+S Group, 2008	March 11, 2009
	K+S Group, 2009	March 11, 2010
	K+S Group, 2010	March 10, 2011
	K+S Group, 2011	March 15, 2012
	K+S Group, 2012	March 14, 2013
	K+S Group, 2013	March 13, 2014
	K+S Group, 2014 (x)	March 24, 2015
LANXESS AG	LANXESS AG, 2004 (x)	March 27, 2005
	LANXESS AG, 2005 (x)	March 5, 2006
	LANXESS AG, 2006 (x)	March 14, 2007
	LANXESS AG, 2007 (x)	March 7, 2008
	LANXESS AG, 2008 (x)	March 16, 2009
	LANXESS AG, 2009 (x)	March 16, 2010
	LANXESS AG, 2010 (x)	March 15, 2011
	LANXESS AG, 2011 (x)	March 22, 2012
	LANXESS AG, 2012 (x)	March 21, 2013
	LANXESS AG, 2013 (x)	May 22, 2014
	LANXESS AG, 2014 (x)	March 19, 2015
Linde AG	Linde Group, 2004 (x)	March 14, 2005
	Linde Group, 2005	March 12, 2006
	Linde Group, 2006	March 12, 2007
	Linde Group, 2007	March 11, 2008
	Linde Group, 2008	March 13, 2009
	Linde Group, 2009	March 16, 2010
	Linde Group, 2010	March 10, 2011
	Linde Group, 2011	March 8, 2012
	Linde Group, 2012	March 7, 2013
	Linde Group, 2013	March 17, 2014

Corporation	Annual Reports (Protected pdf-files marked with (x))	Date of publication
	Linde Group, 2014	March 16, 2015
Merck KGaA	Merck Group, 2004	February 17, 2005
	Merck Group, 2005	February 16, 2006
	Merck Group, 2006	February 18, 2007
	Merck Group, 2007	February 18, 2008
	Merck Group, 2008	Februray 18, 2009
	Merck Group, 2009	Februray 23, 2009
	Merck Group, 2010	Februray 21, 2009
	Merck Group, 2011	February 24, 2010
	Merck Group, 2012	March 7, 2013
	Merck Group, 2013	February 28, 2014
	Merck Group, 2014 (x)	February 27, 2015
Munich RE AG	Munich RE Group, 2004	March 14, 2005
	Munich RE Group, 2005	March 13, 2006
	Munich RE Group, 2006	March 6, 2007
	Munich RE Group, 2007	March 11, 2008
	Munich RE Group, 2008	March 13, 2009
	Munich RE Group, 2009	March 9, 2010
	Munich RE Group, 2010	March 9, 2011
	Munich RE Group, 2011	March 5, 2012
	Munich RE Group, 2012	March 12, 2013
	Munich RE Group, 2013	March 20, 2014
	Munich RE Group, 2014	March 11, 2015
RWE AG	RWE AG, 2004	February 22, 2005
	RWE AG, 2005 (x)	February 14, 2006
	RWE AG, 2006	March 1, 2006
	RWE AG, 2007	March 1, 2007
	RWE AG, 2008	February 13, 2008
	RWE AG, 2009	February 23, 2010
	RWE AG, 2010	February 14, 2011
	RWE AG, 2011	February 20, 2012
	RWE AG, 2012	February 19, 2013
	RWE AG, 2013	February 18, 2014
	RWE AG, 2014	February 21, 2015
SAP SE	SAP AG, 2004	March 17, 2005
	SAP AG, 2005	March 16, 2006
	SAP AG, 2006 (x)	March 7, 2007
	SAP AG, 2007	March 18, 2008
	SAP AG, 2008	March 10, 2009
	SAP AG, 2009	March 10, 2010
	SAP AG, 2010	March 3, 2011
	SAP AG, 2011	February 20, 2014
	SAP AG, 2012	March 22, 2013
	SAP AG, 2013	March 21, 2014
	SAP AG, 2014 (x)	March 20, 2015
Siemens AG	Siemens AG, 2004	November 10, 2004
	Siemens AG, 2005	November 9, 2005
	Siemens AG, 2006 (x)	December 11, 2006
	Siemens AG, 2007	November 28, 2007
	Siemens AG, 2008	November 28, 2008
	Siemens AG, 2009	November 24, 2009
	Siemens AG, 2010	November 25, 2010

Corporation	Annual Reports (Protected pdf-files marked with (x))	Date of publication
	Siemens AG, 2011	November 23, 2011
	Siemens AG, 2012	November 28, 2012
	Siemens AG, 2013	November 27, 2013
	Siemens AG, 2014	November 26, 2014
ThyssenKrupp AG	ThyssenKrupp AG, 2004	December 1, 2004
	ThyssenKrupp AG, 2005	December 1, 2005
	ThyssenKrupp AG, 2006	December 1, 2006
	ThyssenKrupp AG, 2007	December 4, 2007
	ThyssenKrupp AG, 2008	November 28, 2008
	ThyssenKrupp AG, 2009	November 27, 2009
	ThyssenKrupp AG, 2010	November 30, 2010
	ThyssenKrupp AG, 2011	December 2, 2011
	ThyssenKrupp AG, 2012	December 11, 2012
	ThyssenKrupp AG, 2013 (x)	November 29, 2013
	ThyssenKrupp AG, 2014	November 20, 2014
Volkswagen AG	Volkswagen AG, 2004 (x)	March 10, 2005
	Volkswagen AG, 2005	March 9, 2006
	Volkswagen AG, 2006	March 9, 2007
	Volkswagen AG, 2007	February 22, 2008
	Volkswagen AG, 2008 (x)	March 3, 2009
	Volkswagen AG, 2009 (x)	March 11, 2010
	Volkswagen AG, 2010 (x)	March 10, 2011
	Volkswagen AG, 2011	March 12, 2012
	Volkswagen AG, 2012 (x)	February 13, 2013
	Volkswagen AG, 2013 (x)	March 14, 2014
	Volkswagen AG, 2014	March 26, 2015

A.2. FINANCIAL KPIS OF DAX CORPORATIONS FROM 2004 TO 2014

Table 60: Financial KPIs from 2004 to 2014

Annual year	Corporation	Net Income [EUR M]	Operating Income [EUR M]	Shareholders' Equity [EUR M]	Total Assets [EUR M]
2004	Adidas	314	584	1544	4434
2004	Allianz	2199	5183	30828	994698
2004	BASF	2004	5193	16602	26620
2004	BAYER	685	1875	10943	37588
2004	Beiersdorf	302	483	1727	2701
2004	BMW	3583	3774	16534	79057
2004	Commerzbank	3013	796	11023	424877
2004	Continental	716.2	1157.4	1839.3	9695.9
2004	Daimler	2466	3535	33522	182872
2004	Deutsche Ban	2472	4029	25904	840068
2004	Deutsche Boerse	266.1	527.6	2154.5	27699.7
2004	Deutsche Luf	404	2021	2696	18070
2004	Deutsche Pos	1588	3347	7242	153396
2004	Deutsche Telekom	4600	6300	45500	106300
2004	EON	4339	7361	33560	114062
2004	Fresenius	168	845	1603	8188
2004	Fresenius Medical Care AG	296.5	628.7	2681.3	5873
2004	HeidelbergCement	-366	735	3963	10716
2004	Henkel	748	996	4346	13287
2004	Infineon	61	94	5978	10976
2004	KundS	86.8	123.4	880.6	2147.7
2004	Lanxess	-12	59	1365	4577
2004	Linde	266	785	3628	7460
2004	Merck	672	1044	2800	5754
2004	Muenchener Rueck	1833	2604	20196	214791
2004	RWE	2137	3935	11193	93370
2004	SAP	1311	2073	4594	7585
2004	Siemens	3405	4232	26760	79430
2004	ThyssenKrupp	904	1683	7221	31141
2004	Volkswagen	697	1088	22634	127603
2005	Adidas	383	707	2684	5750
2005	Allianz	5766	8003	38656	1054656
2005	BASF	3007	5830	17523	31107
2005	BAYER	1597	2514	11157	36722
2005	Beiersdorf	335	531	1831	2907
2005	BMW	3284	3793	16973	88997
2005	Commerzbank	3172	1680	13518	444861
2005	Continental	929.6	1507.1	3574.2	10547.7
2005	Daimler	4215	2873	35957	228012
2005	Deutsche Ban	3529	6112	29936	992000

Annual year	**Corporation**	**Net Income** [EUR M]	**Operating Income** [EUR M]	**Shareholders' Equity** [EUR M]	**Total Assets** [EUR M]
2005	Deutsche Boerse	427.4	710.9	2186.7	38477.6
2005	Deutsche Luf	453	875	4522	19272
2005	Deutsche Pos	2663	3764	10624	172640
2005	Deutsche Telekom	5600	7600	48600	128500
2005	EON	7407	7293	44500	126600
2005	Fresenius	222	969	2841	11594
2005	Fresenius Medical Care AG	384.2	792.8	3367.5	6740.8
2005	HeidelbergCement	471	1010	5058	11935
2005	Henkel	770	1162	5399	13944
2005	Infineon	-312	-294	5629	10853
2005	KundS	174.4	259.6	942.1	2259.1
2005	Lanxess	-63	28	1256	4341
2005	Linde	514	953	3785	8247
2005	Merck	673	956	3329	7281
2005	Muenchener Rueck	2751	4156	24300	218737
2005	RWE	2231	3828	13117	108122
2005	SAP	1496	2337	5782	9040
2005	Siemens	2248	4185	27022	86117
2005	ThyssenKrupp	1019	2001	8072	36239
2005	Volkswagen	1050	1621	23600	133081
2006	Adidas	483	881	8379	8379
2006	Allianz	8310	9219	49650	1110081
2006	BASF	3215	6750	18578	45291
2006	BAYER	1683	2762	12851	55891
2006	Beiersdorf	668	477	1033	3496
2006	BMW	2874	4124	21045	101086
2006	Commerzbank	3937	2649	15311	608339
2006	Continental	981.9	1601.9	4470.8	10853
2006	Daimler	3783	4992	37356	217634
2006	Deutsche Ban	5986	8125	32808	1520580
2006	Deutsche Boerse	668.7	1029.1	2263.4	65025.1
2006	Deutsche Luf	803	1129	4903	19461
2006	Deutsche Pos	2282	3872	11220	217698
2006	Deutsche Telekom	3173	5300	49678	130200
2006	EON	5057	8150	47800	127200
2006	Fresenius	330	1444	3168	15024
2006	Fresenius Medical Care AG	406.8	999	3748.1	9886.8
2006	HeidelbergCement	1026	1329	5828	12318
2006	Henkel	871	1297	5547	13346
2006	Infineon	-268	-136	5315	11693
2006	KundS	228.9	341.5	1124.3	2830.9
2006	Lanxess	197	376	1239	4205
2006	Linde	1838	989	7090	19297
2006	Merck	1001	1325	3807	8102

Annual year	Corporation	Net Income [EUR M]	Operating Income [EUR M]	Shareholders' Equity [EUR M]	Total Assets [EUR M]
2006	Muenchener Rueck	3519	5877	26300	218639
2006	RWE	3847	3537	14111	93455
2006	SAP	1871	2688	6136	9503
2006	Siemens	3033	4371	29306	90973
2006	ThyssenKrupp	1704	2636	8513	36462
2006	Volkswagen	1955	1793	26904	136603
2007	Adidas	551	949	3023	8325
2007	Allianz	8714	10320	47753	1061149
2007	BASF	4065	7316	20098	46802
2007	BAYER	4711	3154	16821	51378
2007	Beiersdorf	442	616	1293	3884
2007	BMW	3134	3813	21733	101953
2007	Commerzbank	1925	2513	16132	616474
2007	Continental	1020.6	1675.8	6538.2	27737.6
2007	Daimler	3985	8710	29230	135094
2007	Deutsche Bank	6510	8749	37893	1925003
2007	Deutsche Boerse	911.7	1345.9	2377.3	79657.6
2007	Deutsche Lufthansa	1655	2125	6900	22320
2007	Deutsche Post	1885	1188	11058	235450
2007	Deutsche Telekom	1080	2453	45200	120700
2007	EON	7724	9208	49374	137294
2007	Fresenius	410	1609	6059	15324
2007	Fresenius Medical Care AG	491.5	1083	3893.8	9712.3
2007	HeidelbergCement	2119	1850	7519	27795
2007	Henkel	-94	1344	5706	13048
2007	Infineon	-368	37	4914	10753
2007	KundS	-93.3	-142.6	931.8	2857.2
2007	Lanxess	112	215	1403	4049
2007	Linde	952	1591	7521	13821
2007	Merck	3520	200	8688	14922
2007	Muenchener Rueck	3923	5573	25485	214292
2007	RWE	2667	5246	14918	83631
2007	SAP	1919	2587	6503	10366
2007	Siemens	4038	3431	29627	91555
2007	ThyssenKrupp	2190	3330	10026	38074
2007	Volkswagen	4122	6543	31939	145357
2008	Adidas	642	642	9533	9533
2008	Allianz	-2105	7455	33720	954999
2008	BASF	2912	2912	18722	50860
2008	BAYER	1719	3544	16340	52511
2008	Beiersdorf	567	567	1790	4468
2008	BMW	330	351	101086	108867
2008	Commerzbank	62	-407	19842	625200
2008	Continental	-1123.5	-296.2	5265.4	24687.9

Annual year	**Corporation**	**Net Income** [EUR M]	**Operating Income** [EUR M]	**Shareholders' Equity** [EUR M]	**Total Assets** [EUR M]
2008	Daimler	1414	2730	32730	132219
2008	Deutsche Bank	-3896	-5741	30700	2202000
2008	Deutsche Boerserse	1033.3	1508.4	2654.3	145878.6
2008	Deutsche Lufthansa	542	730	6594	22408
2008	Deutsche Post	-1979	-1066	7826	262964
2008	Deutsche Telekom	2024	3452	43112	123100
2008	EON	1604	9878	34467	157045
2008	Fresenius	450	1727	6943	20544
2008	Fresenius Medical Care AG	584.5	1195.1	4375.3	10661.5
2008	HeidelbergCement	1920	2147	8261	26288
2008	Henkel	848	799	6535	16074
2008	Infineon	-3122	-48	1764	7083
2008	KundS	870.9	1199.1	3473.8	3396
2008	Lanxess	183	323	1508	4592
2008	Linde	717	1703	7661	14448
2008	Merck	379.1	731	9536	15645
2008	Muenchener Rueck	1579	3834	26585	215362
2008	RWE	2558	4866	13140	93430
2008	SAP	1848	2624	5658	12520
2008	Siemens	5886	1574	27380	94263
2008	ThyssenKrupp	2276	3128	11007	41642
2008	Volkswagen	4688	6608	37388	167919
2009	Adidas	245	508	3771	8.875
2009	Allianz	4255	7044	40108	583717
2009	BASF	1410	3677	17477	51268
2009	BAYER	1359	3006	16263	51042
2009	Beiersdorf	380	587	2070	4594
2009	BMW	210	413	19902	101953
2009	Commerzbank	-4537	-4659	26576	844103
2009	Continental	-1606.9	-1040.4	3772.6	23049.2
2009	Daimler	-2644	-1513	31827	128821
2009	Deutsche Bank	4958	5202	36647	1500664
2009	Deutsche Boerse	496.1	637.8	2866.2	161360.5
2009	Deutsche Lufthansa	-34	-134	6202	26392
2009	Deutsche Post	693	231	6098	34738
2009	Deutsche Telekom	400	6000	41900	127800
2009	EON	8669	9646	34491	152614
2009	Fresenius	514	2054	7491	20882
2009	Fresenius Medical Care AG	621	1223.7	4899.8	11027.6
2009	HeidelbergCement	168	1317	11003	25508
2009	Henkel	628	1080	4809	12726
2009	Infineon	-674	-189	2333	4366
2009	KundS	96.4	126.5	2094.6	5217.1
2009	Lanxess	40	149	1432	5068

Annual year	Corporation	Net Income [EUR M]	Operating Income [EUR M]	Shareholders' Equity [EUR M]	Total Assets [EUR M]
2009	Linde	591	1430	7682	14232
2009	Merck	376.7	621	9513.6	16713
2009	Muenchener Rueck	2564	4721	22278	223412
2009	RWE	3571	5598	13717	93438
2009	SAP	1750	2588	6240	13656
2009	Siemens	2497	2533	27287	94926
2009	ThyssenKrupp	-1873	-2364	7927	41367
2009	Volkswagen	911	1261	37430	177178
2010	Adidas	567	1159	4616	10.618
2010	Allianz	5209	8243	44491	624945
2010	BASF	4557	7761	22657	59393
2010	BAYER	1301	2730	18897	51506
2010	Beiersdorf	326	583	2920	5095
2010	BMW	3234	4836	23074	110164
2010	Commerzbank	1353	1353	28700	754300
2010	Continental	576	4806.9	5859.6	24390.5
2010	Daimler	4674	7274	37953	135830
2010	Deutsche Bank	2330	3975	48800	1905630
2010	Deutsche Boerse	417.8	2951.4	2951.4	148850.8
2010	Deutsche Lufthansa	1131	1134	8340	18366
2010	Deutsche Post	989	1835	10696	37763
2010	Deutsche Telekom	1700	5500	43000	127800
2010	EON	6281	9454	41653	152881
2010	Fresenius	660	2418	8844	23577
2010	Fresenius Medical Care AG	732.2	1643	5487.9	17094
2010	HeidelbergCement	511	1334	12884	27377
2010	Henkel	1143	1723	7859	17525
2010	Infineon	660	363	2625	4993
2010	KundS	448.6	599.1	2651.6	5573.7
2010	Lanxess	379	607	1746	5666
2010	Linde	1005	1933	7897	26888
2010	Merck	642	1113	9460.1	22388
2010	Muenchener Rueck	2430	3978	23000	236400
2010	RWE	3758	4978	14574	93077
2010	SAP	1502	2591	7137	17741
2010	Siemens	3881	4262	29096	102827
2010	ThyssenKrupp	927	1346	8500	43712
2010	Volkswagen	7226	8994	46000	199393
2011	Adidas	670	1.011	5327	11380
2011	Allianz	2804	7866	44915	641472
2011	BASF	6188	8586	24139	61175
2011	BAYER	2470	4149	18833	52765
2011	Beiersdorf	259	431	2907	5272
2011	BMW	4907	782	27038	123429

Annual year	**Corporation**	**Net Income** [EUR M]	**Operating Income** [EUR M]	**Shareholders' Equity** [EUR M]	**Total Assets** [EUR M]
2011	Commerzbank	747	507	24803	661800
2011	Continental	1242.2	2596.9	7146.1	26038.4
2011	Daimler	6029	8755	41337	148132
2011	Deutsche Bank	4326	5390	53390	2164103
2011	Deutsche Boerse	848.8	1151.7	2953.7	218006.3
2011	Deutsche Lufthansa	-13	446	8044	18014
2011	Deutsche Post	-777	2436	11009	38408
2011	Deutsche Telekom	600	5600	39900	122500
2011	EON	-1861	5438	35737	152872
2011	Fresenius	770	2563	10577	26321
2011	Fresenius Medical Care AG	830.2	1778	6125.3	19532
2011	HeidelbergCement	534	1377	13569	29020
2011	Henkel	1191	1765	8641	18487
2011	Infineon	1119	740	4131	5873
2011	KundS	564.3	818.6	3084.6	6056.9
2011	Lanxess	506	776	2058	6878
2011	Linde	1174	2152	8024	28915
2011	Merck	618	1132	10329.8	22120
2011	Muenchener Rueck	712	1180	23300	247600
2011	RWE	2479	3024	13979	92656
2011	SAP	1903	4881	8433	19041
2011	Siemens	5899	7011	31530	104243
2011	ThyssenKrupp	-1783	-988	9012	43603
2011	Volkswagen	3418	18926	57500	253626
2012	Beiersdorf	451	698	3275	5575
2012	BMW	5111	7803	30499	131835
2012	Continental	1905.2	3073.4	7790	27377.9
2012	Daimler	6830	8820	39330	162978
2012	Deutsche Bank	316	814	54001	2022275
2012	Deutsche Boerse	645	969.4	2946.6	194786.8
2012	Deutsche Lufthansa	1228	1296	4839	28419
2012	Deutsche Post	1658	2665	9019	33480
2012	Deutsche Telekom	-400	-4345	30543	107900
2012	EON	2641	7027	34957	140426
2012	Fresenius	938	3075	12758	30664
2012	Fresenius Medical Care AG	1187	1932	8942.5	22325
2012	HeidelbergCement	457	1248	13708	28005
2012	Henkel	1556	2199	8641	19525
2012	Infineon	427	455	4521	5898
2012	KundS	667.6	1037.7	3473.7	3535.8
2012	Lanxess	514	808	2314	7519
2012	Linde	1232	2055	13094	34297
2012	Merck	579	963.6	103614	21643.3
2012	Muenchener Rueck	3204	5349	27400	258400

Annual year	Corporation	Net Income [EUR M]	Operating Income [EUR M]	Shareholders' Equity [EUR M]	Total Assets [EUR M]
2012	RWE	1306	6416.6	12122	56042
2012	SAP	2511	4041	9717	26306
2012	Siemens	4282	5184	30733	108282
2012	ThyssenKrupp	-5042	-437	3986	38284
2012	Volkswagen	6380	25487	77515	309644
2012	Adidas	791	1185	5304	11651
2012	Allianz	5231	9337	50388	694411
2012	BASF	5155	2231	24580	61175
2012	BAYER	2446	3960	18469	51336
2012	Commerzbank	-47	1170	2696	557600
2013	Adidas	839	1233	5489	11599
2013	Allianz	5996	10066	50083	711079
2013	BASF	4792	7160	27043	64204
2013	BAYER	3189	4934	20718	51317
2013	Beiersdorf	543	820	3393	5798
2013	BMW	5340	7913	35455	138368
2013	Commerzbank	81	731	26933	549700
2013	Continental	1923.1	3263.7	9011.2	26820.8
2013	Daimler	8720	10815	43363	168518
2013	Deutsche Bank	681	1456	54719	1611400
2013	Deutsche Boerse	478.4	738.8	3036.6	189309.9
2013	Deutsche Lufthansa	313	546	6108	21264
2013	Deutsche Post	2211	2861	9844	35461
2013	Deutsche Telekom	900	-1404	32063	118148
2013	EON	2459	5624	36638	132330
2013	Fresenius	1051	3045	13260	32758
2013	Fresenius Medical Care AG	1110	1847	9234.6	23119
2013	HeidelbergCement	933	1559	12514	26276
2013	Henkel	1625	2285	9376	19344
2013	Infineon	272	325	4782	6790
2013	KundS	413.3	548.8	3396.6	5941.6
2013	Lanxess	-159	-93	1895	6811
2013	Linde	1317	2171	12766	32749
2013	Merck	1209	1610.8	11020	20818.6
2013	Muenchener Rueck	3333	4398	26200	254312
2013	RWE	-2016	5369	12137	50787
2013	SAP	2505	4479	11295	27094
2013	Siemens	4409	5813	28111	101936
2013	ThyssenKrupp	-1536	-552	2242	35304
2013	Volkswagen	3078	12428	87733	324333
2014	Adidas	568	961	5624	12417
2014	Allianz	6603	10402	60747	805787
2014	BASF	5155	7626	27614	71359
2014	BAYER	3426	5506	20106	70234

Annual year	**Corporation**	**Net Income** [EUR M]	**Operating Income** [EUR M]	**Shareholders' Equity** [EUR M]	**Total Assets** [EUR M]
2014	Commerzbank	264	684	2625	636000
2014	Beiersdorf	537	796	3629	6330
2014	BMW	5817	8707	37220	154803
2014	Continental	2375.3	3344.8	10672.1	30241.1
2014	Daimler	7290	10752	44584	189635
2014	Deutsche Bank	1691	3116	68351	1708703
2014	Deutsche Boerse	788.5	1006.5	3429.7	215908.1
2014	Deutsche Lufthansa	55	180	4031	20721
2014	Deutsche Post	2177	2965	9376	36979
2014	Deutsche Telekom	2900	4663	34066	129400
2014	EON	-3130	4664	26713	125690
2014	Fresenius	1086	3158	15483	39897
2014	Fresenius Medical Care AG	1045	1843	9443.0	25447
2014	HeidelbergCement	687	1560	14245	28133
2014	Henkel	1662	2244	10044	20961
2014	Infineon	535	525	6002	7458
2014	KundS	381.2	534.6	3969.7	6010.6
2014	Lanxess	47	218	2159	7250
2014	Linde	1102	1885	13406	34425
2014	Merck	1165	1762	117416	26101.1
2014	Muenchener Rueck	3171	4028	30300	272979
2014	RWE	2246	4017	11772	51360
2014	SAP	2307	4331	12494	30169
2014	Siemens	5507	7427	30954	104879
2014	ThyssenKrupp	195	1145	2981	36045
2014	Volkswagen	2476	14794	84950	351209

A.3. GLOBAL GOOGLE TREND INDEX DATA

Rank	Country	Frequency
1	United States	288
2	United Kingdom	198
3	India	196
4	Canada	152
5	Australia	142
6	Germany	130
7	Philippines	96
8	South Africa	90
9	Netherlands	88
10	Singapore	86
11	Malaysia	83
12	Spain	81
13	France	80
14	Italy	77
15	China	71
16	Hong Kong	71
17	Pakistan	68
18	Ireland	67
19	New Zealand	66
20	Nigeria	65
21	Sweden	65
22	Switzerland	65
23	Thailand	64
24	Japan	62
25	South Korea	62
26	United Arab Emirates	62
27	Indonesia	61
28	Belgium	60
29	Brazil	58
30	Turkey	57
31	Denmark	55
32	Poland	54
33	Mexico	53
34	Taiwan	49
35	Austria	48
36	Egypt	47

Rank	Country	Frequency
37	Greece	47
38	Vietnam	47
39	Finland	46
40	Kenya	44
41	Saudi Arabia	44
42	Israel	43
43	Russia	43
44	Norway	42
45	Portugal	41
46	Romania	41
47	Colombia	37
48	Iran	37
49	Argentina	36
50	Bangladesh	34
51	Hungary	34
52	Chile	33
53	Sri Lanka	31
54	Czech Republic	30
55	Ukraine	28
56	Morocco	27
57	Peru	24
58	Bulgaria	23
59	Ghana	21
60	Croatia	20
61	Slovakia	20
62	Venezuela	20
63	Bolivia	19
64	Serbia	19
65	Lithuania	17
66	Ecuador	16
67	Algeria	15
68	Slovenia	15
69	Tunisia	15
70	Jamaica	14
71	Jordan	14
72	Dominican Republic	13
73	Ethiopia	13
74	Nepal	13

Rank	Country	Frequency
75	Tanzania	12
76	Trinidad & Tobago	11
77	Uganda	11
78	Zimbabwe	11
79	Costa Rica	8
80	Guatemala	8
81	Lebanon	8
82	Qatar	7
83	Kazakhstan	6
84	Mauritius	6
85	Oman	6
86	Uruguay	6
87	Belarus	5
88	Iraq	5
89	Kuwait	5
90	Luxembourg	4
91	Azerbaijan	3
92	Botswana	3
93	Puerto Rico	3
94	Zambia	3
95	Bahrain	2
96	Angola	1
97	Bosnia & Herzegovina	1
98	Cambodia	1
99	Cameroon	1
100	Côte d'Ivoire	1
101	Cyprus	1
102	El Salvador	1
103	Fiji	1
104	Panama	1
105	Senegal	1

A.4. ANNUAL REPORT EVALUATION DATASET

No	Year	Corporation	CRI index	Total direct TPs	Total indirect TPs	Total risks	Total oppor-tunities
1	2004	Adidas AG	90	0	90	1	1
2	2004	Allianz SE	300	0	300	4	1
3	2004	BASF SE	180	0	180	2	2
4	2004	Bayer AG	340	0	340	4	3
5	2004	Beiersdorf AG	140	0	140	2	0
6	2004	BMW AG	70	0	70	1	0
7	2004	Commerzbank AG	20	1	20	0	1
8	2004	Continental AG	230	1	230	3	1
9	2004	Daimler AG	110	1	110	1	2
10	2004	Deutsche Bank AG	140	1	140	2	0
11	2004	Deutsche Börse AG	180	1	180	2	2
12	2004	Deutsche Lufthansa AG	170	0	170	2	1
13	2004	Deutsche Post AG	280	0	280	2	7
14	2004	Deutsche Telekom AG	310	0	310	2	8
15	2004	E.ON SE	140	1	140	2	0
16	2004	Fresenius Medical Care AG	180	0	180	2	2
17	2004	Fresenius SE	180	0	180	2	2
18	2004	HeidelbergCement AG	90	0	90	1	1
19	2004	Henkel AG & Co. KGaA	70	0	70	1	0
20	2004	Infineon Technologies AG	40	0	40	0	2
21	2004	K+S AG	90	1	90	1	1
22	2004	LANXESS AG	80	0	80	1	0
23	2004	Linde AG	360	0	360	4	4
24	2004	Merck KGaA	40	0	40	0	2
25	2004	Munich RE AG	410	0	410	5	3
26	2004	RWE AG	270	0	270	3	3
27	2004	SAP SE	130	6	130	1	3
28	2004	Siemens AG	230	4	230	3	1
29	2004	ThyssenKrupp AG	110	4	110	1	2
30	2004	Volkswagen AG	340	1	340	4	3
31	2005	Adidas AG	130	0	130	1	3
32	2005	Allianz SE	360	0	360	4	4
33	2005	BASF SE	70	0	70	1	0

No	Year	Corporation	CRI index	Total direct TPs	Total indirect TPs	Total risks	Total oppor-tunities
34	2005	Bayer AG	190	0	190	1	6
35	2005	Beiersdorf AG	180	0	180	2	2
36	2005	BMW AG	70	0	70	1	0
37	2005	Commerzbank AG	140	0	140	2	0
38	2005	Continental AG	140	3	140	2	0
39	2005	Daimler AG	250	1	250	3	2
40	2005	Deutsche Bank AG	70	1	70	1	0
41	2005	Deutsche Börse AG	180	3	180	2	2
42	2005	Deutsche Lufthansa AG	310	0	310	4	1
43	2005	Deutsche Post AG	110	0	110	1	2
44	2005	Deutsche Telekom AG	160	1	160	2	1
45	2005	E.ON SE	140	0	140	2	0
46	2005	Fresenius Medical Care AG	80	0	80	0	4
47	2005	Fresenius SE	180	0	180	2	2
48	2005	HeidelbergCement AG	200	0	200	2	3
49	2005	Henkel AG & Co. KGaA	20	0	20	0	1
50	2005	Infineon Technologies AG	130	1	130	1	3
51	2005	K+S AG	300	1	300	4	1
52	2005	LANXESS AG	20	1	20	0	1
53	2005	Linde AG	20	2	20	0	1
54	2005	Merck KGaA	20	0	20	0	1
55	2005	Munich RE AG	310	0	310	3	5
56	2005	RWE AG	300	0	300	4	1
57	2005	SAP SE	60	0	60	0	3
58	2005	Siemens AG	620	0	620	5	9
59	2005	ThyssenKrupp AG	330	0	330	3	6
60	2005	Volkswagen AG	480	0	480	4	10
61	2006	Adidas AG	60	0	60	0	3
62	2006	Allianz SE	400	0	400	4	6
63	2006	BASF SE	90	0	90	1	1
64	2006	Bayer AG	330	0	330	3	6
65	2006	Beiersdorf AG	140	0	140	2	0
66	2006	BMW AG	90	2	90	1	1
67	2006	Commerzbank AG	70	0	70	1	0
68	2006	Continental AG	210	0	210	3	0
69	2006	Daimler AG	200	0	200	2	3

No	Year	Corporation	CRI index	Total direct TPs	Total indirect TPs	Total risks	Total oppor-tunities
70	2006	Deutsche Bank AG	420	0	420	5	3
71	2006	Deutsche Börse AG	200	0	200	2	3
72	2006	Deutsche Lufthansa AG	340	0	340	4	2
73	2006	Deutsche Post AG	200	0	200	2	3
74	2006	Deutsche Telekom AG	70	0	70	0	3
75	2006	E.ON SE	140	2	140	2	0
76	2006	Fresenius Medical Care AG	160	0	160	2	1
77	2006	Fresenius SE	220	0	220	2	4
78	2006	HeidelbergCement AG	110	0	110	1	2
79	2006	Henkel AG & Co. KGaA	90	0	90	1	1
80	2006	Infineon Technologies AG	90	0	90	0	3
81	2006	K+S AG	300	1	300	4	1
82	2006	LANXESS AG	60	2	60	0	3
83	2006	Linde AG	90	4	90	1	1
84	2006	Merck KGaA	20	6	20	0	1
85	2006	Munich RE AG	760	2	760	10	3
86	2006	RWE AG	180	8	180	2	2
87	2006	SAP SE	150	5	150	1	4
88	2006	Siemens AG	580	3	580	5	8
89	2006	ThyssenKrupp AG	80	0	80	0	4
90	2006	Volkswagen AG	350	0	350	5	0
91	2007	Adidas AG	200	0	200	2	3
92	2007	Allianz SE	790	0	790	10	4
93	2007	BASF SE	320	0	320	4	2
94	2007	Bayer AG	510	0	510	5	8
95	2007	Beiersdorf AG	130	1	130	1	3
96	2007	BMW AG	150	0	150	1	4
97	2007	Commerzbank AG	180	0	180	2	2
98	2007	Continental AG	100	1	100	1	1
99	2007	Daimler AG	280	0	280	4	0
100	2007	Deutsche Bank AG	740	0	740	9	5
101	2007	Deutsche Börse AG	120	0	120	0	6
102	2007	Deutsche Lufthansa AG	140	1	140	2	0
103	2007	Deutsche Post AG	100	1	100	0	5
104	2007	Deutsche Telekom AG	190	0	190	1	5
105	2007	E.ON SE	210	0	210	3	0

No	Year	Corporation	CRI index	Total direct TPs	Total indirect TPs	Total risks	Total oppor-tunities
106	2007	Fresenius Medical Care AG	180	1	180	1	5
107	2007	Fresenius SE	270	1	270	3	3
108	2007	HeidelbergCement AG	110	1	110	1	2
109	2007	Henkel AG & Co. KGaA	60	3	60	0	3
110	2007	Infineon Technologies AG	90	0	90	1	1
111	2007	K+S AG	20	0	20	0	1
112	2007	LANXESS AG	30	0	30	0	1
113	2007	Linde AG	90	0	90	1	1
114	2007	Merck KGaA	20	0	20	0	1
115	2007	Munich RE AG	490	0	490	7	0
116	2007	RWE AG	210	0	210	3	0
117	2007	SAP SE	30	0	30	0	1
118	2007	Siemens AG	270	0	270	3	2
119	2007	ThyssenKrupp AG	290	0	290	3	3
120	2007	Volkswagen AG	540	0	540	6	5
121	2008	Adidas AG	230	1	230	3	1
122	2008	Allianz SE	580	1	580	8	1
123	2008	BASF SE	670	1	670	7	6
124	2008	Bayer AG	460	2	460	5	4
125	2008	Beiersdorf AG	230	0	230	3	1
126	2008	BMW AG	140	0	140	2	0
127	2008	Commerzbank AG	370	0	370	5	1
128	2008	Continental AG	270	0	270	3	2
129	2008	Daimler AG	90	2	90	1	1
130	2008	Deutsche Bank AG	250	0	250	3	2
131	2008	Deutsche Börse AG	60	2	60	0	3
132	2008	Deutsche Lufthansa AG	210	1	210	3	0
133	2008	Deutsche Post AG	270	0	270	3	3
134	2008	Deutsche Telekom AG	40	0	40	0	2
135	2008	E.ON SE	20	0	20	0	1
136	2008	Fresenius Medical Care AG	280	0	280	3	3
137	2008	Fresenius SE	360	0	360	4	4
138	2008	HeidelbergCement AG	300	0	300	3	4
139	2008	Henkel AG & Co. KGaA	70	0	70	0	3
140	2008	Infineon Technologies AG	90	0	90	1	1
141	2008	K+S AG	120	3	120	1	2

No	Year	Corporation	CRI index	Total direct TPs	Total indirect TPs	Total risks	Total oppor-tunities
142	2008	LANXESS AG	280	0	280	3	2
143	2008	Linde AG	240	0	240	0	8
144	2008	Merck KGaA	230	1	230	3	0
145	2008	Munich RE AG	480	0	480	6	3
146	2008	RWE AG	490	1	490	7	0
147	2008	SAP SE	350	2	350	5	0
148	2008	Siemens AG	420	0	420	2	10
149	2008	ThyssenKrupp AG	140	1	140	0	5
150	2008	Volkswagen AG	590	1	590	7	4
151	2009	Adidas AG	180	1	180	2	2
152	2009	Allianz SE	300	1	300	4	1
153	2009	BASF SE	530	0	530	5	7
154	2009	Bayer AG	340	0	340	3	6
155	2009	Beiersdorf AG	380	0	380	5	1
156	2009	BMW AG	40	0	40	0	2
157	2009	Commerzbank AG	140	0	140	2	0
158	2009	Continental AG	330	0	330	3	4
159	2009	Daimler AG	140	0	140	2	0
160	2009	Deutsche Bank AG	280	0	280	4	0
161	2009	Deutsche Börse AG	180	0	180	2	2
162	2009	Deutsche Lufthansa AG	210	1	210	3	0
163	2009	Deutsche Post AG	550	1	550	7	3
164	2009	Deutsche Telekom AG	140	2	140	1	3
165	2009	E.ON SE	40	1	40	0	2
166	2009	Fresenius Medical Care AG	380	0	380	3	8
167	2009	Fresenius SE	190	0	190	1	6
168	2009	HeidelbergCement AG	160	0	160	2	1
169	2009	Henkel AG & Co. KGaA	20	1	20	0	1
170	2009	Infineon Technologies AG	330	1	330	4	2
171	2009	K+S AG	160	1	160	1	3
172	2009	LANXESS AG	220	0	220	2	3
173	2009	Linde AG	20	0	20	0	1
174	2009	Merck KGaA	20	1	20	0	1
175	2009	Munich RE AG	950	0	950	13	2
176	2009	RWE AG	230	0	230	3	1
177	2009	SAP SE	220	0	220	3	0

No	Year	Corporation	CRI index	Total direct TPs	Total indirect TPs	Total risks	Total oppor-tunities
178	2009	Siemens AG	740	0	740	6	12
179	2009	ThyssenKrupp AG	80	0	80	0	3
180	2009	Volkswagen AG	1340	0	1340	18	3
181	2010	Adidas AG	400	0	400	3	9
182	2010	Allianz SE	370	0	370	5	1
183	2010	BASF SE	280	0	280	2	5
184	2010	Bayer AG	150	0	150	0	7
185	2010	Beiersdorf AG	290	0	290	4	0
186	2010	BMW AG	90	0	90	1	1
187	2010	Commerzbank AG	270	0	270	3	3
188	2010	Continental AG	300	0	300	2	5
189	2010	Daimler AG	210	0	210	2	3
190	2010	Deutsche Bank AG	310	0	310	4	1
191	2010	Deutsche Börse AG	360	0	360	4	4
192	2010	Deutsche Lufthansa AG	210	1	210	3	0
193	2010	Deutsche Post AG	520	0	520	6	5
194	2010	Deutsche Telekom AG	260	0	260	3	2
195	2010	E.ON SE	250	0	250	3	2
196	2010	Fresenius Medical Care AG	260	0	260	2	6
197	2010	Fresenius SE	170	0	170	1	5
198	2010	HeidelbergCement AG	270	0	270	3	3
199	2010	Henkel AG & Co. KGaA	110	0	110	1	2
200	2010	Infineon Technologies AG	100	0	100	0	5
201	2010	K+S AG	180	0	180	1	4
202	2010	LANXESS AG	340	0	340	0	12
203	2010	Linde AG	330	1	330	3	3
204	2010	Merck KGaA	20	0	20	0	1
205	2010	Munich RE AG	580	0	580	8	1
206	2010	RWE AG	250	0	250	3	2
207	2010	SAP SE	360	4	360	5	0
208	2010	Siemens AG	790	2	790	5	16
209	2010	ThyssenKrupp AG	50	2	50	0	2
210	2010	Volkswagen AG	590	0	590	7	5
211	2011	Adidas AG	180	0	180	1	5
212	2011	Allianz SE	440	3	440	6	1
213	2011	BASF SE	180	0	180	1	5

No	Year	Corporation	CRI index	Total direct TPs	Total indirect TPs	Total risks	Total oppor-tunities
214	2011	Bayer AG	240	0	240	1	7
215	2011	Beiersdorf AG	140	1	140	1	3
216	2011	BMW AG	160	0	160	2	1
217	2011	Commerzbank AG	370	3	370	5	1
218	2011	Continental AG	200	0	200	2	2
219	2011	Daimler AG	250	0	250	3	2
220	2011	Deutsche Bank AG	450	1	450	6	1
221	2011	Deutsche Börse AG	350	0	350	5	0
222	2011	Deutsche Lufthansa AG	360	0	360	4	3
223	2011	Deutsche Post AG	520	0	520	6	5
224	2011	Deutsche Telekom AG	210	0	210	2	3
225	2011	E.ON SE	170	1	170	2	1
226	2011	Fresenius Medical Care AG	230	3	230	1	8
227	2011	Fresenius SE	240	3	240	2	5
228	2011	HeidelbergCement AG	450	2	450	5	5
229	2011	Henkel AG & Co. KGaA	250	2	250	3	2
230	2011	Infineon Technologies AG	110	2	110	0	4
231	2011	K+S AG	170	0	170	1	4
232	2011	LANXESS AG	560	1	560	0	19
233	2011	Linde AG	190	0	190	2	2
234	2011	Merck KGaA	70	0	70	1	0
235	2011	Munich RE AG	240	1	240	3	1
236	2011	RWE AG	90	3	90	1	1
237	2011	SAP SE	210	2	210	2	3
238	2011	Siemens AG	670	10	670	6	9
239	2011	ThyssenKrupp AG	30	18	30	0	1
240	2011	Volkswagen AG	620	25	620	5	11
241	2012	Adidas AG	140	15	140	1	3
242	2012	Allianz SE	480	9	480	4	10
243	2012	BASF SE	450	0	450	5	5
244	2012	Bayer AG	110	0	110	1	2
245	2012	Beiersdorf AG	500	0	500	6	3
246	2012	BMW AG	160	0	160	2	1
247	2012	Commerzbank AG	380	8	380	4	4
248	2012	Continental AG	390	0	390	1	12
249	2012	Daimler AG	360	6	360	4	4

No	Year	Corporation	CRI index	Total direct TPs	Total indirect TPs	Total risks	Total oppor-tunities
250	2012	Deutsche Bank AG	90	1	90	0	4
251	2012	Deutsche Börse AG	550	2	550	7	3
252	2012	Deutsche Lufthansa AG	60	5	60	0	3
253	2012	Deutsche Post AG	470	5	470	4	8
254	2012	Deutsche Telekom AG	480	0	480	5	6
255	2012	E.ON SE	100	0	100	1	1
256	2012	Fresenius Medical Care AG	230	0	230	2	4
257	2012	Fresenius SE	60	0	60	0	3
258	2012	HeidelbergCement AG	130	2	130	1	3
259	2012	Henkel AG & Co. KGaA	300	0	300	2	6
260	2012	Infineon Technologies AG	250	0	250	3	2
261	2012	K+S AG	120	0	120	0	5
262	2012	LANXESS AG	950	0	950	2	28
263	2012	Linde AG	60	6	60	0	2
264	2012	Merck KGaA	290	4	290	3	4
265	2012	Munich RE AG	50	0	50	0	2
266	2012	RWE AG	20	0	20	0	1
267	2012	SAP SE	190	0	190	1	5
268	2012	Siemens AG	290	0	290	0	11
269	2012	ThyssenKrupp AG	90	0	90	0	3
270	2012	Volkswagen AG	550	0	550	2	16
271	2013	Adidas AG	110	0	110	0	5
272	2013	Allianz SE	700	1	700	9	3
273	2013	BASF SE	220	1	220	0	11
274	2013	Bayer AG	230	0	230	3	1
275	2013	Beiersdorf AG	340	0	340	2	10
276	2013	BMW AG	180	0	180	2	2
277	2013	Commerzbank AG	490	0	490	7	0
278	2013	Continental AG	310	0	310	2	6
279	2013	Daimler AG	190	0	190	2	2
280	2013	Deutsche Bank AG	230	0	230	2	3
281	2013	Deutsche Börse AG	530	0	530	5	9
282	2013	Deutsche Lufthansa AG	240	0	240	2	4
283	2013	Deutsche Post AG	250	0	250	3	2
284	2013	Deutsche Telekom AG	690	0	690	9	3
285	2013	E.ON SE	130	0	130	1	2

No	Year	Corporation	CRI index	Total direct TPs	Total indirect TPs	Total risks	Total oppor-tunities
286	2013	Fresenius Medical Care AG	40	0	40	0	2
287	2013	Fresenius SE	160	0	160	2	1
288	2013	HeidelbergCement AG	430	0	430	5	4
289	2013	Henkel AG & Co. KGaA	320	0	320	2	8
290	2013	Infineon Technologies AG	130	1	130	1	3
291	2013	K+S AG	220	0	220	2	3
292	2013	LANXESS AG	900	1	900	3	27
293	2013	Linde AG	150	1	150	0	5
294	2013	Merck KGaA	250	1	250	1	6
295	2013	Munich RE AG	170	2	170	1	5
296	2013	RWE AG	90	2	90	1	1
297	2013	SAP SE	440	3	440	2	14
298	2013	Siemens AG	230	0	230	0	8
299	2013	ThyssenKrupp AG	140	9	140	1	3
300	2013	Volkswagen AG	630	7	630	7	6
301	2014	Adidas AG	280	2	280	3	3
302	2014	Allianz SE	590	8	590	7	5
303	2014	BASF SE	680	8	680	8	6
304	2014	Bayer AG	540	12	540	5	9
305	2014	Beiersdorf AG	440	7	440	4	8
306	2014	BMW AG	560	7	560	6	6
307	2014	Commerzbank AG	830	7	830	11	3
308	2014	Continental AG	440	4	440	3	10
309	2014	Daimler AG	200	0	200	2	3
310	2014	Deutsche Bank AG	250	0	250	3	2
311	2014	Deutsche Börse AG	200	0	200	1	6
312	2014	Deutsche Lufthansa AG	320	2	320	3	5
313	2014	Deutsche Post AG	250	4	250	3	2
314	2014	Deutsche Telekom AG	500	2	500	6	4
315	2014	E.ON SE	280	1	280	3	3
316	2014	Fresenius Medical Care AG	160	1	160	2	1
317	2014	Fresenius SE	300	3	300	4	1
318	2014	HeidelbergCement AG	180	1	180	2	2
319	2014	Henkel AG & Co. KGaA	80	2	80	0	3
320	2014	Infineon Technologies AG	290	0	290	2	7
321	2014	K+S AG	110	0	110	1	2

No	Year	Corporation	CRI index	Total direct TPs	Total indirect TPs	Total risks	Total oppor-tunities
322	2014	LANXESS AG	690	0	690	6	9
323	2014	Linde AG	510	2	510	4	9
324	2014	Merck KGaA	220	2	220	0	9
325	2014	Munich RE AG	620	2	620	8	3
326	2014	RWE AG	530	0	530	7	2
327	2014	SAP SE	440	5	440	5	3
328	2014	Siemens AG	140	9	140	0	5
329	2014	ThyssenKrupp AG	170	2	170	1	4
330	2014	Volkswagen AG	1430	7	1430	16	12

A.5. R-SOURCECODE GOOGLE TRENDS IMPLEMENTATION

```
# R-Version: 3.1.3
# Author: Frank Bezjak
# Name: GoogleTrends database implementation

# Set home library
r_library <- "T:/20 R/library"
.libPaths(r_library)
setwd(r_library)

# Note: Install the packages if these are required by R
library(googletrend)
require("devtools")
library(RMySQL)
library(plyr)
library(dplyr)

# Create Schema and tables
build_db <- 0

#beginning index
index <- 1

# extract trend data for query
main_query <- paste("SELECT * FROM mydb.webtrends where row_names > ",index)

# schema for trends
schema <- "webtrends2"


# Set Download_Dir in the same Folder as default webbrowser
c_downdir <- "C:/Users/frankbezjak/Downloads"
setdownloaddir(c_downdir)
setwd("T:/20 R")

# Create annual and monthly means
# with plyr

f_split <- function(GTrend) {

    if (is.null(GTrend) != TRUE) {

    r_rownum <- 0
    r_rownum <- nrow(GTrend)
      for (i in 1:r_rownum){
        c_t <- unlist(strsplit(toString(GTrend[i,1]), "-"))[1]
        c_t2 <- unlist(strsplit(toString(GTrend[i,1]), "-"))[2]
        GTrend[i,3] <- c_t
        GTrend[i,4] <- c_t2
        colnames(GTrend) <-c("week","index","year","month")
      }
    }
  GTrend
}
```

```
f_createTrendDB <- function(c_l,l_c_l) {
  o <- 10
  z <- 0

  # build database
  if(build_db > 0) {
    c_mysql_dropSchema <- paste("DROP DATABASE ",  schema)
    rs = dbSendQuery(mydb,c_mysql_dropSchema)
    c_mysql_createSchema <- paste("CREATE SCHEMA ", schema)
    rs = dbSendQuery(mydb,c_mysql_createSchema)
    c_mysql1 = paste("DROP TABLE", "web_linktrenddatabase", sep =" ")
    rs = dbSendQuery(mydb,c_mysql1)
    t_logging <- data.frame(id = numeric(), keyword = character(), linktotable =
character(), c_length = numeric())
    }
    else  {

      t_logging <- data.frame(id = numeric(), keyword = character(), linktotable
= character(), c_length = numeric())
    }

  c_mysql_createSchema <- paste("USE ", schema)
  rs = dbSendQuery(mydb,c_mysql_createSchema)

  for (i in 1:length(c_1)){
    z <- c_1[i]
    c_keywords <- input_trends[,3]
    c_targetfile <- "T:/20 R/GoogleTrendDownload/10.csv";
    c_searchterm <- paste("'",z,"'",sep="")
    c_tablename = paste(i + index,"_Trend", sep = "");
    c_tablename_2 = paste(i + index,"_TopSearch", sep = "");
    c_tablename_3 = paste(i + index,"_Region", sep = "");
    c_tablename_4 = paste(i + index,"_City", sep = "");
    c_tablename_5 = paste(i + index,"_year", sep = "");
    c_tablename_6 = paste(i + index,"_month", sep = "");
    results = tryCatch({
      c_readtrendfile <- googletrend::gettrend(c_searchterm,simple = FALSE, plot
= TRUE)
    })

    c_lengthQuery <- length(c_readtrendfile)
     if (i > 1) {
       filled <- rbind(filled, data.frame(id = i + index , keyword = c_searchter
m, linktotable=c_tablename, c_length = c_lengthQuery ))
     }
     else {
      filled <- rbind(t_logging, data.frame(id = i + index , keyword = c_searcht
erm, linktotable=c_tablename, c_length = c_lengthQuery ))
     }
     RMySQL::dbWriteTable(mydb,"web_linktrenddatabase", filled,  overwrite = TRU
E);

    c_mysql_createSchema <- "USE mydb"
    rs = dbSendQuery(mydb,c_mysql_createSchema)

    results = tryCatch({
```

```
      if (length(c_readtrendfile) > 0) {
        c_mysql_createSchema <- paste("USE ",schema)
        rs = dbSendQuery(mydb,c_mysql_createSchema)

        if (length(c_readtrendfile$trend) > 0) {
          RMySQL::dbWriteTable(mydb,c_tablename, c_readtrendfile$trend,  overwri
te = TRUE);
          c_readtrendfile$trend <- f_split(c_readtrendfile$trend)
          cs <- c_readtrendfile$trend
          cs1 <- aggregate(cs$index,list(totl=cs$year),mean)
          colnames(cs1) <-c("year","meanindex")
          cs2 <- aggregate(cs$index,list(totl=cs$month),mean)
          colnames(cs2) <-c("month","meanindex")
          RMySQL::dbWriteTable(mydb,c_tablename_5, cs1,  overwrite = TRUE);
          RMySQL::dbWriteTable(mydb,c_tablename_6, cs2,  overwrite = TRUE);
        }
        if (length(c_readtrendfile$top.region) > 0) {
          RMySQL::dbWriteTable(mydb,c_tablename_3, c_readtrendfile$top.region,
overwrite = TRUE);
        }
        if (length(c_readtrendfile$top.search) > 0) {
          colnames(c_readtrendfile$top.search) <-c("searchindex","indexvalue")
          RMySQL::dbWriteTable(mydb,c_tablename_2, c_readtrendfile$top.search,
overwrite = TRUE);
        }
        if (length(c_readtrendfile$top.city) > 0) {
          RMySQL::dbWriteTable(mydb,c_tablename_4, c_readtrendfile$top.city,  ov
erwrite = TRUE);
        }
      }
    })

    if (i == o) {
      p1 <- proc.time()
      Sys.sleep(5)
      proc.time() - p1
      o = o + 5
    }
  }
}

# Runtime setting

all_cons <- dbListConnections(MySQL())
for(con in all_cons){dbDisconnect(con)}
mydb = dbConnect(MySQL(), user='root', password='', dbname='mydb', host='localho
st')
rs = dbSendQuery(mydb, main_query)
input_trends <- fetch(rs, n=-1)
c_1 <- input_trends$keyword
l_c_l <- length(c_1)
c_l <- data.frame("ID"=1:length(c_1), "Trends"=c_1)
system.time(f_createTrendDB(c_1,l_c_l))
dbDisconnect(mydb)
```

A.6. R-SOURCECODE AUTOMATED CORRELATION

```
# R-Version: 3.1.3
# Prepare libraries
# Author: Frank Bezjak
# Name: Automated Correlation Script

# Optional parameter for installation of packages
build_db <- 0

# configuration section
schema_trends <- "webtrends2"
schema_main <- "mydb"
schema_eval <- "webtrend_evaluation"

# Install package routines
if(Installpackages > 0) {
    install.packages("ggplot2")
    install.packages("devtools")
    install.packages("RMySQL")

}

# build database
if(build_db > 0) {
  c_mysql_dropSchema <- paste("DROP DATABASE ",  schema_eval)
  rs = dbSendQuery(mydb,c_mysql_dropSchema)
  c_mysql_createSchema <- paste("CREATE SCHEMA ", schema_eval)
  rs = dbSendQuery(mydb,c_mysql_createSchema)
}

# clausal open database connection
close_dbs <- function () {
  all_cons <- dbListConnections(MySQL())
  for(con in all_cons){dbDisconnect(con)}
}
#configure program
regression <- function(trendname,Table,FKTrendpassge,Tablename,mydb,dax_report,d
ax_pindex,dax_dividend) {
  c_mysql_createSchema <- paste("USE ", schema_trends)
  rs = dbSendQuery(mydb,c_mysql_createSchema)
  webdb_query <- paste("SELECT * FROM" , Tablename," where year < 2015")
  rs = dbSendQuery(mydb, webdb_query)
  input_trends <- fetch(rs, n=-1)
  y <- unlist(input_trends$row_names)
  x1 <- unlist(input_trends$year)
  x2 <- unlist(input_trends$meanindex)

  # build regression model
  fit <- lm(input_trends$year ~ input_trends$meanindex, data=input_trends)
  l_grep <-
    data.frame(
      "Intercept" = character(0),
      "coefficient" = integer(0)
    )
```

```
  # create an empty dataframe as a new / add empty tow
  temprow <-
    matrix(c(rep.int(NA,length(l_grep))),nrow = 1,ncol = length(l_grep))
  newrow <- data.frame(temprow)
  colnames(newrow) <- colnames(l_grep)
  l_1 <- fit$coefficients[1]
  l_2 <- fit$coefficients[2]
  newrow$Intercept[] <- l_1
  newrow$coefficient[] <- l_2

  l_grep <- rbind(l_grep,newrow)
  c_mysql_createSchema <- paste("USE ", schema_main)
  rs = dbSendQuery(mydb,c_mysql_createSchema)
  t_name <-paste0("webtrends_regression_",Table)
  RMySQL::dbWriteTable(mydb,t_name, l_grep,  overwrite = TRUE);
}
main_routine <- function(sql) {
  mydb = dbConnect(MySQL(), user = 'root', password = '', dbname = 'mydb', host
= 'localhost')

  tp_webtrends <- paste("SELECT * FROM mydb.tp_webtrends where TYPE like '%YEAR%
'")
  rs = dbSendQuery(mydb, tp_webtrends)
  input_trends <- fetch(rs, n=-1)

  sql_aggregation_reports <- paste("SELECT * FROM mydb.dax_aggregation_reports")
  rs = dbSendQuery(mydb, sql_aggregation_reports)
  dax_report <- fetch(rs, n=-1)

  sql_priceindex <- paste("SELECT * FROM mydb.dax_priceindex")
  rs = dbSendQuery(mydb, sql_priceindex)
  dax_pindex <- fetch(rs, n=-1)

  sql_dividend <- paste("SELECT * FROM mydb.dax_dividend")
  rs = dbSendQuery(mydb, sql_dividend)
  dax_dividend <- fetch(rs, n=-1)
  c_mysql_createSchema <- paste("USE ", schema_main)
  rs = dbSendQuery(mydb,c_mysql_createSchema)
  tp_webtrends_Trend <- input_trends$Trend

  for (i in 1:length(input_trends$Trend)) {
    trendname <- input_trends$Trend[i]
    c_table <- input_trends$Table[i]
    FKTrendpassage <- input_trends$FKTrendpassage[i]
    Tablename <- input_trends$Tablename[i]
    regression(trendname,c_table,FKTrendpassage,Tablename,mydb,dax_report,dax_pi
ndex,dax_dividend)
  }
  dbDisconnect(mydb)
}

#Runtime setting
setup_libraries()
close_dbs()
```

A.7. R-SOURCECODE ANNUAL REPORT IMPORT

```
# R-Version: 3.1.3
# Prepare libraries
# Utilize pdfgrep for automated searches of pdf files.
# Extract the passages in to the database.
# Author: Frank Bezjak

file_path <- "T:/00 Quellen/ARP_txtfiles"
file_path_report <- "T:/00 Quellen/AnnualReport_Final"
library(RMySQL)

## Loading required package: DBI

require("devtools")

## Loading required package: devtools

# 1. prepare textfiles
# prepare Textfiles with pdfgrep
prepareTextfiles <- function() {
  # extract trend data for query
  main_query <- paste("SELECT * FROM mydb.arp_reports")

  # idwebtrends = fk_evaluationid
  mydb = dbConnect(MySQL(), user='root', password='', dbname='mydb', host='local
host')
  rs = dbSendQuery(mydb, main_query)
  input_reports <- fetch(rs, n=-1)

  setwd(file_path_report)
  # split files
    if (length(input_reports) > 0) {
      for (i in input_reports) {
        if (i[9] != 0) {
          count_command <- paste0("pdfgrep.exe" , '-c ' , i[7] , " > " , "_count
_" , i[7],"")
          passage_command <- paste0("pdfgrep.exe" , '-n -C 1000000 trend' , i[7]
, " > " , "_trends_" , i[7],"")
          t1 <- try(system(count_command, intern = TRUE))
          t1 <- try(system(passage_command, intern = TRUE))
        }
      }
    }
}


# 2. Import the identified passages into the database
# split by ":" and identify the references page numbers
# in the pdf file
arp_passage <- function() {

  # read in directory
  d_filescomplete <-
    list.files("T:/00 Quellen/ARP_txtfiles/", pattern = "trends*")

```

```
d_files <- d_filescomplete

#prepare an empty line
l_grep <-
  data.frame(
    "pass_year" = integer(0),
    "pass_company" = character(0),
    "pass_page" = integer(0),
    "pass_passage" = character(0)
  )


for (i in 1:length(d_files)) {
    c_in <- d_files[i]
    x_1 <- substr(c_in, start = 1, stop = 5)
    x_2 <- substr(c_in, start = 8, stop = 11)
    x_3 <- unlist(strsplit(c_in,"_",fixed = FALSE))

    # Readin report andn
    c_annualfile <- sprintf("T:/00 Quellen/ARP_txtfiles/%s",c_in)
    c_report <- readLines(c_annualfile,warn = FALSE)

    temprow <-
      matrix(c(rep.int(NA,length(l_grep))),nrow = 1,ncol = length(l_grep))

        # split files
        if (length(c_report) > 0) {
          for (i in c_report) {

            # make it a data.frame and give cols the same names as data
            newrow <- data.frame(temprow)
            colnames(newrow) <- colnames(l_grep)


              x_0 <- unlist(strsplit(i,":",fixed = FALSE))
              newrow$pass_year[] <- x_2
              newrow$pass_company[] <- x_3[3]
              newrow$pass_page[] <- x_0[1]
              passage <- x_0[2]
              p <- 1
              additional <-""
              for (i in x_0) {
                if (p > 1) {
                  additional <- paste(additional,x_0[p])
                }
                p <- p +1
              }
              newrow$pass_passage[] <- paste0(passage,additional,"")

              print(newrow)
              l_grep <- rbind(l_grep,newrow)
          }
        }
    }

# Write extracted data into the database
```

```
  dbWriteTable(mydb,"arp_passage", l_grep, overwrite = TRUE)
}

# 3. Extract the count of trend passages
get_files <- function() {
  # read in directory
  d_filescomplete <-
    list.files("T:/00 Quellen/ARP_txtfiles/", pattern = "count*")

  d_files <- d_filescomplete
  # hier wird die leere Zeile erstellt
  l_grep <-
    data.frame(
      "count_year" = integer(0),
      "count_company" = character(0),
      "count_value" = integer(0)
    )

  for (i in 1:length(d_files)) {
    c_in <- d_files[i]
    x_1 <- substr(c_in, start = 1, stop = 5)
    x_2 <- substr(c_in, start = 7, stop = 10)
    x_3 <- unlist(strsplit(c_in,"_",fixed = FALSE))

    # Readin report andn
    c_annualfile <- sprintf("T:/00 Quellen/ARP_txtfiles/%s",c_in)
    c_report <- readLines(c_annualfile,warn = FALSE)

    temprow <-
      matrix(c(rep.int(NA,length(l_grep))),nrow = 1,ncol = length(l_grep))

    # make it a data.frame and give cols the same names as data
    newrow <- data.frame(temprow)
    colnames(newrow) <- colnames(l_grep)


    if (length(c_report) > 0) {
      newrow$count_year[] <- x_2
      newrow$count_company[] <- x_3[3]
      newrow$count_value[] <- c_report
      print(newrow)
      l_grep <- rbind(l_grep,newrow)
    }
  }
  dbWriteTable(mydb,"arp_count", l_grep, overwrite = TRUE)
}

mydb = dbConnect(
  MySQL(), user = 'root', password = '', dbname = 'annualreports', host = 'local
host'
)

system.time(prepareTextfiles())
system.time(get_files())
system.time(arp_passage())
dbDisconnect(mydb)
```

A.8. R-SOURCECODE GVISMAPCREATOR FOR CRI INDEX

```
# R-Version: 3.1.3
# Prepare libraries
# Author: Frank Bezjak
# Name: MapIndex

# configuration section
schema_main <- "mydb"
schema_trends_ger <- "webtrends2"
schema_trends <- "webtrends_germany"

# Install package routines
if(Installpackages > 0) {
  install.packages("RMySQL")
  install.packages("Hmisc")
  library(Hmisc)
  install.packages("googleVis")
  library("RMySQL")
  library(plyr)
  library(dplyr)
}

# build database
if(build_db > 0) {
  c_mysql_dropSchema <- paste("DROP DATABASE ",  schema_eval)
  rs = dbSendQuery(mydb,c_mysql_dropSchema)
  c_mysql_createSchema <- paste("CREATE SCHEMA ", schema_eval)
  rs = dbSendQuery(mydb,c_mysql_createSchema)
}

# setup libraries
setup_libraries <- function () {
  library(googletrend)
  require("devtools")
  library(RMySQL)
  library(plyr)
  library(dplyr)
  schema_main <- "mydb"
  library(googleVis)
}

# clausal open database connection
close_dbs <- function () {
   all_cons <- dbListConnections(MySQL())
   for(con in all_cons){dbDisconnect(con)}
}

#configure program
preparemap <- function(Tablename,mydb,Type,schema,indicator, destination) {

  # Schema
  c_mysql_createSchema <- paste("USE ", schema)
  rs = dbSendQuery(mydb,c_mysql_createSchema)
```

```
  # Query tables
  webdb_query <- paste("SELECT * FROM" , Tablename,"")
  rs = dbSendQuery(mydb, webdb_query)
  input_trends <- fetch(rs, n=-1)

  # 2. prepare the map index based on existing data
  c_mysql_createSchema <- paste("USE ", schema_main)
  rs = dbSendQuery(mydb,c_mysql_createSchema)

  l <- length(input_trends)
  # Regression analysis for webtrends international
  for (i in 1:length(input_trends$row_names)) {
    row_names <- input_trends$row_names[i]
    region <- input_trends$region[i]
    index <- input_trends$index[i]

    savemap(Tablename,row_names,region,index,l,mydb, destination)
  }
}

#create index
create_index <- function() {
  mydb = dbConnect(MySQL(), user = 'root', password = '', dbname = 'mydb', host
= 'localhost')

  x_1 <- "map_data_city_global"
  d_1 <- "plot_data_city_global"
  x_2 <- "map_data_city_local"
  d_2 <- "plot_data_city_local"
  x_3 <- "map_data_region_global"
  d_3 <- "plot_data_region_global"
  x_4 <- "map_data_region_local"
  d_4 <- "plot_data_region_local"
  # city_glboal
  mp <- paste("SELECT * FROM ", x_1)
  rs = dbSendQuery(mydb, mp)
  regional_tables_local <- fetch(rs, n=-1)
  m_1 <- aggregate(regional_tables_local$Index,list(totl=regional_tables_local$R
egion),sum)
  colnames(m_1) <-c("City_Global","sum")
  RMySQL::dbWriteTable(mydb,d_1, m_1,  overwrite = TRUE);
  createChart_city_global(m_1,'City_Global')

  # city_glboal
  mp <- paste("SELECT * FROM ", x_2)
  rs = dbSendQuery(mydb, mp)
  regional_tables_local <- fetch(rs, n=-1)
  m_1 <- aggregate(regional_tables_local$Index,list(totl=regional_tables_local$R
egion),sum)
  colnames(m_1) <-c("City_Local","sum")
  RMySQL::dbWriteTable(mydb,d_2, m_1,  overwrite = TRUE);
  createChart_city_local(m_1,'City_Local')

  # city_glboal
  mp <- paste("SELECT * FROM ", x_3)
  rs = dbSendQuery(mydb, mp)
```

```
  regional_tables_local <- fetch(rs, n=-1)
  m_1 <- aggregate(regional_tables_local$Index,list(totl=regional_tables_local$R
egion),sum)
  colnames(m_1) <-c("Region_Global","sum")
  RMySQL::dbWriteTable(mydb,d_3, m_1,  overwrite = TRUE);
  createChart_region_global(m_1,'Region_Global')

  # city_glboal
  mp <- paste("SELECT * FROM ", x_4)
  rs = dbSendQuery(mydb, mp)
  regional_tables_local <- fetch(rs, n=-1)
  m_1 <- aggregate(regional_tables_local$Index,list(totl=regional_tables_local$R
egion),sum)
  colnames(m_1) <-c("Region_Local","sum")
  RMySQL::dbWriteTable(mydb,d_4, m_1,  overwrite = TRUE);
  createChart_region_local(m_1,'Region_Local')
  dbDisconnect(mydb)
}

#create chart local
createChart_city_local <- function(dataset,locationvar,region_code) {
  G4 <- gvisGeoChart(dataset, locationvar=locationvar, colorvar = 'sum', sizevar
='sum',
                     options= {list(region="DE",gvis.editor="S&P",displayMode='m
arkers',
                     backgroundColor='lightblue',sizeAxis="{maxSize:'3'}")})
  plot(G4)
}

createChart_city_global <- function(dataset,locationvar,region_code) {
  G4 <- gvisGeoChart(dataset, locationvar=locationvar, colorvar = 'sum', sizevar
='sum',
                     options={list(gvis.editor="S&P",displayMode='markers',
                                   backgroundColor='lightblue',sizeAxis="{maxSi
ze:'3'}")})
  plot(G4)
}

#create chart
createChart_region_local <- function(dataset,locationvar,region_code) {

  dataset$Region_Local[dataset$Region_Local == "Lower Saxony"] <- 'Sachsen-Anhal
t'
  dataset$Region_Local[dataset$Region_Local == "North Rhine-Westphalia"] <- 'Nor
drhein-Westfalen'
  dataset$Region_Local[dataset$Region_Local == "Rhineland-Palatinate"] <- 'Rhein
land-Pfalz'
  dataset$Region_Local[dataset$Region_Local == "Saxony"] <- 'Sachsen'
  dataset$Region_Local[dataset$Region_Local == "Saxony-Anhalt"] <- 'Sachsen-Anha
lt'
  dataset$Region_Local[dataset$Region_Local == "Thuringia"] <- 'DE-TH'
  dataset$Region_Local[dataset$Region_Local == "Baden-Wurttemberg"] <- 'DE-BW'
  dataset$Region_Local[dataset$Region_Local == "Bavaria"] <- 'Bayern'
  dataset$Region_Local[dataset$Region_Local == "Lower Saxony"] <- 'DE-NI'
  dataset$Region_Local[dataset$Region_Local == "Brandenburg"] <- 'DE-BB'
  G4 <- gvisGeoMap(dataset, locationvar=locationvar, numvar='sum',  options=list
```

```
(gvis.editor="S&P",region="DE",displayMode="regions",

resolution="provinces"))
  plot(G4)
}

#create chart
createChart_region_global <- function(dataset,locationvar,region_code) {
  G4 <- gvisGeoMap(dataset, locationvar=locationvar, numvar='sum')
  plot(G4)
}

#save_regressionresults
savemap <- function(Tablename,row_names,region,index,l,mydb,destination){
  l_grep <-
    data.frame(
      "Original_tablename" = character(0),
      "Region" = character(0),
      "Type" = character(0),
      "Index" = integer(0),
      "value" = integer(0)
    )

  # create an empty dataframe as a new / add empty tow
  temprow <-
    matrix(c(rep.int(NA,length(l_grep))),nrow = 1,ncol = length(l_grep))

  # make it a data.frame and give cols the same names as data
  newrow <- data.frame(temprow)
  colnames(newrow) <- colnames(l_grep)


  newrow$Original_tablename[] <- Tablename
  newrow$Region[] <- region
  newrow$Type[] <- "Region"
  newrow$Index[] <- index
  newrow$value <- l

  # Rbind new rows.
  l_grep <- rbind(l_grep,newrow)


  # Store results
  RMySQL::dbWriteTable(mydb,destination, l_grep, append=TRUE,  overwrite = FALSE
)
}

# Mainroutine
main_routine <- function(sql) {
  # DB Connection
  mydb = dbConnect(MySQL(), user = 'root', password = '', dbname = 'mydb', host
= 'localhost')

  # clear existing tables
  try( {
    c_trunate_1 <- paste("drop table mydb.map_data_region_global")
```

```
    c_trunate_2 <- paste("drop table mydb.map_data_region_local")
    c_trunate_3 <- paste("drop table mydb.map_data_city_global")
    c_trunate_4 <- paste("drop table mydb.map_data_city_local")
    c_trunate_5 <- paste("drop table mydb.plot_data_region_global")
    c_trunate_6 <- paste("drop table mydb.plot_data_region_local")
    c_trunate_7 <- paste("drop table mydb.plot_data_city_global")
    c_trunate_8 <- paste("drop table mydb.plot_data_city_local")

    rs = dbSendQuery(mydb,c_trunate_1)
    rs = dbSendQuery(mydb,c_trunate_2)
    rs = dbSendQuery(mydb,c_trunate_3)
    rs = dbSendQuery(mydb,c_trunate_4)
    rs = dbSendQuery(mydb,c_trunate_5)
    rs = dbSendQuery(mydb,c_trunate_6)
    rs = dbSendQuery(mydb,c_trunate_7)
    rs = dbSendQuery(mydb,c_trunate_8)
  })

  # extract all global regions
  tp_regions <- "SELECT * FROM mydb.map_cityregion where mydb.map_cityregion.Sch
ema ='webtrends_ge' and Type ='region'"
  rs = dbSendQuery(mydb, tp_regions)
  regional_tables_local <- fetch(rs, n=-1)
  # Regression analysis for webtrends international
  for (i in 1:length(regional_tables_local$ID)) {
    schema <- regional_tables_local$schema[i]
    Type <- regional_tables_local$Type[i]
    tablename <- regional_tables_local$tablename[i]
    schema <- "webtrends_germany"
    indicator <- "region"
    destination <- "map_data_region_local"
    preparemap(tablename,mydb,Type,schema,indicator,destination)
  }
  # extract all local regions
  tp_regions <- "SELECT * FROM mydb.map_cityregion where mydb.map_cityregion.Sch
ema ='webtrends2' and Type ='region'"
  rs = dbSendQuery(mydb, tp_regions)
  regional_tables_global <- fetch(rs, n=-1)
  # Regression analysis for webtrends international
  for (i in 1:length(regional_tables_global$ID)) {
    schema <- regional_tables_global$schema[i]
    Type <- regional_tables_global$Type[i]
    tablename <- regional_tables_global$tablename[i]
    schema <- "webtrends2"
    indicator <- "region"
    destination <- "map_data_region_global"
    preparemap(tablename,mydb,Type,schema,indicator,destination)
  }
  # extract all cities on the global level
  tp_regions <- "SELECT * FROM mydb.map_cityregion where mydb.map_cityregion.Sch
ema ='webtrends_ge' and Type ='city'"
  rs = dbSendQuery(mydb, tp_regions)
  city_tables_local <- fetch(rs, n=-1)
  # Regression analysis for webtrends international
  for (i in 1:length(city_tables_local$ID)) {
    schema <- city_tables_local$schema[i]
```

```
    Type <- city_tables_local$Type[i]
    tablename <- city_tables_local$tablename[i]
    schema <- "webtrends_germany"
    indicator <- "city"
    destination <- "map_data_city_local"
    preparemap(tablename,mydb,Type,schema,indicator,destination)
  }
  # extract all cities on the global level
  tp_regions <- "SELECT * FROM mydb.map_cityregion where mydb.map_cityregion.Sch
ema ='webtrends2' and Type ='city'"
  rs = dbSendQuery(mydb, tp_regions)
  city_tables_local <- fetch(rs, n=-1)
  # Regression analysis for webtrends international
  for (i in 1:length(city_tables_local$ID)) {
    schema <- city_tables_local$schema[i]
    Type <- city_tables_local$Type[i]
    tablename <- city_tables_local$tablename[i]
    schema <- "webtrends2"
    indicator <- "city"
    destination <- "map_data_city_global"
    preparemap(tablename,mydb,Type,schema,indicator,destination)
  }

  dbDisconnect(mydb)
  print("--------------------------------------------------")
}

# Runtime setting

setup_libraries()
```

A.9. OPERATIONALIZABLE CONCLUSIONS

Operationalizable Conclusion 1: The literature does not distinguish between the terms ″global economic trends″ and ″megatrends.″ The terms have similar meanings in the context of globalization, changes in technology and innovation, and they both reflect a current (subjective) state of mind.

Operationalizable Conclusion 2: Phenomenon like "global economic trends" and ″megatrend″ work over an extended period (10 years and longer) and have a strong impact on the society. They refer to institutional changes of markets and affect all entities within local communities, clusters, and vice versa. The transformation is ongoing, fundamental, sustainable, and long-term. Since 2000, the term has gained popularity among corporations that lead to the implementation of trends in corporate strategy.

Operationalizable Conclusion 3: The STEEPV approach provides the capability to categorize trends along the dimensions social, technological, economic, environmental, political, and value dimensions from an ex-post perspective.

Operationalizable Conclusion 4: The environmental impact of a trend can have a push or a pull effect on corporations. Corporations or regions benefit from a trend or need to provide counterstrategies to cope with the impact of a trend.

Operationalizable Conclusion 5: Trend research studies provide various terms and rather arbitrary explanations for trends. This inconsistent use of "trends" observed in literature may also occur in business.

Operationalizable Conclusion 6: Environmental scanning is crucial for the future orientation and the success of a business strategy. However, GET research lacks on information quality, and does not lead directly to in-depth knowledge or competitive advantage.

Operationalizable Conclusion 7: Trend research studies draw a wide variety of trends and agree on the description and impact of these trends, but differ in the labelling of the trends. In comparison, a compound term like "environmental trend" has a higher information value then the term "megatrend," and provides a better ground for interpretation and categorization of the trend.

Operationalizable Conclusion 8: GETs affect all participants (households, governments, and corporations) within a macroeconomic environment, such as a nation, a region, or a certain geographical setting. This effect is measurable quantitatively by macroeconomic indicators.

Operationalizable Conclusion 9: Knowledge about GETs is perceived as a strategic lever that fosters the quality of investment decision-making. Methods in the field of economic theory need refinement to cope with the complexity of markets. Data sources (big data) from social media like web trends provide new possibilities to raise the quality of economic models.

Operationalizable Conclusion 10: GETs effect all entities of an economy, but the impact is mainly important to the business of MNEs due to their degree of international business activity, and the decision-making processes on the political level in economically developed countries. To gain knowledge about GETs, it is crucial to analyze the regional influence of a certain trend.

Operationalizable Conclusion 11: The practices of foresight help to estimate the impact of GETs to the competitive advantage of clusters and regions. Geographical data provide insights for localizing the impact of GETs.

Operationalizable Conclusion 12: Detecting the weak signals that are sent by GETs requires an optimal configuration of the forecast horizon and response time in order to gain enough knowledge about the possible impact of trends. This is true for all members of a macroeconomic environment.

Operationalizable Conclusion 13: Forecasting and foresighting are either independent or mutual activities that foster the creation of a completely exhaustive view in the field of future studies with global, multinational, regional, or technological focus.

Operationalizable Conclusion 14: Corporate and technology foresighting processes are a key competency for corporations to foster innovative development for products (and services) and to create a customer benefit.

Operationalizable Conclusion 15: An effective and efficient foresight exercise requires careful planning and extensive practical preparation to foster the development of a common vision and a high integration of the foresight stakeholders.

Operationalizable Conclusion 16: Successful foresighting founds on the collaboration of stakeholders. Political institutions should concentrate on (a) tacit (collective) knowledge to create or to enhance a fruitful knowledge culture or on (b) fostering of knowledge management, which enables the interchange of knowledge across regions.

Operationalizable Conclusion 17: Developing a mutual vision that results in a strategic plan that is followed by all participating stakeholders is a key requirement to raise the effectiveness and efficiency of capital investments.

Operationalizable Conclusion 18: The domain of foresight lacks a clear methodological toolkit and a common understanding what concepts have to be included into a toolkit, and how these concepts should be labeled. Furthermore, the availability of quantitative methods in the discipline of foresight has to be pointed out.

Operationalizable Conclusion 19: The combination of foresight methodologies improves the effectiveness of innovation and reduces organizational barriers. This effect is strengthened by online surveys and collaboration platforms.

Operationalizable Conclusion 20: Developing scenarios under the influence of GETs is complex and has a high degree of uncertainty. It requires an environment that provides collaborative thinking and communication among experts, expertise on quantitative data, and the integration of up-to-date information.

Operationalizable Conclusion 21: Web search data as provided by Google Trends provide behavioral data of online activity by users and enable researchers to make inferences about the economic decision-making of users (nowcasting). Furthermore, the data are capable of portraying the development of economic growth.

Operationalizable Conclusion 22: Nowcasting based on web data is able to outperform survey-based indicators and provides new approaches for research on economic indicators. The aggregated data of Google Trends on an annual basis provides explanatory capabilities for behavioral research in economics and finance.

Operationalizable Conclusion 23: Data sources provide information about online behavior, raise the quality of economic predictions, and enhance the quality of analysis and foresighting practices.

A.10. OPERATIONALIZABLE HYPOTHESES

Operationalizable Hypothesis 1: GETs and megatrends show similarities with respect to globalization, market competition, changes in the organization of production, and innovation. They aim to gain knowledge about the current economic situation and economic downturns, or economic crises to anticipate the actual as-is situation and future development (foresight).

Operationalizable Hypothesis 2: GETs are especially interesting to multinational enterprises (MNEs). Therefore, future-orientated corporations like MNEs use terms like ″global trends,″ ″megatrends,″ ″GETs″ actively in their business practices.

Operationalizable Hypothesis 3: Literature indicates that regions with a higher GDP tend to be more future-oriented. MNEs are future-oriented and have a special interest in and actively search the web for future oriented terms like ″megatrends,″ ″GETs,″ or ″global trends.″ Therefore, web searches should correlate with the geographical locations of MNEs.

A.11. HYPOTHESES

Hypothesis 1: German DAX (German stock index) companies actively use GETs and megatrends in annual reports. At the same time, corporations from different industries set different priorities to trends, which is observable in behavioral patterns and in the spatial distribution of trends.

Hypothesis 2: Corporations perceive trends business opportunities rather than as risk, and communicate a positive vision to their shareholders.

Hypothesis 3: Trends be subsumed deductively and inductively in similar categories with the same traits and characteristics, based on the concept of qualitative content analysis.

Hypothesis 4: Spatial analysis based on web search data related to global economic trends used in annual reports of DAX corporations could be used to analyze economic growth based on macroeconomic indicators like GDP.

Hypothesis 5: Financial KPIs might have a causal relation to the utilization of trends used in annual reports of DAX corporations. Quantitative indicators founded on the information of trends in annual reports are able to portray the confidence of a corporation into the relevance of a trend.

Hypothesis 6: Web search information is able to improve existing multivariate models for the assessment of global economic trends.

A.12. CONCLUSIONS

Conclusion 1: The utilization and distribution of direct and indirect trends passages in annual reports by DAX corporations depends on the annual year. The frequency of both categories grows annually, which represents a growing interest in the topic of GETs.

Conclusion 2: From the cross-sectional view, the use of ”GETs” is not equally distributed in the overall index. Instead, five corporations use 60% of all “direct TPs” identified. From the LTA perspective, there is no relevant correlation between the variables “DIRECT”, “INDIRECT” and “CORPORATION_ID.”

Conclusion 3: Energy- and resource-intensive industries like the chemical, engineering, and the automobile industries are predominantly addressing direct TPs (GETs) in their investor relation communication.

Conclusion 4: The results of the long-term analysis match the results from the pilot study concerning the distribution of gross domestic product (GDP) and the use of trends.

Conclusion 5: The population reveals that directly mentioned TPs are more likely to be depicted as an opportunity, rather than a risk in annual reports with an odds-ratio of 6.63.

Conclusion 6: The STEEPV categorization system is applicable to the data from an ex-post perspective. The distribution of STEEPV categorization system shows low emphasis on “Political,” and “Value” trends. In most cases, the category “Economic” matches the TP best from an expert point of view.

Conclusion 7: The STEEPV categorization system is applicable to the data from an ex-post perspective. The distribution of the STEEPV categorization system shows low emphasis on “Political” and “Value” trends. Within the population, the category “Economic” matches the TPs best from an expert point of view.

Conclusion 8: The individual trends found in annual reports qualify as a foundation to develop an individual categorization system. The ICS-finalized category system contains nine individual categories for expert analysis.

Conclusion 9: The frequency of specific ICS categories applied to the population depends on individual corporations. The association between the variables "ICS_Category" and "CORPORATION_ID" is moderate.

Conclusion 10: The ICS categories are distributed equally in the total population. In comparison to STEEPV, the category system does not depend on the annual year.

Conclusion 11: The regional indicator (RI) reveals that web searches for trends used in annual reports of German DAX corporations also occur outside of Germany.

Conclusion 12: The correlation between the variable global regional index (RI) and GDP at purchaser's price seem to be spurious.

Conclusion 13: The global RI indicator is not able to explain the development of GDPpc on the level of regions and cities.

Conclusion 14: The index local RI for regions is able to make predictions about GDPpc. However, the regression model show a rather low quality with R2 .248.

Conclusion 15: Even though there is no causal relation between the variables, local RI for cities is able to predict GDPpc partially. The regression model shows a rather low quality with R2 of .104.

Conclusion 16: Financial KPIs for each corporation are provided consistently in the overall population (n=330). The correlation between the CRI index and the financial indicators provide a foundation for the development of linear regression models from the cross-sectional and the LTA point of view.

Conclusion 17: The developed regression model for CRI based on the financial KPIs for the cross-sectional population is valid from the statistical point of view. Approximately 10 % of the total variation in the overall population is explainable by the model. The results of the model are integrated into the exploratory research.

Conclusion 18: The above results stress the superiority of the unstructured model. It is less restrictive, and shows absolutely no correlation between the annual years. However, the logical interdependence of annual years could be modeled with the autoregressive structure to provide enough quality from the statistical point of view.

Conclusion 19: The implementation of variables based on Google Trend into existing regression models, in our case CRI index based on financial KPIs, was able to deliver improvement. The improvement amounts to an additional 5% of explanatory capacity of the total variance.

Conclusion 20: The "global Google Trends" index provides an ideal ground for the optimization of the previously developed GEE model. The generalized estimated equation based on one-period autoregressive correlation fits the conceptual model best.

A.13. RESEARCH CONCLUSIONS

Research conclusion 1: German DAX companies actively utilize GETs and megatrends in their annual reports. A detailed analysis of trends reveals behavioral patterns in the frequency of usage, in direct and indirect use and in the spatial and regional distribution of trend patterns.

Research conclusion 2: Trends are often perceived as business opportunities by corporations. In general, an annual report (ARP) contains more TPs that describe the observed GET as a business opportunity.

Research conclusion 3: Trends that show the same traits and characteristics can be summarized deductively with the foresight method STEEPV. The inductively developed individual categorization system provides better options for categorization.

Research conclusion 4: Web search data cannot be used to make detail analysis on global economic trends used in annual reports of DAX corporations and economic growth. The data only gives a general indication which regions show an interest into the utilized trends.

Research conclusion 5: A quantitative indicator based on (1) the total utilization of TPs identified as risks and opportunities, as well as by (2) the total amount of direct and indirect TPs implemented is able to portray the certainty or confidence of a corporation concerning the business relevance of a trend. Financial KPIs have a relation to this indicator. However, this cannot be perceived as a causal relation. In addition, the developed regression model and the generalized estimated equation model are of rather low quality.

Research conclusion 6: Web search information is able to improve multivariate models that explain the certainty or confidence of a corporation into the business relevance of a trend with the help of financial KPIs on an annual basis.