



ΔΙΑΤΜΗΜΑΤΙΚΟ ΠΡΟΓΡΑΜΜΑ ΜΕΤΑΠΤΥΧΙΑΚΩΝ ΣΠΟΥΔΩΝ ΣΤΗ  
ΔΙΟΙΚΗΣΗ ΕΠΙΧΕΙΡΗΣΕΩΝ

Διπλωματική Εργασία

**BUSINESS EXCELLENCE AND DEVELOPING  
CHALLENGES ON COMMERCIAL ROAD TRANSPORT**

του

Ζαρογιάννη Ι. Λουκά (Α.Μ. 1435)

Υποβλήθηκε ως απαιτούμενο για την απόκτηση του μεταπτυχιακού διπλώματος ειδίκευσης  
στη Διοίκηση Επιχειρήσεων

Μάρτιος 2016

## **ABSTRACT**

The current thesis discusses the subject of business excellence in the context of commercial road transport and taken into account the challenges that arise. The analysis focuses on the business excellence models generally but also in the context of Supply Chain Management (SCM) which is tightly linked to the commercial road transportation. In this context two important and widely recognized and accepted business excellence models, the EFQM and the Baldrige framework are mentioned and briefly explained. Furthermore, a number of challenges, with some possible solutions, for the particular sector are discussed and all these in the context of business excellence. Finally, the current thesis mentions some valuable conclusions that were drawn out from the analysis of the specific subject.

## TABLE OF CONTENT

INTRODUCTON.....	1
LITERATURE REVIEW.....	3
BUSINESS EXCELLENCE .....	7
<i>Business Excellence Core Values and Concepts</i> .....	7
<i>An Overall Business Excellence Framework</i> .....	8
<i>What is a Business Excellence Model?</i> .....	9
<i>The European Foundation for Quality Management (EFQM) model</i> .....	10
<i>The Baldrige framework and the Malcolm Baldrige National Quality Award (MBNQA)</i> .....	11
<i>Business Excellence and Supply Chain Management (SCM)</i> .....	15
<i>Business Excellence Model Assessments</i> .....	20
<i>Limitations of Business Excellent Models</i> .....	<b>Fehler! Textmarke nicht definiert.</b>
CHALLENGES AND DEVELOPMENTS INFLUENCING COMMERCIAL TRANSPORTATION- THE CASE OF GERMANY .....	21
<i>Globalization</i> .....	21
<i>Demographic change</i> .....	25
<i>Urbanization</i> .....	29
<i>Sustainability</i> .....	31
<i>Limited resources</i> .....	32
POSSIBLE SOLUTIONS TO CHALLENGES INFLUENCING COMMERCIAL TRANSPORTATION .....	35
Digitization.....	35
<i>Internet of Things</i> .....	36
<i>Intelligent traffic guidance systems</i> .....	37
<i>Intelligent freight cars</i> .....	38
Flexible management .....	39
<i>Quiet nighttime transport</i> .....	39
<i>Integrating modes of transport and consolidating transport volumes</i> .....	40
<i>Deceleration</i> .....	40
<i>Attractive workplace design</i> .....	41
Technology.....	41
<i>Modular container construction</i> .....	42
<i>Automatic coupling</i> .....	42
<i>Waste heat utilization</i> .....	43
<i>Autonomous assistance systems</i> .....	43
<i>Autonomous driving in rail transportation</i> .....	44
<i>Alternative propulsion technologies</i> .....	45
CONCLUSIONS.....	49
REFERENCES .....	50

## **LIST OF FIGURES**

*Figure 1: An Overall Business Excellence Framework*

*Figure 2: 2011-2012 Baldrige Criteria for Performance Excellence*

*Figure 3: Weighting/scores attached to 2011-2012 Baldrige CPE*

*Figure 4: Existing SCM models and their inadequacies*

*Figure 5: A different SCM model*

*Figure 6: Europe's largest logistics regions*

*Figure 7: Forecast of volume sold in freight transportation– Germany up to the year 2050*

*Figure 8: Population pyramids for 2008 and 2060 in comparison*

*Figure 9: Number of days of incapacity to work per 1,000 members (excluding retired)*

*Figure 10: Urban and rural populations compared to world population*

*Figure 11: Areas of innovation and solutions*

## INTRODUCTON

Nowadays that the economy and the competition are globalized the corporations try to contract out logistics operations and reduce costs in an effort to focus on their core competences. Currently a transformation of the commercial road transportation and logistics industry is taking place and it moving very fast away from the traditional transportation industry. This transition is reflected by the fact that most of the processes such as planning, implementing and controlling the related information from point-of-origin to point-of-consumption aim to conform to the customer needs. In the past, commercial road transportation was regarded as a classical, necessary function, which involves adversarial relationships among suppliers and customers but nowadays firms finally understand that it can play an important role regarding the firm's competitive advantage and its strategic alliances with other companies.

Due to the most companies' recognition of the importance of meeting the customers' needs so that they can nowadays succeed in the competitive environment, it is also recognized that optimizing operations within the context of their enterprises is not enough to achieve business excellence. Therefore, supply chain management (SCM) has a great importance as a means to help firms leverage their suppliers' resources in improving their own competitive edges, as it is supported by a number of researchers such as Cavinato, (1991), Ellram & Cooper (1990), Houlihan (1985), Jones & Riley (1985) and Towill et al. (1992). Nevertheless, according to the particular authors, the existing SCM models seem to be inadequate thus a number of new SCM models have been developed so that firms can use them in order to reach the goal of business excellence.

In addition to all the above mentioned facts, it is also worth mentioning that the importance of the commercial transportation sector has been further increased the last decade mainly due to the rising demand for freight transportation that is taking place on a global scale. The infrastructure suffers today from the overload of the transport volumes and in addition to these, there are significant population shifts that are taking place and indicate that the number of people who live in cities increase rapidly. All these factors combined together with the increasing individualization already play and will play an important role in the transformation of the commercial road transportation.

The above mentioned trends are only some of the challenges that the road commercial transportation sector is going to face in the near future, leading many people to wonder about the way the commercial road transportation sector is going to respond to these changes. In order for someone to be able to answer this, the challenges, and their corresponding possible solutions, that already influence or will influence the particular sector have to be discussed. Specifically, the current thesis presents the impacts and developments related to the most significant trends such as globalization, demographic change, urbanization, sustainability and the limited resources and it also presents a number of potential approaches for solving them in order for the firms in this sector to achieve business excellence not only nowadays but also in the years ahead.

The aim of the current thesis is to examine some well-known business excellence models and frameworks that are used worldwide but at the same time taking into account the recent and possible future challenges of the commercial road transportation. The added value of such a research derives from the more holistic discussion of the business excellence subject for the particular sector since most of the times researches on business excellence, even when they refer to only one sector, do not taken into account or focus on the specific current and future needs of the particular firms. Therefore, the current analysis aims to examine the way that firms of the commercial road transportation can achieve business excellence taking into account the developing challenges of the sector in order to provide a basis for future research on a more holistic business excellence framework for commercial road transportation.

The thesis is structured as follows: the next chapter discusses the subject of business excellence, its core values and concepts. In this context two business excellence models are presented and briefly explained. The next part refers to the challenges and recent developments that influence the commercial transportation sector and in this context the commercial rail and road transportation sector of Germany is being used due to its importance to the country's economy. Some of the challenges that are discussed include the globalization, the urbanization, the problem of limited resources etc. After the discussion of the recent developments and challenges in the particular sector, the following chapter discusses a number of possible solutions to the above mentioned challenges in order to achieve business excellence in the particular sector. Finally, the last part of the current thesis includes the conclusions that were drawn out from this discussion and that can be valuable for other researchers and practitioners.

## LITERATURE REVIEW

Business Excellence plays an important role in promoting and rewarding organizational and performance excellence. Thus, receiving a business excellence award is the highest honor an organization can attain (Ghobadian and Woo, 1996) and adopting the corresponding business excellence models plays an important role in a firm's success. The first quality award that was introduced to reward organizations that demonstrates significant growth in performance is the Deming Prize. The Deming Prize was established by the Board of Directors of the Japanese Union of Scientists and Engineers (JUSE) in 1951. The improved performance in Japanese companies under the influence of quality gurus such as, Deming and Juran inspired the United States to develop the Malcolm Baldrige Award. This prestigious American quality award was named after President Reagan's Secretary of Commerce who was killed in a rodeo accident in 1987 (Bohoris, 1995). The Malcolm Baldrige is designed to recognize American firms that practice effective quality management and make significant improvements in the quality of their goods and services. Furthermore, the European Quality Award (EQA) and the corresponding model were officially introduced by the European Foundation for Quality Management (EFQM) and led the 14 leading Western European businesses of EFQM to realize that the only way to survive in the today's world economy is to adopt the practice of quality (Bohoris, 1995). The Australian Quality Award was first established by Australian Quality Council (AQC) in 1988 and was later acquired by SAI Global (formerly known as Standards Australia International Limited) in February 2002. The Australian Quality Award seeks to increase management's quality awareness and recognizes accomplishment in quality and productivity improvement. The award also provides a benchmark for their achievements among Australian organizations. Hence, this led to a global interest in following the approach of quality. The Malcolm Baldrige framework and the Deming Prize criteria was further improved and integrated into a Business Excellence framework in the late 1990s (Oakland, 2003).

Nevertheless, even though business excellence models (BEMs) seem to be extremely effective, some researchers suggest otherwise. BEM in fact does not guarantee success for every company, and companies often criticize the effectiveness of those models (Powell, 1995; Jennings & Beaver, 1997; Fisher et al., 2001; Stephens et al., 2005). In order for BEMs to properly function, both the employers and the employees need to be

involved and accept the system in place. Every organization is different, meaning that the amount of infrastructure, commitment, resources and drive for success varies. Companies often are not receptive of change and do not actively pursue the improvement of their customer service and the education of their staff (Corbett & Angell, 2011). In order for a Business Model to work the leadership of the company needs to guide the behavior of all the stakeholders, which is a hard task in itself (Dahlgaard-Park, 2008).

Clear cut examples of the weaknesses of existing BEMs are the failures of past MBNQA (Malcolm Baldrige National Quality Award) award winners such as Cadillac, Motorola, Wallace and Federal Express. The effectiveness of some of these awards is being questioned by experts, due to the poor performance of these companies. Many argue that these allegations are false, because even though BEMs are tools that create profit, a National Quality Award such as the MBNQA is not a clear indicator for future success. (Wisner & Eakins, 1994; Powell, 1995; Melnyk & Denzler, 1996; Fisher et al., 2001; Evans, 2012).

Another research that points out some probable shortcomings of the BEMs examines the method with which the awards are given and the nominees are selected (Miller, 1993; McTeer & Dale, 1994; Wilkes & Dale, 1998; Lee et al., 2006). These shortcomings include the overcomplicated assessment criteria, the excessive paperwork, the tiresome procedures, the lack of infrastructure, the excessive bureaucracy, the time consumption and the overall lack of focus (Main, 1991). Against these accusations, a committee of jury members of the Danish, the Swedish and the Taiwanese Quality Awards try to present the possible counter arguments.

The first argument is defending the utility of the BEMs and the significance of the Awards is that, according to the award giving organizations, companies often need help when using the BEMs for management control purposes. The applications seem over complicated and bureaucratic because the companies have trouble understanding the various BEM criteria and are often unable to self-assess. According to the committee, companies need to be able to complete simple self-assessments and also motivate their staff into getting involved with regular assessments. One way that companies can achieve that is by following a questionnaire approach where the staff members are asked to assess the key criteria and potential areas for improvement and ranking them based on their importance (Dahlgaard et al., 2011).



The second argument point is that the existing BEMs often failed to attract total employee involvement which we is a crucial factor of the BE pursuit. Research in this area indicates that cooperation, involvement and teamwork are essential parts of a successful BEM implementation (Chapman, 2000; Jackson, 2001; Dahlgaard & Dahlgaard-Park, 2004; Dahlgaard et al., 2011; Dahlgaard-Park, 2012). However, overall team involvement is beyond the control of any single individual within the team, meaning that it is not a weakness of the BEM that the work staff is not involved, but it is a systematic failure within the company itself. The fact that people are not willing to participate in activities that they are supposed to support, indicates an operational weakness of the company (Oakland, 1999; Dahlgaard-Park, 2012).

The third argument point is that despite the holistic approach of the BEMs, the overall models lack a clear guideline on an operational level. A good example is the European Excellence Model (2010) where EFQM claims that the BEM is supposed to give practical knowledge to companies by integrating already existing models and creating a specialized model based on the strengths and weaknesses of the company. The committee argues that the problem within the EFQM model is located in the inconsistency between the goals and the practices. The inconsistency is observed between leadership intention and the practices (processes), in particular. The cultural aspect of the company was focused under the leadership of the company, while there was no apparent focus of strategy crafting and resources development. These inconsistencies seem to majorly downgrade the model's performance and may be the reason that many companies have failed to integrate the model. Also, when it comes to giving the awards, these inconsistencies cause problems for both companies and the examiners. (Dahlgaard-Park, 2008).

Another potential problem is caused by the over-complexity of the EFQM Business Model. This model consists of consists of 9 criteria and 32 sub-criteria, which break down organizational management into an excessive fragmentation that results in self-assessments. Usually excessive fragmentation forces people to focus on the "tree and not the forest", meaning that assessors often get hindered by the criteria and sub-criteria of the model, and are not able to develop strategies that will improve the company. A simplified BEM will solve some of the problems regarding the assessor's focus and involvement which will result in a more accurate and concrete Business Model. Furthermore, it is also crucial that BEMs are not only simplified but also take into

consideration a number of challenges and factors that affect firms and that can vary from sector to sector.

## **BUSINESS EXCELLENCE**

The main goal of Business Excellence (BE) is to develop and strengthen the structural and operating systems of the organization, while increasing the productivity and the overall value for the stakeholders. Striving for BE means that companies aim to maximize their performance in marketing, strategy, people management, leadership and customer support. To paraphrase Kenny Yap, CEO of Qian Hu Corporation Ltd, business excellence overall ensures the company's longevity and sustainability.

### *Business Excellence Core Values and Concepts*

Successful organizations achieve excellence by inserting fundamental values and concepts into the philosophy of their business. BE utilizes these attributes as the foundation that allows for the growth and improvement of the company.

A key attribute that greatly improves the fabric of the business is the implementation of values such as productivity, personal improvement and customer support. Generally organizations that aim towards the improvement of their workforce, create systems that allow the employees to learn by sharing knowledge. The learning process is a product of the constant improvement of the techniques and approaches that is followed by the continuous reevaluation of the company's goals. The main factor that allows the growth and improvement of the workforce is the existence of a team leader. The leader of the workforce implements clear and understandable instructions and values to the team helps develop a high productivity workplace, while focusing mainly on the optimal customer support. This way, the stakeholders achieve a higher understanding of the organization's direction and goals, while the workforce is allowed to engage into more meaningful and productive activities, greatly improving the work environment.

BE should always be driven by the desire to support the customer in the best way possible. The judges of the company's product quality are the customers meaning that the organizations should implement the characteristics, features and functions that appeal to the customer base. Product accessibility is also extremely important. BE also dictates that the company has to be agile and flexible in order to survive in the ever changing global market. They have to be open to rapid changes and innovation that aim to improve the operations, the processes and the overall business model, in order to

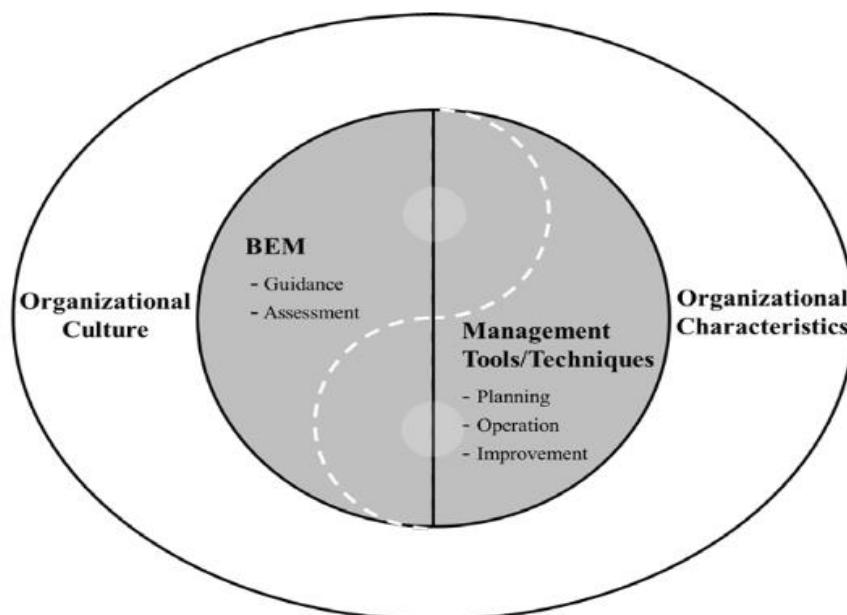
maximize productivity. The improved results will essentially create and balance the company's value for the stakeholders.

The way companies improve and prosper is by following a management model that's based on fact. The organizations analyze data, critically assess information, and utilize business models, strategies and processes from other companies. Basically companies can achieve excellence by examining the factors that lead to success. It is also important that the company takes into account factors such as longevity and long-term prosperity. This implies that the organization achieves BE by taking a holistic business approach, taking into account both the stakeholders interests, and the customer's needs.

The companies also have societal issues that they have to tackle and responsibilities to the public. The company's leadership holds most of the responsibility of creating a successful company that also takes into account the society's wellbeing, while ensuring the company's ethical behavior.

### *An Overall Business Excellence Framework*

*Figure 1: An Overall Business Excellence Framework*



Source: Dahlgard et al (2013)

Based on the above graph the overall BE of the company is a combination of the management tools and techniques on the right, and the Business Excellence Model (BEM), on the left, that the company uses. The two parts of BE function independently but also coexist within the fabric of the company. The graph indicates that BEM should be used for guidance and for acquiring BE, while utilizing the management tools and techniques for supporting the pursuit for BE. It is important to note that the outer circle of the graph that in order for BEM and management tools and techniques to properly function, there needs to be a desirable work environment and also a clear organizational business model. The characteristics and the culture of the company need to be explained, deployed, implemented and improved after reflection by the leadership figures within the company. (Dahlgaard & Dahlgaard-Park, 1999, 2004)

Different companies have unique business cultures that vary depending on the company itself, the cultural background of the workforce and the characteristics of the customer base. For example Post Denmark focuses on principles like leadership, customer service, team chemistry, while Samsung builds their culture around excellence, integrity, prosperity and longevity. The main factor that connects the different work philosophies is the will to achieve business excellence.

### *What is a Business Excellence Model?*

As the global market turns into a more developed and competitive environment, BE becomes a crucial goal for all the companies that aim to survive and thrive. The need for BE enforced companies to search for fresh business approaches, in order to enhance the effectiveness and productivity of their workforce. The companies developed BEMs, Total Quality Management (TQM), Business Process Reengineering (BPR), Enterprise Resource Planning (ERP), Organizational Change Management (OCM), that are essentially business systems that allow the organizations to detect their strengths and weaknesses, to improve, and to find the proper formula that will allow them to succeed and prosper.

As the name implies, BEMs are developed by companies in order to achieve excellence and are essentially the key factor for improvement. The BMEs implement the organization's core values and strengths in the fabric of the workforce and are the main guidelines for the leadership figures. BEMs aim to create the ideal business model,

and in a sense take the role of an internal consultant, by guiding the company to the desirable destination for all the stakeholders.

### *The European Foundation for Quality Management (EFQM) model*

One of the most well-known BEMs is the EFQM Excellence Model which was introduced by EFQM in 1991. The EFQM is the organization which was formally established by 14 European companies in 1988 to guide organizations to improve performance and the EFQM Excellence Model is a nonprescriptive framework to help guide an organization and improve its performance. The model is based on eight Fundamental Concepts of Excellence: Results Orientation, Customer Focus, Leadership and Constancy of Purpose, Management by Processes and Facts, People Development and Involvement, Continuous Learning, Innovation and Improvement, Partnership Development, and Corporate Social Responsibility. According to EFQM 'Truly excellent organizations are those that strive to satisfy their stakeholders by what they achieve, how they achieve it and what they are likely to achieve'. Based on this definition, the stakeholders include those individuals or groups that impact upon, or have an impact on, the organization, such as customers, employees, partners, suppliers, the society in which the organization operates, and those with a financial stake in the company. Furthermore, the particular model consists of nine criteria which can be divided into two groups: *Enablers and Results*. The five 'Enabler' criteria cover what an organization does and the rest four 'Results' cover what an organization achieves. The connection between 'Results' and 'Enablers' is as follows: 'Results' are caused by 'Enablers', and 'Enablers' are improved using feedback from 'Results'.

Apart from the above characteristics of the model, EFQM also includes 8 fundamental concepts, 9 criteria measurement model, some management framework, and may be implemented by the following ten steps as it is supported by Oakland (2004):

1. Set direction through leadership
2. Establish the results it wants to achieve
3. Establish and drive policy and strategy
4. Set up and manage appropriately its approach to process, people, partnerships and resources

5. Deploy the approaches to ensure achievement of the policies, strategies and thereby the results
6. Assess the 'business' performance, in term of customers, its own people and society results
7. Assess the achievements of key performance results
8. Review performance and areas for improvement
9. Innovate to deliver performance improvements
10. Learn more about the effects of the enablers on the results

At this point it has to mentioned that based on the particular business excellence model awards are given once a year to the best performing European companies based on the following factors: Adding Value for Customers, Creating a Sustainable Future, Developing Organizational Capability, Harnessing Creativity & Innovation, Leading with Vision, Inspiration & Integrity, Managing with Agility, Succeeding through the Talent of People and Sustaining Outstanding Results. The specific award is widely known and the firms that receive it can enhance their reputation regarding their performance and business excellence.

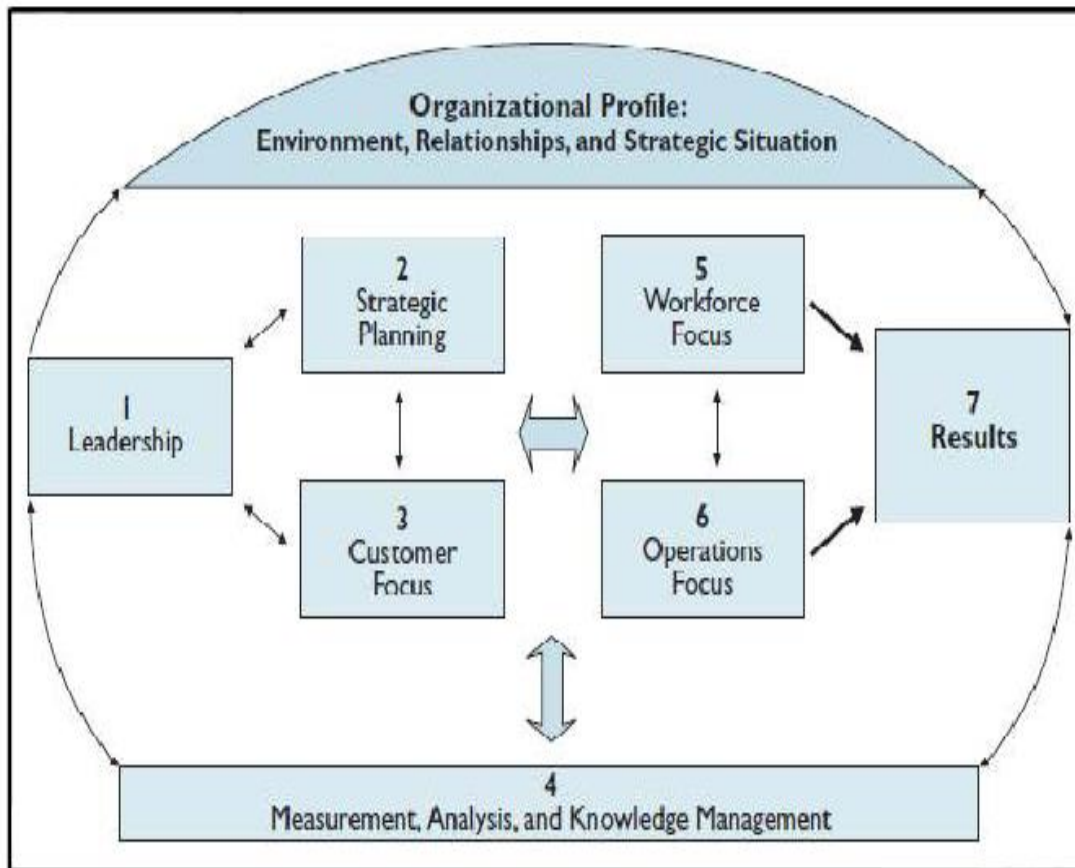
### *The Baldrige framework and the Malcolm Baldrige National Quality Award (MBNQA)*

Another example of a BEM that is being used to a high extend is the Baldrige Criteria for Performance Excellence (CPE)<sup>1</sup> that is being used both in the United States but also in Asia, that is showed below. The CPE model is composed of seven categories. The categories from 1 to 6 are the processes and the final category indicates the results. Also, the organizational profile is taken into account. The organizational profile includes the work environment, the business model, the culture and the strategic approach of the company as it is shown in Figure 2 below.

---

<sup>1</sup> See Figure 3

Figure 2: 2011-2012 Baldrige Criteria for Performance Excellence



Source: Mann et al (2012)

As far as the meaning and substance of the categories:

1) Leadership: The actions and the guidance of senior leaders of the team that increase the sustainability of the company. It also involves the ethical and legal responsibilities of the company towards its stakeholders and society.

2) Strategic Planning: The development of strategies and the definition of the company's goals. It's also important to note that the implementation itself and the progress are examined.

3) Customer Focus: The organization's engagement with the customer base. It includes the way the company accepts and responds to criticism, and the actions towards creating a stronger bond with the customers.

4) Measurement, Analysis, and Knowledge Management: The way the company obtains, analyzes, and examines utilizes information, improves data gathering and reviews the results.



5) Workforce Focus: Examination of the workforce’s productivity, performance and overall team chemistry. Also involves the development of the workforce and the utilization of potential of every employee.

6) Operations Focus: The designing and management of a business system and the improvement of the customer support. The operations focus is mainly about the overall success, longevity and sustainability of the organization.

7) Results: The results category examines the company’s overall performance and improvement in all the above categories. The results are always examined relatively to the performance of the competitors.

Figure 3: Weighting/scores attached to 2011-2012 Baldrige CPE

Categories and Items		Point Values
<b>1</b>	<b>Leadership</b>	<b>120</b>
	1.1 Senior Leadership	70
	1.2 Governance and Societal Responsibilities	50
<b>2</b>	<b>Strategic Planning</b>	<b>85</b>
	2.1 Strategy Development	40
	2.2 Strategy Implementation	45
<b>3</b>	<b>Customer Focus</b>	<b>85</b>
	3.1 Voice of the Customer	45
	3.2 Customer Engagement	40
<b>4</b>	<b>Measurement, Analysis, and Knowledge Management</b>	<b>90</b>
	4.1 Measurement, Analysis, and Improvement of Organizational Performance	45
	4.2 Management of Information, Knowledge, and Information Technology	45
<b>5</b>	<b>Workforce Focus</b>	<b>85</b>
	5.1 Workforce Environment	40
	5.2 Workforce Engagement	45
<b>6</b>	<b>Operations Focus</b>	<b>85</b>
	6.1 Work Systems	45
	6.2 Work Processes	40
<b>7</b>	<b>Results</b>	<b>450</b>
	7.1 Product and Process Outcomes	120
	7.2 Customer-Focused Outcomes	90
	7.3 Workforce-Focused Outcomes	80
	7.4 Leadership and Governance Outcomes	80
	7.5 Financial and Market Outcomes	80
<b>TOTAL POINTS</b>		<b>1,000</b>

Source: Mann et al (2012)

All of those are analyzed and evaluated on their own merits. The importance of every category is shown in the figure below. This weighting can vary dependent on the BEM but most BEMs have a maximum score of 1000 points. The scoring is important when organizations apply for a national BE award as it enables the BE maturity of applicant organizations to be compared. When an organization is not applying for an award, the scores are useful for tracking year on year improvements. Whilst scores are important for monitoring progress, the main value from using BEMs is that they help organizations to clearly understand their strengths and opportunities for improvement for each category and/or item. This information helps organizations to identify what they need to do to improve.

Furthermore, next to the Baldrige frameworks it has to be mentioned that the particular criteria are also linked to the Malcolm Baldrige National Quality Awards that are given by the Foundation for the Malcolm Baldrige National Quality Awards. The specific award is also held once a year, like the EFQM award, and includes a very important feature for the firms that participate and this is the sharing of information and best practices of US firms that participate.

At this point it is important to mention the research of Boulter et al. (2013) that highlighted the financial benefits from the implementation of BEMs. The research followed the model of a previous study by Hendrics & Singhal, and compared 120 companies of national and regional caliber that had won awards from the period 1990 to 2006, with other companies from the same industry and region as the BEM BME there were no significant financial differences in the 5 year period before winning the award. Nevertheless, after winning the award and implementing the BEM in its entirety, the award winning companies showed great improvement. In just one year after winning the award, the companies showed an 8% in sales revenue, a 17% after 3 years, and an incredible 77% after 5 years of winning the award. Also, the companies that won the award showed increase in operating income (18%), in total assets (40%) and 4.4% decrease in cost over sales. The particular research shows that the implementation of BEMs contributes to an increase in performance, sales, productivity and a reduction in costs. The bottom line is that investing in Business Excellence is a valuable and functional strategy.

### *Business Excellence and Supply Chain Management (SCM)*

One aspect of business that is extremely important is the value of an advanced and functional supply chain. According to Christopher (1992), a supply chain network involves all the various linkages, activities and processes of an organization, that concern the production and distribution of the products to the customer base. Companies realize that by improving their supply chain management (SCM), they are able to enhance their overall performance and meet their customers' expectations. SCM is a tool that allows companies to leverage their suppliers' resources in order to create profit (Cavinato, 1991; Ellram & Cooper, 1990; Houlihan, 1985; Jones & Riley, 1985; Towill et al., 1992). SCM is basically a business approach that maximizes profits for stakeholders, improves the efficiency of the supplying processes, in order to improve the customer service. For SCM to function properly, companies and suppliers must develop a long-lasting, profitable business partnership.

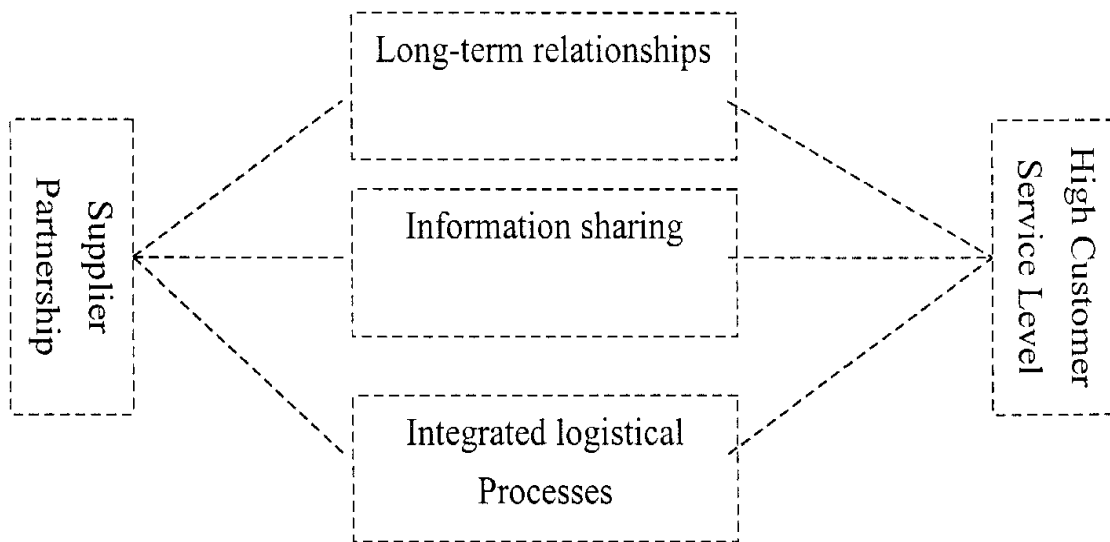
The way supply chains function is that organizations inform the suppliers of their needs, and the suppliers provide the goods. Creating relationships enhances the ability of both parties to meet their requirements. It is important to note that both parties respect their internal and external partners and aim to satisfy both their needs. The internal partners mainly involve stakeholders and the customer base while external partners include organizations, individuals or governments that work with the suppliers and the companies. Supply chains are extremely fragile, meaning that failing to fulfill the request of an external partner may lead to dissatisfaction, that later expands to an impairment of the whole supply operation. Companies that have built a healthy relationship with their internal partners, often serve their external customers in a similar manner, meaning that satisfaction of both parties leads to improved business performance in the future.

Creating a functional and productive SCM model is necessary for companies that strive to achieve business excellence. SCM models utilize the values of BE and TQM models, and dictate the company's business models. The core principles and values of BEMs include process management, customer satisfaction, teamwork, strategic leadership, systems thinking and a continuous improvement (Kanji & Asher, 1993; Zairi, 1997). The holistic approach of the TQM requires that all of the above principles are

taken under consideration. In order for those models to work, the companies have to fully commit to their philosophy and adopt the principles that lead to business excellence. Although BEMs are important, companies also rely on the performance of their partners. The core concept of the SCM lies in that quality chain: different parties working together in order to meet the needs of the customer base. In conclusion, partnership and efficient collaboration is the key to a successful SCM.

Companies use their SCM models in order to improve their supply model and manage their organization in a more effective manner. The goal of SCM is similar to TQM's and it is to achieve business excellence. This is achieved by improved management and utilization of the organization's resources of the supply chain. It is generally accepted that the core principles of TQM can be also applied to SCM models. By expanding TQM models into SCM, companies utilize values and concepts of business models, and effectively apply them on their SCM network.

Figure 4: Existing SCM models and their inadequacies



Source: Kanji and Wong (1999)

As the graph indicates, long term business partnerships are essential to SCM. Long term relationships improve the chemistry between parties and make it easier to satisfy the customers. Under this specific SCM model close relationships with the suppliers are necessary, meaning that the company has to undergo some changes. Interorganizational relationships are not an easy task; hence the need for cultural changes. Moreover it is extremely important that there is a leadership figure that sustains the relationship between both parties and helps share valuable information.

The supply chain's main goal should be to satisfy the customer base's needs. Nevertheless, SCM also has to focus on the overall cost and quality of the end product. This is the reason why information sharing is vital; logistical information on quality, quantity and cost of the right goods, will not only allow companies to produce in a more efficient manner, but will also enable the customers to buy their desirable products on a better price. For example, suppliers may help their partners to produce and design an improved product, by using their expertise and experience, raising the products overall quality. In the same manner, companies can help their suppliers redesign and reform their production process. By cooperating, partners can build long lasting relationships that will benefit themselves and their customers.

The above graph includes SCM values such as:

- cooperative and quality culture
- development of a close relationship
- managing processes other than logistical processes
- leadership's role in the supply chain relationship
- quality and cost requirements of customers
- Continuous improvement.

The SCM models' aim is to improve the performance of the supply chain. These models are basically integrating the core values of BEMs and utilizing them in a supply chain context (Kanji, 1998). These principles include leadership, customer focus, cooperative relationship, integrated process and information management, continuous improvement and business excellence.

Leadership is essential in order to create a functional supply chain. The leaders of different supply chain parties should join and determine their common goals and expectations, while creating a clear strategy that integrates the core values of BE. This type of relationship has to be a long-lasting one, meaning that the leadership figures have to fully commit to the model. The leadership is also required to create a quality work culture, while maintaining clear and achievable goals. Leadership is considered to be the vocal point of the model and it essential to the effective implementation of SCM (Kanji, 1998). The leaders are raw models, and they have to show their commitment to customer service and quality.

The supply chain parties should always aim to meet the customer base's needs and requirements. In order for this to happen, the different parties should be committed to the model and, importantly, should respect their internal partners. The other members of the supply chain fall under the internal partner category, meaning that their satisfaction, or dissatisfaction, can greatly affect the whole chain's performance. In conclusion, customer service should not only focus on the external customers' needs, but should also take into account the internal partners.

Teamwork between the supply chain parties is essential in order to coordinately cooperate. Efficient teamwork, should lead to an improve supply chain performance. External teamwork requires communication, information sharing, trust building and absolute commitment from all parties. According to Kanji, a cooperative relationship, instead of a competitive one, is more beneficial to all parties and promotes growth and teamwork. Hence, companies need to develop solid, long-lasting relationships with their supply chain partners.

Companies and organizations put through a vast variety of processes, from production/delivery and production, to support processes. These processes generally rely on good communication between the involved parties and can fall apart by a lack of coordination. This means that effectively completing those processes requires efficient communication between supply chain members and also a systematic structure that fully utilizes the members' supplies and tools. It is also important to have a solid information sharing system in place that allows the different members to discuss on supply market, technical and forecast information. According to Kanji, integrated processes and information management are an essential principle in creating an efficient and productive SCM model.

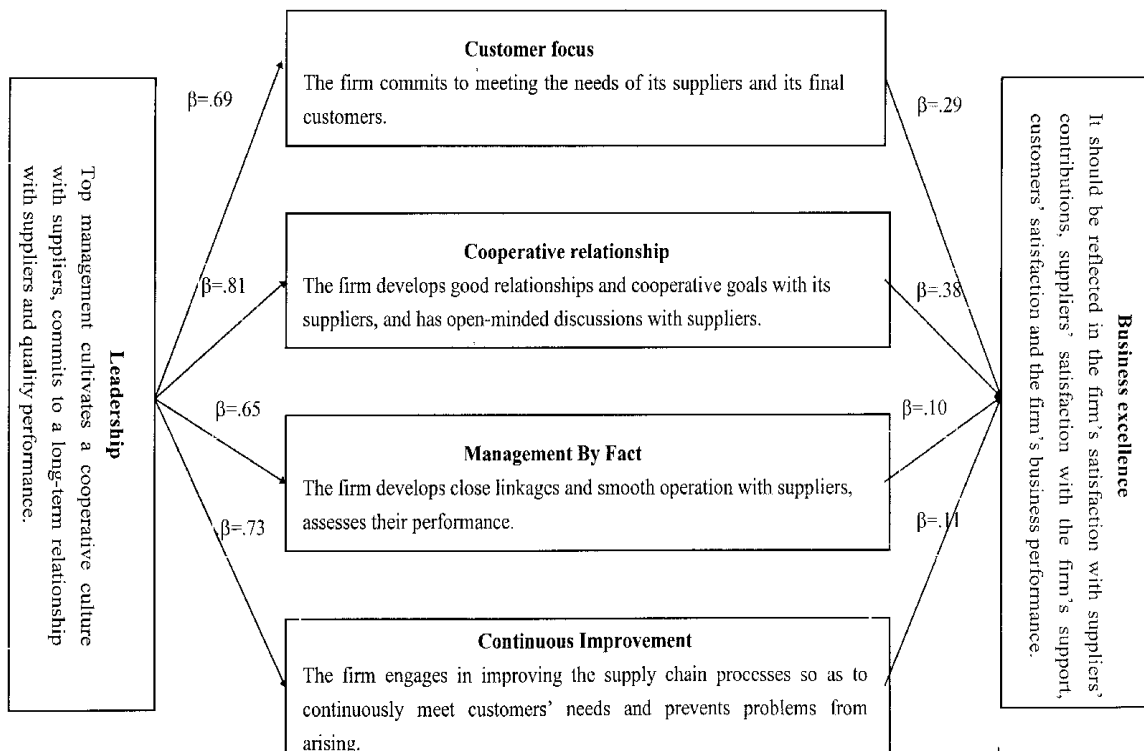
Companies should generally strive to continuously improve on every facet of their business model, especially when it concerns the performance of a supply chain. The involved parties benchmark and pay attention to the important details of their operations, in order to recognize their problems and overcome them. The members need to consciously strive for BE and improvement. The problems that they have to overcome, involve all the processes and mechanisms that are included during the supply chain procedures. Efficient communication and teamwork are essential for improvement.

By applying the general concepts and values of BE, companies achieve an improvement in their SCM. The costs are lower, the quality is enhanced, the customer

service is better and all the stakeholders and customers are satisfied. All the supply chain members can freely contribute to the chain, while communicating with their partners. In these benefits lies the importance of creating a stable and consistent SCM model. Every member of the partnership can freely contribute, while exchanging information with their partners. The improvement of the services and the processes of the company maximize the quality of the end product, meaning that the customers receive an optimal product. Satisfied customers are loyal customers, meaning that an SCM model is an essential tool for building a sturdy customer base.

The below graph constructs a SCM model, that has integrated BEM values. Leadership is shown to be extremely important, influencing every facet of the model. The management is responsible for the customer focus, the cooperation between parties, the commitment and the relationship of the partners, always aiming to improve the customer service. The commitment and teamwork of the members involved, causes an improvement of the product and the service, allowing the companies to achieve business excellence.

Figure 5: A different SCM model



Source: Kanji and Wong (1999)

## *Business Excellence Model Assessments*

BEMs are basically assessment formulas that aim to define the organization's strengths and weaknesses. Management is important in order for companies to critically and accurately self-assess. The five basic ways that allow BEM assessment are:

(1) A questionnaire approach: A questionnaire BE approach consists of a set of questions to assess an organization's performance for each category. The answers will be examined in order to determine the optimal course of action.

(2) A pro forma approach. This involves forms being designed for every single category. Each form would require the organization to explicate the ways it approached every category and to point out the strengths and the weaknesses of its methods.

(3) A workshop approach. This approach usually involves data and evidence gathering by the management team that is going to present its results to the other staff members. After the presentation the workers discuss the potential issues and construct a future action plan.

(4) A matrix chart approach. This involves the creation of a company specific achievement matrix within the framework of a BEM. It typically consists of a series of statements of achievements for each category using a scale of 1-10 points. Individuals or teams use the matrix to score their business processes/organization.

(5) An award approach. A condition for the award winning approach is writing a full submission document along the lines described by the administrators of a country's national BE award. The submission is followed by an external or internal evaluation.

The decision of which approach to use depends on the company's objectives and level of BE maturity. In general, companies should follow the questionnaire approach and then develop a more in depth and adjusted approach. Whichever assessment approach is used it is recommended that all the senior management team are involved and at least a cross-section of employees so that a consensus view on the state of the organization and the actions required is obtained. Involving a wide-group of participants will help everyone to understand the issues the organization is facing and lead to a greater level of buy-in to any actions that follow.



## CHALLENGES AND DEVELOPMENTS INFLUENCING COMMERCIAL TRANSPORTATION- THE CASE OF GERMANY

Having already discussed generally about business excellence and also in the context of Supply Chain, the current analysis focuses on the various factors that influence road and rail transportation. In order to examine the particular factors better and more practically, the case of Germany is used since the location of the country and the importance of rail and road transportation to the country's economy make it a perfect example for the current analysis. The above mentioned factors are divided into five categories which are as follows: *globalization, demographic change, urbanization, sustainability and resource scarcity*. Furthermore, at the end of each category key findings and trends are summarized so that the next chapter of the current analysis can be produced and linked to the previous parts easier.

### *Globalization*

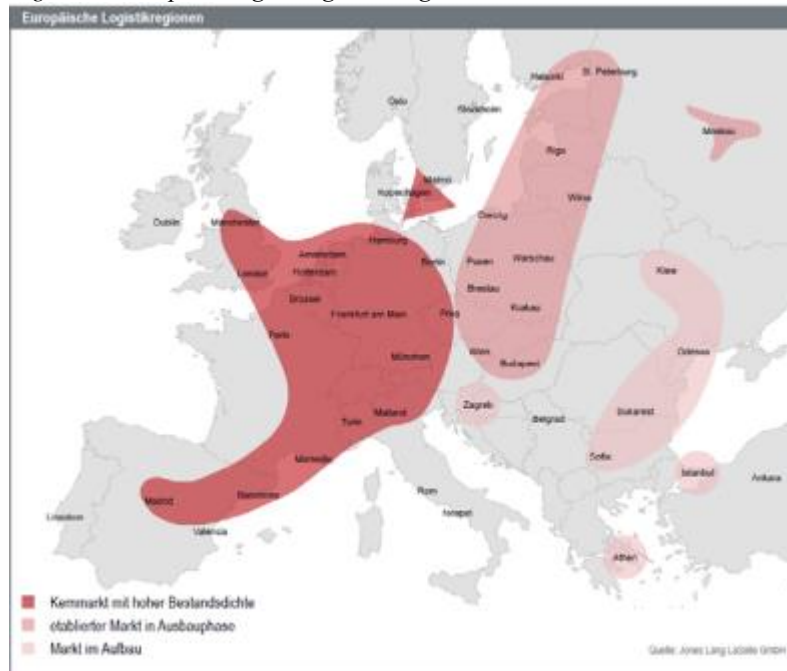
By the term *globalization* is meant that the labor market and the industrial sector are opened up to new markets on an international level and consequently, the transportation sector is also being affected by this phenomenon. The particular integration process has already taken place for a significant number of years and has affected the majority of industrial sectors across the world and this is mainly the reason why a great number of firms have formed their structure and strategy at an international level. The specific trend is shown by the fact that the revenues of the majority of German firms that are generated in other countries are an important share of the total revenues of those companies. Specifically, as it is presented in Holtbrügge's work (2010), Siemens's revenues produced in other countries account for 83.7% of its total revenues, at Daimler 77.2% and at Deutsche Post 69.2%. Therefore, it can be supported that corporations have been presented with the mission of prevailing over foreign competitors and international competitive pressure.

A term that has been used by Thomi et al (2001) and describes the increasing penetration and influence that global processes are exerting on regional conditions, customs and habits, is the *glocalization* and it follows a parallel course to globalization and shows its influence at regional level. Furthermore, increased costs for the

production of goods and services in countries that were until recently often selected as outsourcing destinations, highlight the importance of nearshoring. As far as Western European companies are concerned, the above mentioned trend often leads them in having their production locations in Eastern Europe and as far as the American corporations are concerned, it means moving most of their production lines to Latin America. Next to this trend there is also another one, as it is mentioned by ten Hompel (2009), according to which it is becoming more important to have the production line near the sales market rather than having it near the raw material that are needed for the production.

Additionally, a very important trend that affects the transportation sector is the increasing volume of international trade and the world's population since both of them affect the demand for transportation. According to DVWG (2009), the specific trends affect both the passenger transportation and the freight transportation especially in emerging markets where the population and trade growth is higher than the average forecast for the global economy. Apart from the emerging markets, the particular trend has consequences for Germany too since the country's corporations are linked tightly with the global economy and therefore its growth affects Germany's transportation needs and volumes. At this point it is important to explain that one of the reasons that the goods exports are increasing at a faster pace than the economy, is the high cross-border trade in intermediate goods. A crucial factor also is the relative low trading costs due to which splitting value chains and creating regional and international production processes with many layers has become very attractive. As it can easily be understood, all of the above mentioned trends affect Germany significantly since the country is one of the most important logistic centers in Europe due to its location and its level of infrastructure as it can be seen in the figure below.

Figure 6: Europe's largest logistics regions



Source: LaSalle (2013)

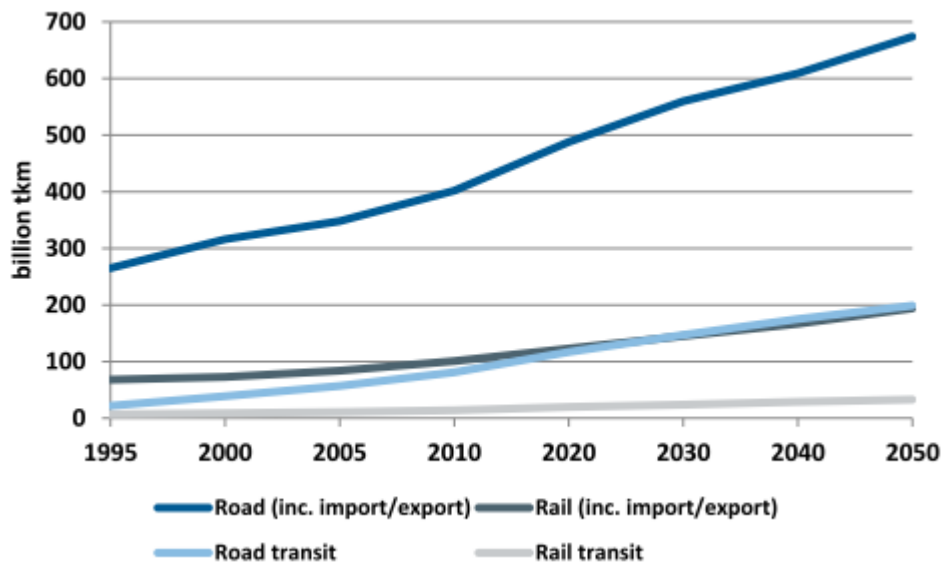
Based on figure 6, it is quite clear that Germany's part of the red zone is significant and that the country's position is also important due to its proximity to the surrounding markets of Eastern Europe. The importance of the logistics sector for the German economy is also shown by its revenues (223 billion euros) which exceed France's and UK's revenues according to the available 2011 data. Apart from the revenues, the particular sector is also important for Germany due to the number<sup>2</sup> of people working in the specific field. As a result a number of logistics clusters have emerged in the particular country since the companies want to benefit from the location of the country and the ability of networking with other firms and thereby increasing their global position. As it mentioned in HMWVL (2013) for example, the airport of Frankfurt plays an important role in the logistic region since it is very significant not only for the distribution of high-value parts but also for the supply of the domestic market. Therefore, a significant number of firms have been established to that region leading to the areas development as a whole. The region of Ruhr is also another good example of clustering that leads to increased efficiency and business excellence in the transportation sector. The high level of urbanization, the increasing logistics sector and the constant

<sup>2</sup> 2.82 million according to LaSalle (2013)

need for interregional networks have caused the different clusters to grow even more tightly together.

All of the above have led the country's national road and rail freight transportation to grow strongly since the early 1990s and the location of the particular country has also given it a key role as a transit country. In order to understand the importance of transit freight, it has to be only mentioned that transit traffic across all modes of transport is expected to increase by around 25% in the period from 2012 to 2030 (ProgTrans, 2012) and transit by road is expected to increase faster than by rail as it can be seen in figure 2 below.

Figure 7: Forecast of volume sold in freight transportation – Germany up to the year 2050



Source: ProgTrans (2007)

Another trend that can be seen in figure 7 is that there will be considerable regional differences within Germany in road transport growth. The regions of the Hamburg - Ruhr region - Stuttgart - Munich axes and around Berlin will experience the highest growth according to BMVBS (2011). Furthermore, it has to be mentioned that the increasing freight transportation in the states of Baden-Württemberg, Bavaria, Hesse, Lower Saxony, North Rhine-Westphalia and Rhineland-Palatinate will probably lead to parking shortages which in turn will lead to illegal stationing of vehicles along entrances and exits at rest areas and chaotic parking. These negative results can cause dangerous situations by reducing braking distances, obstructing visibility and even endanger traffic.

Next to all the above mentioned factors, seaports play also a key role to the growth of freight transportation. Especially for Germany, the North Range ports (Antwerp, Rotterdam, Bremen/Bremerhaven and Hamburg) are very significant as far as the logistic sector is concerned since the Port of Hamburg is used as a logistics hub not only for Germany but also for the entire Southern and Eastern Europe, as it mentioned in HHLA (2013) and since the western ports of the western end of the North Range, *the ARA ports*, are important for seaport hinterland traffic along the Rhine. Regarding the transport flows of Germany it is important to mention that there is a mismatch in many places due to the imbalanced consumption and production of goods. For instance, the region of Berlin generates a small amount of outgoing freight, compared to other regions in Germany, because of the region's low industrial production. Same or similar mismatched flows can generally be observed in areas with extensive logistics sector but at the same time with poor industrial production.

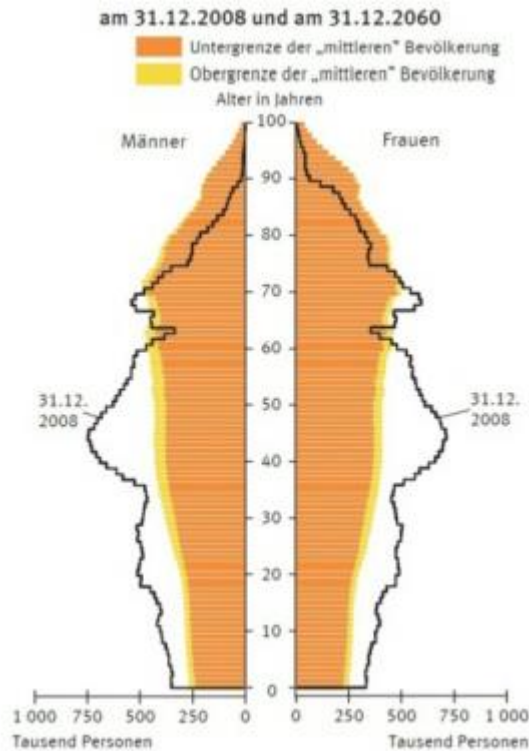
To sum up, traffic will increase in coming years, and also create significant challenges, especially for the fields of road and rail transportation. Furthermore, the international traffic's share and in particular the transit traffic, is expected to increase significantly in the years ahead. The factors that play key role in the particular trend are the general growth in transport levels, particularly in freight, and its close link with the economic growth. Nevertheless, the cross-border cooperation between logistics service providers also strengthens this trend and even though road will remain the most significant mode of freight transportation in the coming years, there are also trends which support rail transportation and cause the share of cross-border international traffic to increase. All the above mentioned challenges are the results of globalization and the growth of freight transportation and concern all countries that have extensive road and rail transportation systems and understanding them is important in order to achieve business excellence in the particular sector.

### *Demographic change*

By the term demographic change it is meant that the distribution of ages is changing and it results from the ratio of birth and death rates and is used to indicate the population's trends. Generally, it can be supported that demographic change is widely used as indicator of how a country's future labor force is going to be. Germany, as most

of the Western European countries shows signs of a declining and aging population<sup>3</sup>. This trend is the outcome of the increased life expectancy combined with a decreasing birthrate and without replacing this deficit by migration (Destatis, 2009). As it can be easily seen in the figure 8 below, a population pyramid which shows the expected demographic change, exists, indicating increased life expectancy and reduced birthrate.

Figure 8: Population pyramids for 2008 and 2060 in comparison



Source: Destatis (2009)

As it can be understood, the factor of demographic change affects significantly the labor market and the supply of qualified labor in the developed countries. According to Brücker (2010), in the period from 2010 to 2025, the labor force is expected to decrease by around 6.5 million to 38.1 million economically active individuals in Germany. Based on the McKinsey report (2008), by 2020, more than 50% of the population will be aged over 50, accounting for over 60% of total income. There is therefore a shortage of skilled labor, which will continue to increase in the coming years and people working in the areas of engineering and the natural sciences, technology, IT and health will be especially affected by this trend. To be more precise, it is forecasted that by 2020, the

<sup>3</sup> Germany is used as the primarily example because the country's demographic trends are similar to most of the developed countries in the world and combined with its extensive road and rail commercial transportation sector, it is a very good example for the current analysis.

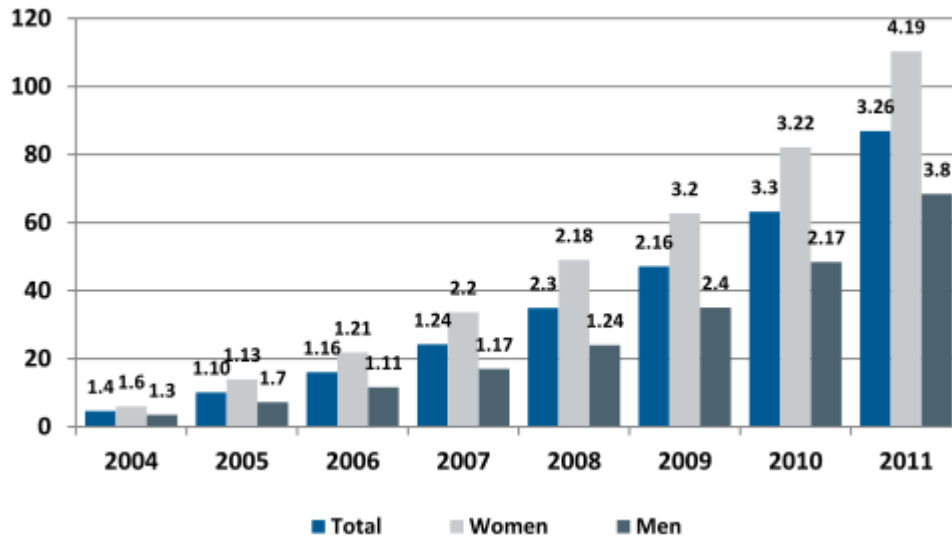
deficit of engineers will reach the number of 200,000 which can be easily understood by the fact that the current average age of an engineer is 50 years old, meaning that one in two will retire by 2020 according to VDI (2012).

As it has already been mentioned, the transportation and logistics sector is still an important part of the job market in Germany, employing more than 2.6 million people but there is a shortfall of qualified skilled employees, in operational areas for instance such as truck driving. According to TU Berlin (2008), a reason for this trend lies on the fact that the workplaces in operational logistics are often unattractively designed. Despite these obstacles, the logistics sector is expected to record high growth rates in the coming years and also increase employment in other industries due to its correlation with many sectors of the whole economy. Therefore, it is imperative to train skilled employees, improve the attractiveness of careers in logistics and win foreign labor in order to avoid endangering growth of such a vital sector as it is highlighted by the report of McKinsey (2008).

At this point it has to be mentioned that a survey in several companies, which looked at the obstacles to improving the supply of skilled labor in the logistics industry revealed a worrying sign regarding the view of many companies about the training of their employees. The particular survey found that 27.6% of respondents did not view the shortage of skilled labor as the responsibility of the industry itself, or did not see any obstacles from this corner. As a result this means that a significant number of businesses are proactively dealing with the particular issue. 19% of those questioned considered that they could do little to exert influence as they considered the issue to be dominated by political corporate interests. Another 27.6% of respondents could not provide information on the extra needs of skilled labor, while the remaining 25.8% described high costs, insufficient technical and scientific progress or lack of market relevance as obstacles (TU Berlin 2008).

The search and acquisition of qualified employees in the company for a long time is a difficult challenge for every business. Furthermore, the increasing competitive pressure leads to increased demands and pressures on staff too. In particular, many companies now demand that their employees are reachable outside of their normal working hours via their PC or their smartphone. The results of such increased demands are often physical symptoms of illness as it is also illustrated in figure 9 which indicates a continual increase in sick days caused by burnout between 2004 and 2012.

Figure 9: Number of days of incapacity to work per 1,000 members (excluding retired)



Source: BKK (2013)

Therefore, enabling employees to have a balance between professional and private life is going to play an important role in coming years for all firms regardless of the sector and the industry they belong to. As far as logistics is concerned, the sector suffers significantly from its poor image to the public as it is shown in BVL (2010). Nevertheless, the image problem is not related to a possible deficit of skilled labor in senior and executive positions (Verkehrsrundschau, 2012), but rather the industry's general working environments, for example the warehouse or truck. This was one of the most important reasons why pro-trucking group "Initiative ProLkw" began the "Mit Bock auf'n Bock" (up for a truck) campaign in 2011 (Süderelbe, 2012). Various firms have also launched marketing strategies to show the public that the logistics sector is an attractive industry for people to work. Such initiatives and the general improvement of the industry's image have as target to deal with the shortage of labor.

Both the recent and future demographic changes and the appeal of the workplace should be taken seriously into consideration since they pose significant challenges for the logistics and transportation industry since the workplace itself is becoming a competitive factor for companies.

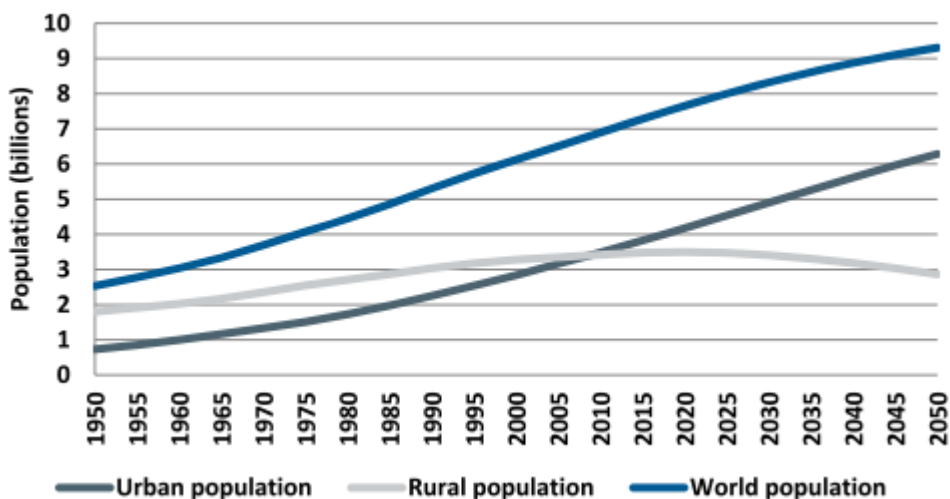


## Urbanization

One of the most important phenomena that play a key role to the logistics sector is the *urbanization* i.e. the spread of urban lifestyles to surrounding areas and large-scale migration from the countryside to the cities, leading to significant increases of city populations. Re-urbanization is a return to the cities following a period of depopulation and it causes higher populations and employment in downtown and inner city areas. This trend is currently observable in most of the countries around the world, and will lead to changing social demands in future.

Rural areas and suburban towns are often no longer people's first choice of place to live. In future, as it supported by Brake (2012), the process of urbanization will lead to a renewed importance of cities and cause the population in many urban areas to increase, despite the fact that the overall population is declining in most of the developed countries. One of the basic reasons for this trend is the flight from the countryside since more and more people are leaving rural regions and returning to major cities (Globe Scan 2011). Figure 10 below illustrates exactly the above mentioned trend i.e. the change from a rural to an urban population in relation to the development of total world population.

Figure 10: Urban and rural populations compared to world population



Source: United Nations (2012)

Around half of the world's population today lives in cities and it is forecasted that as early as 2030, this share will have risen to 60% or some five billion people. In

Germany, for instance, significant cities such as Munich, Hamburg and Berlin, and the surrounding areas, are already facing high growth rates (Ifmo 2005). A side-effect of re-urbanization is the growth in traffic levels in the city's core and based on various reports (Globe Scan 2011), in the coming years, the fastest growing cities will be confronted with an increase in traffic jams, environmental damage and capacity choke points. The results will be dense land use, bottlenecks in supply and waste disposal, high resource consumption, and air and noise pollution. Together with societal trends such as increasing and more individualized patterns of consumption, these developments are already placing demands on infrastructure that will become ever more complex in the future. In the years ahead, the challenge will be both to manage the increasing traffic in cities and shape it in an environmentally friendly way.

The various lifestyles in a global society require also a variety of development options. Maintaining and further developing these individualized lifestyles is a difficult challenge for the future. Therefore, consumer behavior and the equally rapid changes and individualization of customer demands increasingly require customized solutions. For instance, ever more customers expect next-day delivery when ordering goods, resulting in smaller consignments and increasing traffic levels. Growing online sales, for instance, of clothing are often associated with return consignments for wrong sizes or colors. Consumers are increasingly turning to internet purchases, presenting new challenges for the logistics and transportation sectors. The consequences of this greater individualism are already becoming apparent as traditional economic models seem to be out of date. In future, the logistics industry's main task will be to create the conditions for maintaining this individuality and to offer more customized delivery concepts and logistics services.

In the context of the call for greater sustainability, systems should be developed that are resource-efficient, economic and can adapt to the individual needs of every person. Central elements of the strategy for sustainable city logistics and commercial transportation are innovative mobility concepts, dynamic coordination of different modes of transport within small areas, more productive use of existing infrastructure and more efficient networking of urban areas, especially in supply and waste disposal.

## *Sustainability*

A critical issue in today's world economy is sustainability. Companies, the environment and society should function in a way that meets current needs without endangering the development in the years ahead. Sustainability is based on the following elements: the environment, the economy and social factors. Environmental aspects are of great importance for the logistics industry and vice versa since logistics industry and especially the transportation sector, are responsible for the 18% share of global CO<sub>2</sub> emissions (ten Hompel 2009). Experts predict that, in future, carbon emissions in the structure of transportation systems will represent a decisive factor in competition as the demand for "green supply chain" is going to reach higher levels. The costs of freight and passenger transportation will increase due to both increased personnel and energy costs and greater consideration of environmental impacts, pushing noise, air pollution and emissions of CO<sub>2</sub> forward. Corporations will become more open with regard to environmental aspects and reduce their carbon emissions (TU Darmstadt 2008). In order to be a successful market player over a long period of time, it is crucial not to stop developing these approaches further and implement improvements. From today's perspective, R&D investments, modernization of vehicle fleets and training of employees in logistics companies will become increasingly important (Deutsche Post 2009). Properly functioning companies are the economic element of sustainability. A firm's activities should provide a stable financial performance and continued existence. Political guidelines relating to employment, prosperity and competitiveness of companies can help towards this direction since competition generally drives quality and efficiency.

A well-developed strategy enables economic sustainability by allocating resources in accordance with the basic economic principle of profit maximization (Gabler 2010). However, companies do not always exploit this approach to its full extent nowadays since the more capacity utilization a firm has the less flexibility and customer satisfaction it can offer. Businesses try to find the best possible balance between these aspects in competition with other companies. However, they can improve resource deployment more with the help of sustainable technologies (Baldauf 2010). Increased levels of quality and efficiency are crucial at this point for achieving long-lasting customer loyalty. Competition between different companies can motivate them to offer the customer the best possible product at an economic price. A firm's long-term

survival can also be depended by the cooperation in logistics management, which can in turn create synergy effects and specialization among the companies that are involved.

The third pillar of sustainability includes social factors, meaning corporate social responsibility. It includes a company's responsibility to its employees and to the society generally. The workplace itself and its entire design play an important role at this part too. The more satisfied employees are with their working environment, the higher their productivity is. Companies should therefore aim to promote the human capital of trained staff, which represents a major competitive factor, and retain these employees in the company. Rising energy costs, resource scarcity and development costs are making individual mobility more expensive. From a social perspective, however, this individual mobility must remain affordable for employees. Increasing environmental awareness is leading to a growing demand for "green logistics" throughout society. Companies that offer green logistics in freight or public transportation can improve their corporate image and showcase their social responsibility. This can give them a market advantage and improve their revenues. Social sustainability is therefore become increasingly important against the backdrop of demographic change, the shortage of skilled labor and growing environmental problems.

Sustainability is already an important topic of discussion in public life and its getting more and more significant day by day. The logistics industry, and especially transportation providers, is a key player in this area. Transportation should start taking into account the environmental aspects, without neglecting the economic factors that businesses have to deal with. As far as its social role is concerned, transportation should enable all individuals to participate in public life, meaning that they have to work in order for them to ensure the safety of transport and the good working conditions in the transportation sector (BMVBS 2008).

### *Limited resources*

As it is well-known, a balanced ecosystem has a limit on the things it can sustain and given the increasing scarcity of certain commodities such as oil, a new way of thinking is imperative in order for sustainable, balanced and efficient processes to be designed and preserved. The recycling economy is an important aspect of this. The recycling rate of a great number of commodities should be significantly increased so that the demand

the demand for further extraction can be reduced. This can both reduce environmental impact and present a decisive competitive advantage for the companies involved. Germany has decided to move to a transition face of its energy needs and consumption with the objective of environmental sustainability. In addition to switching to sustainable energy sources, Europe has introduced emissions of CO<sub>2</sub> trading rights in specific industries. From an economic point of view, trading in emissions rights seems to be an efficient tool for achieving environmental targets (ISI 2009). By setting limits for a country's total CO<sub>2</sub> emissions, firms are to be forced in the coming years to implement measures for reducing their own emissions as well. Furthermore, trading gives the chance for the lowest-cost opportunities to be realized here.

Additionally, renewable energies are going to become a significant component of the energy mix. Political motivation is currently growing, especially in Western Europe, to start using regenerative energy sources. A great number of multiple research projects are being carried out to make the use of alternative energy sources both practical and financially affordable. Many studies forecast that renewables will reach a 31% share of German energy production by 2035 (MWV 2013) and an almost 60% share by 2050 (BMW<sub>i</sub> 2013). This will be accompanied by decreasing investment costs of alternative energies, resulting in cheaper renewable energy sources in the long run compared to fossil fuels (UBA 2012). The choice of fuel for the vehicles used is a crucial aspect of environmental sustainability in the logistics and transportation sector. Road freight transport has an important role to play in the context of the growing scarcity of oil reserves. There are now more than 700 million automobiles on the road around the world, and experts expect this number to double by 2030 (Eberl 2011). The majority of vehicles are currently driven by gasoline or diesel engines; however the price of oil is expected to increase (ADAC 2013). These forecasts will require logistics providers to use alternative propulsion in future. The German government set itself the target in 2004 of increasing the use of alternative fuels on the roads. This tendency towards alternatives is also reflected in the increase in global production of biofuels as it is presented in the report of BP (2013). Furthermore, electrical propulsion is another option, especially in city logistics and by the year 2050 some 50% of the cars sold in Germany will probably be hybrid or electric vehicles. The particular trend will extend to city center delivery concepts and call upon the use of electric commercial vehicles.

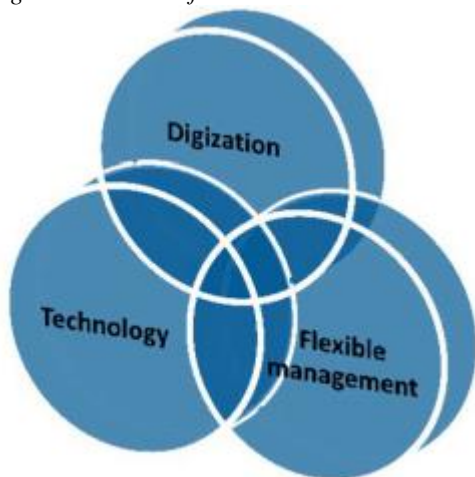
Sometimes, the production of alternative fuels requires mineral commodities that are only provided on the world market by a small number of countries. Furthermore, the

world's commodities sector has as main characteristic its increasing market concentration on the supply side. Few providers dominate the market and are forming commodity oligopolies that determine prices. A study of KfW (2011) already described the situation in Germany as critical for 13 mineral commodities the access to which is essential for the further development of future technologies.

## POSSIBLE SOLUTIONS TO CHALLENGES INFLUENCING COMMERCIAL TRANSPORTATION

Having already discussed some of the most important challenges in the field of road and rail transportation, the current chapter focuses on a number of possible solutions so that business excellence can be successfully achieved despite the many obstacles that have been mentioned in the previous chapter. The solutions that are discussed below can be seen in Figure 11 and are as follow: *digitization, flexible management and technology*. Flexible management promotes collaboration not only within organizations but also between organizations as well. Technology improvements lead to process optimizations and digitization leads to planning optimization.

*Figure 11: Areas of innovation and solutions*



*Source: LaSalle (2013)*

### **Digitization**

The process of globalization, interconnectedness and digitization are already affecting every aspect of our lives. For instance, people use mobile phones for more than just phone calls, since they serve as a platform to surf on the internet and allow the user to remain online all the time. As far as the transportation sector is concerned, the high degree of interconnectedness and digitization offers new opportunities and solutions to deal with the increasing traffic flows. Good examples of this new approach

to commercial road and rail transportation are the Internet of Things, the intelligent traffic guidance systems on the roads and the intelligent freight cars.

### *Internet of Things*

Due to the high rate of urbanization and globalization, the volume of freight traffic in Europe is increasing and has already started creating infrastructure bottlenecks. Next to this, there is a demand for greater sustainability which in turn leads to new ways of transportation planning. The cyber- physical systems (also called Internet of Things) allow the resources to be used much more efficiently and help to address these issues. The term Internet of Things refers to a vision in which all physical objects regardless of their type are integrated into one digital network. A variety of products can identify and control themselves by the use of radio-frequency identification (RFID) – a communication-capable localization technology. This involves implanting miniature tags into objects in order to store data and combined with a reader, these devices are able to communicate via radio waves<sup>4</sup>. The tags are equipped with microprocessors and can detect their surroundings, process information and interact with other devices. Some of the uses of this technology include vehicles, electricity meters and consumer goods<sup>5</sup>. For instance, trucks could automatically notify freight forwarding companies of their location and whether any delays are likely<sup>6</sup>.

Furthermore, the communication from vehicle to vehicle could also be an option for the use of the Internet of Things in future. By independently exchanging information on their status and surroundings, vehicles themselves have the potential to improve the safety and efficiency of transportation. On the other hand, there are various problems linked to the implementation of the Internet of Things in its forms. The potential dangers and scope for misuse of the data collected are one possible obstacle and will require solutions to be developed to ensure comprehensive data protection. Nevertheless, the Internet of Things will offer diverse solutions to some of the problems of modern industrialized societies<sup>7</sup>.

---

<sup>4</sup> Schoblick (2005)

<sup>5</sup> Horvath (2012)

<sup>6</sup> Malaka (2009)

<sup>7</sup> Horvath (2012)



### *Intelligent traffic guidance systems*

The rising traffic levels and urbanization in Europe is pushing infrastructure beyond its limits. As a result long delays caused by traffic jams, inefficient use of working time and higher fuel consumption. Traffic control, data collection and forecasts based on intelligent traffic management systems can help a lot regarding the above mentioned issues. The main challenge is to develop navigation solutions which, unlike existing systems based on navigation for private cars, offer person- customized navigation regardless of the industry or the user. Traffic control options for better use of capacity could involve separating freight traffic from private transport or offering route recommendations adapted to the each case. In that case, these route calculations should not only include major highways but also more minor roads. Static features such as environmental zones and preferred routes for trucks, as well as dynamic information like congestion reports and road closures should be factored in.

On many roads, jams can be avoided not only by taking an alternative route, but also by travelling at a different time of day. Route planning should in future be harmonized with the daily rhythm of traffic flows and take advantage of periods when traffic levels are lower. This would make traffic volumes more homogeneous throughout the day, reducing or avoiding congestion. It would also enable arrival time to be predicted more precisely and thus provide more efficient route scheduling. Equipping sections of the highway with telematics systems could bring additional benefits such as the better use of parking space for example. Information on available parking places could also be displayed on navigational devices in the vehicle instead of on highway signs<sup>8</sup>.

As far as the rail freight is concerned, developments and ideas like those seen in road freight transportation extend up to a common European Rail Traffic Management System. In rail freight sector, the European Train Control System (ETCS) is a component of this rail traffic management system, which is intended to replace the many different train protection and control systems in use across the EU. The main objective is to simplify European cross-border traffic, making it faster and more cost-efficient. In order to enable safe and reliable rail transportation, ETCS takes over various functions, some of which are carried out by trains and some by route infrastructure. These include monitoring the train's maximum speed and identifying its direction of travel and suitability for the respective route. ETCS is being implemented in different levels, in order for the most suitable variant to be selected depending on the

---

<sup>8</sup> BMVBS (2011)

different route requirements<sup>9</sup>. ETCS Level 3 is the highest level and as by ETCS Level 2, trains determine their positions themselves with the help of sensors. This means, for example, that permission to proceed can be transmitted to trains automatically. In addition, trains are able to monitor their own integrity and report their position to the signaling center, which can identify what section of the route the train has successfully cleared. The advantage of this technology is that the following train can then be granted movement authority up to this point. Line-clear authorization can be provided continuously and the route is no longer divided up into fixed signaling blocks<sup>10</sup>.

### *Intelligent freight cars*

Rising traffic volumes increase the demand for better use of the resources offered by rail freight transportation. Optimizing processes, minimizing unproductive elements such as empty runs and reducing energy costs are important steps here. Intelligent freight cars enable better use of existing capacity. The cars are equipped with special telematics systems, which collect, save and process data and communicate with each other within telecommunications networks. The data must be continuous, comprehensive and reliable and generating and transmitting it cost effectively is vital<sup>11</sup>. Complex processes at dispatching and receiving offices, as well as at changeover points for wagonload freight – for example, car sequence data collection– also show major potential for optimization. RFID could automate wagon departure checks, for instance. With the development of these systems, RFID will be connected with sensor technology in order to automatically identify technical data relating to the freight car – e.g. closed doors and vents and the status of the brakes. Readers fixed in the track bed are able to capture data from the RFID chips on the bottom of freight cars passing at speeds of up to 140 km/h<sup>12</sup>.

Freight services do not currently have an electricity supply running the full length of the train and this rules out the use of sensors in each freight car and satellite tracking of individual cars. However, sensors with low power requirements could be installed on each car if suitable power management is provided. Alongside other functions, sensors can monitor loads and thus offer added value and security for transportation companies,

---

<sup>9</sup> DB (2013)

<sup>10</sup> SBB (2013)

<sup>11</sup> Stopka (2009)

<sup>12</sup> SBB (2009)

who face the additional challenge of theft protection. In this area too, location devices and sensors can help to make rail freight transportation more attractive. Key functions include detecting the opening of doors or unloading of containers, as well as temperature monitoring and light sensors.

## **Flexible management**

Through flexible management capacity utilization and improvement of processes are enabled due to internal and cross-company cooperation and consolidation of transport volumes. In this context realizing organizational solutions to improve logistics systems is also included.

### *Quiet nighttime transport*

Moving transport to the nighttime is an attractive option for reducing traffic during the day, especially when it comes to supplying cities. Ever more people live in or close to cities, meaning that the population of metropolitan areas is continually growing. Systems need to be developed to ensure comprehensive supply without disrupting everyday life. One option could be to deliver at nighttime but this is prohibited by law. Current technology often creates too much noise for use in nighttime delivery. There are various options for reducing noise emissions that address the individual delivery processes. The noise of delivery vehicles, which is largely generated by the engine, can be reduced using electric or hybrid vehicles, for example. The noise created when vehicles are stationary and unloading (e.g. movement of lifting ramps) can be countered by structural measures such as erecting noise barriers or by ongoing development of quieter loading technology. Furthermore, behavioral aspects should also be considered and employees must use technologies as quietly as possible and not create more noise than the devices themselves (e.g. through communication, movement and other behavior). Quieter technologies and logistics systems are essential for deliveries during the night.

### *Integrating modes of transport and consolidating transport volumes*

Globalization is posing challenges to the firms regarding the security of their market position and their expansion at international level. This means adapting corporate strategy accordingly and making efficient use of the available resources and probably the most important change in this context is specialization on the most profitable product areas, which will result into reducing the breadth and depth of operations. To remain able to offer individualized products and respond as well as possible to customer requirements, collaboration and integration into value chains will be vitally important to companies in the future as this will give rise to new ideas of competition. One option is for the transport volumes to be consolidated so that the traffic levels are reduced. Different providers may cooperate to transport cargo over long distances, consolidating supply flows. Cooperation in consolidating transport volumes and integrating the different modes of transport will make it possible to expand the number of services offered and reduce costs through synergy effects, environmentally friendly transport of goods and through making better use of capacity. The role of companies in some areas will be completely transformed by 2020. Logistics service providers will ultimately only be able to survive in the market if they intensify cooperation with competitors, manufacturers and suppliers. They will also form regional clusters responsible for many links in the value chain and unlike today, logistics processes will not adapt to production processes. Instead, it will be the logistics processes that form the basis for planning and managing production<sup>13</sup>.

A further option for reducing traffic levels is the use of attractive combined transportation (CT) networks, i.e. shifting transport flows and finding a sustainable, balanced distribution of transportation between the different modes. Intermodal transportation will play an important role here. This is also one of the main objectives anchored in the European Union's White Paper on the objectives of transport policy in Europe<sup>14</sup>.

### *Deceleration*

An important factor that is also promoting change is the deceleration of transport. In the Internet age, when everyone is connected with mobile devices, it can seem that

---

<sup>13</sup> TU Darmstadt (2008)

<sup>14</sup> Schmidt (2008)

people's environment is continually speeding up, both in private and professional life. Goods ordered online have to be delivered on the same or following day. The resulted traffic involves unnecessary costs and is detrimental to the environment. In future, consumers will be persuaded to forego unnecessary quick deliveries in some cases, or not to regard this as a decisive factor for making an online purchase and will not be essential for every order to reach the customer the following day<sup>15</sup>. As a result, logistics providers will be able to better utilize truck capacity or use combined transportation.

### *Attractive workplace design*

The standards for workplaces have changed considerably in recent years, often demanding a balance between professional and private life and necessitating redesign of workstations. This issue is often described as the work-life balance<sup>16</sup>. The impact of this is already being seen in the need for more places for the children of employees and working hours that are flexible. A model calculation developed by German organizations shows that integrating ideas of work-life balance into corporate policy has a positive effect if implemented successfully. All these could lead to an increased consumer demand and raise workers' hourly productivity, improving companies' competitive positions internationally<sup>17</sup>. Therefore, ideas of work-life balance do not only make sense at company level, but are already showing a positive impact at macroeconomic level too<sup>18</sup>. The design of workplaces, and especially those of truck and train drivers, has a major impact on health, transportation safety and efficiency. Cabs must therefore be adapted to meet the drivers' needs<sup>19</sup>. Additionally, these employees also have further duties that are physically demanding, like for example securing loads.

## **Technology**

Apart from digitization and flexible management, ongoing technological development – both in terms of whole technologies and individual components – plays a crucial role and will impact road and rail freight transportation alike in areas such as

---

<sup>15</sup> Breitingner (2012)

<sup>16</sup> Prognos (2005)

<sup>17</sup> Prognos (2005)

<sup>18</sup> Prognos (2005)

<sup>19</sup> Brauckmann (2007)

modular container construction, waste heat utilization, alternative propulsion technologies and special technologies such as automatic coupling or autonomous driving in rail freight transportation. Technology will serve to further automate processes in future, making them faster and safer.

### *Modular container construction*

Load carriers are the mainstay of all freight transportation. They enable products and materials to be handled and moved. With consignment sizes decreasing (e-commerce, individuality etc), the europallet is no longer the ideal load carrier. The lack of standardization of the load carriers used is leading both to greater handling costs in transshipment and inefficient use of load space. An approach for dealing with these problems is a modular system of load carriers and containers. The basic principle is that different container sizes form whole number divisors or multiples of the next-smallest/next-largest container and this means that they can be combined without loss of load space. On the other hand, the enormous potential of such a system can only be realized if it becomes an international standard.

### *Automatic coupling*

Automatic coupling enables rail freight cars to be joined together without manual work by operators – for instance with a single central buffer coupling at the car ends that includes all supply lines<sup>20</sup>. By speeding up train formation, better use can be made of freight car resources, the system and turnaround speed of the cars can be increased and cost savings in staff and materials realized. Automatic couplings also enable longer and heavier trains and thereby increase capacity. The improved distribution of forces throughout the train places fewer demands on wheelsets and rails. Automatic coupling of brake lines and electronic data cables helps enable the "intelligent freight car" to become a reality. Automatic couplers have a longer operational life than screw couplers.

---

<sup>20</sup> Sünderhauf (2009)

### *Waste heat utilization*

Next to the environmentally friendly sources of propulsion, today's combustion engines also offer opportunities to use the energy generated in a more sustainable way that conserves resources. With modern combustion engines only achieving an average rate of 40% efficiency, waste heat utilization enables some of this lost energy to be regained. The illustration above shows that the majority of the energy (60%) contained in the fuel is not converted into moving the vehicle, but escapes unused into the atmosphere in the form of heat through exhaust gases and the engine-cooling system. One way of using the waste heat is to recover this energy; heat recovery systems are used together with diesel engines and are a direct component of the propulsion system and they are already found in some diesel locomotives and ships. Development for commercial road vehicles is to follow in the next few years. Construction of these new systems can be accompanied by retrofitting existing propulsion systems. Depending on its application, energy recovery can reduce fuel consumption and emission of pollutants by some 4-12%<sup>21</sup>.

### *Autonomous assistance systems*

Driver-assistance systems can help reduce accidents since they can assist drivers and relieve the pressure, but by no means are they meant to replace the human presence. Radar, infrared and video cameras are capable of detecting and identifying hazards. Driver error is responsible for most accidents that result in injury – caused, for example, by insufficient distance from the vehicle in front, mistakes while entering side roads and making turns, reversing and parking maneuvers, or driving at an inappropriate speed. Assistance systems are able to make a major contribution to reducing accidents in precisely these areas<sup>22</sup>. Cars and trucks feature various assistance systems whose functions include maintaining a safe distance, keeping in lane, ESP, emergency braking, traffic signs, night vision, intersections, fatigue detection, parking and changing lanes.

Furthermore, trucks used in road freight also feature special systems such as active roll stabilization. Such systems minimize instability, i.e. rolling and pitching movements, especially when cornering<sup>23</sup>. A feature that is especially interesting for

---

<sup>21</sup> FAZ (2011)

<sup>22</sup> Destatis (2012)

<sup>23</sup> MAN (2013)

trucks is a turning assistant to monitor the vehicle's blind spot and warn the driver before a turn of any hazards or other road users. These systems can prevent accidents with bikes or other road users<sup>24</sup>. The EU has agreed regulations mandating an emergency braking system for all medium and heavy duty trucks from 2015 as well as a lane departure warning system and electronic stability program<sup>25</sup>. This is a major step in the introduction of new safety standards for road transportation. Further regulations or subsidies for assistance systems to reduce danger are desirable. The experience of trucking companies shows that assistance systems are worth the investment as serious accidents are avoided and insurance companies are gradually responding positively to these technologies<sup>26</sup>.

### *Autonomous driving in rail transportation*

The rail industry has been trying to create self-driving trains for many years. The approaches implemented range from supportive functions, such as automatic speed regulation, to fully automated driving<sup>27</sup>. Autonomous transportation systems can create many advantages in both passenger and freight transportation. Organizations involved in rail operations (companies, local governments) can save on drivers and retrain staff in customer service, which increases the level of service and means more personnel are available to assist passengers<sup>28</sup>. Additionally, the frequency of trains can be increased and flexibly adapted to meet demand without needing to consider staff availability. Autonomous systems also allow departure and arrival times to be forecast more accurately, and save power by optimizing acceleration and braking patterns<sup>29</sup>. Such systems have already been implemented in various cities in relatively small, closed systems (e.g. subways). In freight transportation, however, progress has been slower.

There is currently only a small number of applications where active implementation work is taking place. The Rio Tinto company planned to use autonomous trains from 2014 to transport iron ore on a route in the Pilbara region of Western Australia. The automation aimed to increase production capacity here by 50%<sup>30</sup>. Another example is the FlexCargoRail project. The basic concept is to equip the individual freight cars with

---

<sup>24</sup> BG (2013)

<sup>25</sup> VDA (2012)

<sup>26</sup> Verkehrsrundschau (2010)

<sup>27</sup> Siemens (2012 b)

<sup>28</sup> Spiegel (2006)

<sup>29</sup> Handelsblatt (2012)

<sup>30</sup> Schenker (2012)



their own source of propulsion so that they can travel the "last mile" to their destination under remote control and independently of the locomotive. The advantages of this system include greater flexibility as well as time and energy savings<sup>31</sup>.

### *Alternative propulsion technologies*

Due to the scarcity of resources, the increased costs, the negative environmental impact and the legislation, researchers are working on alternative sources of propulsion in addition to ongoing development of internal combustion engines. Progress is made in the areas of electromobility, hybrid solutions and natural gas propulsion.

#### *Electromobility*

Electromobility is currently being developed as an alternative solution to today's technologies in the long term. Thanks to technological progress and falling prices, the market share of electrically powered vehicles in Europe will rise over the coming years according to recent forecasts<sup>32</sup>. The demands of urban spaces are driving this development because cities provide the ideally necessary infrastructure to operate electric vehicles. The large number of potential users favors the establishment of charging stations, battery exchange facilities and special services in built-up areas<sup>33</sup>. The development is initially being driven by private cars as the technical challenges can be tackled at lower cost in this environment than in commercial vehicles. Electric commercial vehicles do not currently have sufficient range or load capacity to make them economic for use in freight transportation. Nevertheless, various manufacturers are currently developing concepts for the future use of electrically powered commercial vehicles. If these prove successful, it can be expected of them to become a more regular feature of distribution traffic and city logistics.

#### *CNG - Compressed natural gas*

Compressed natural gas is another alternative fuel that can be used in the transportation industry. While manufacturers today offer series production of gas-

---

<sup>31</sup> BMWi (2007)

<sup>32</sup> Öko-Institut (2012)

<sup>33</sup> EffizienzCluster (2010)

powered private cars, gas is the exception when it comes to commercial vehicles. The disadvantages compared to diesel vehicles include the smaller range of around 400km and the relative lack of gas stations selling compressed natural gas. To increase the range, special trailers are available with additional tanks in pallet boxes, enabling around 1,000 km to be travelled between refueling.

### LNG - Liquefied natural gas

A promising alternative to the use of conventional gas is unconventional liquefied natural gas (LNG) which is natural gas that has been cooled to a temperature of around -160°C, turning it into a liquid. As a result, it only takes up a fraction of the volume of natural gas in its gas state (CNG) and enables a large range, almost equaling that of diesel vehicles, to be achieved with only a moderately sized tank<sup>34</sup>. Natural gas offers some advantages compared to diesel. The combustion process emits less carbon dioxide in relation to the energy produced and therefore burning LPG is very clean compared to the other fuels being currently used. Moreover, natural gas reserves are still relatively high compared to those of crude oil and can be expected to last the next 200 years<sup>35</sup>. So far, there are only a few commercial trucks in service with LNG propulsion. However, the trend shows that LNG represents a promising alternative and enables quieter and more environmentally friendly engines.

### Hybrid technology

Hybrid technology offers a further innovation for both road and rail freight transportation by combining two methods of propulsion. The basic concept is the use of two different sources of motive power in a single vehicle. In some applications, the driver can switch between these, while in others the two power sources assist each other, for example diesel and electricity. Hybrid technology has great potential in rail freight transportation on routes with both electrified and non-electrified sections. Currently, such routes require either a change of locomotive or the use of diesel power under the overhead wires. Furthermore, there is also a further model involving switchyard locomotives that largely run on battery power and use a diesel generator unit to recharge at intervals. The relative dimensions of the diesel and electrical units in

---

<sup>34</sup> Daimler (2012)

<sup>35</sup> FAZ (2013)

hybrid locomotives can be adapted based on the intended use and length of the relevant route. At present, however, there are no hybrid locomotives (offering diesel power greater than around 1.5 MW) with sufficiently large diesel units to cope with longer and more arduous routes. They quickly run up against weight limits here. The great efficiency of electric power from the overhead catenary makes intensive development work on hybrid locomotives worthwhile. The aim must be to avoid running with diesel under the wires as far as possible while maintaining efficient operation at the transition points between electrified and non-electrified lines.

As far as commercial rail transportation is concerned, hybrid technology is used both by main line and switchyard locomotives. One method is to equip an electric locomotive with an additional diesel power unit, enabling it to run short distances beyond the electrified network. The other is to equip diesel vehicles with an electrical power unit to assist the diesel. When the train brakes, energy is recovered and stored in a battery, which can be used to assist reacceleration and power the train in low-speed operations. Potential diesel savings of up to 40%, environmental benefits due to reduced particle emissions and nitrogen oxides, noise reductions of 15% and a lower life-cycle cost make the hybrid locomotive a promising alternative. Different hybrid technologies are also available for road transportation. The serial hybrid consists of a combustion engine linked to a generator and electric motor. The electric motor provides the actual power to the wheels. Meanwhile, the combustion engine and generator deliver energy that is either fed directly into the electric motor or stored in the battery. The alternative is the parallel hybrid, in which both combustion engine and electric motor are linked to the driving wheels. Here, it is possible in theory to drive in both pure electric and pure combustion engine modes. The electric and combustion engine power sources can also be used to drive the vehicle simultaneously. This technology enables quiet nighttime deliveries, for instance, as the last mile to the customer can be driven on electric power alone, while the longer distances on major roads can be covered using the diesel engine. All types of hybrid drive offer the general advantage of reducing fuel consumption by combining a conventional engine and an electric motor. This is because the electric motor helps to power the vehicle, or alternatively powers it alone, and the internal combustion engine can always operate at an optimum rpm-range.

## Hydrogen

Regarding the use of hydrogen as a power source in vehicles, there are currently two different approaches. The first one is to use a bi-fuel engine that burns both gasoline and hydrogen. This is intended to enable the vehicle to be used without a comprehensive infrastructure of hydrogen filling stations. However, it represents something of an interim solution for the second technology: the hydrogen fuel cell. The fuel cell is able to generate electricity using an electrochemical process. The major advantage of this technology is that it eliminates all emissions as the chemical reaction only produces water. Fuel cell systems also enable efficient, quiet operation with continuous power transmission thanks to the high torque levels of the electric motor.

Nevertheless, it has to be mentioned that hydrogen has some disadvantages. One of these is the complex method of storage. If hydrogen is stored as a gas, the tanks must be able to withstand a pressure of at least 350 bar when full. Another option is to store the hydrogen as a liquid. This does not require high-pressure containers; however the gas must be cooled to minus 253°C before it turns to liquid. The tanks must therefore be extremely well insulated<sup>36</sup>. At present, however, the greatest problem is the inadequate infrastructure available. In 2010 there were only ten public hydrogen filling stations in the whole of Germany. This number is set to rise to more than 12,000 by 2050<sup>37</sup>, potentially making hydrogen vehicles an attractive alternative for the future.

---

<sup>36</sup> ADAC (2013 a)

<sup>37</sup> Wietschel (2008)

## CONCLUSIONS

The theory that claims that firms which tend to focus on the creation of cooperative culture with their suppliers and on the commitment to supplier relationship and quality, commit themselves to supplier satisfaction and develop strong relationships with supply partners, seems to be supported by the available data. Furthermore, the particular tight relationships with their suppliers could lead to suppliers' quality contributions to the firms. Additionally, many people support that corporations which tend to promote a cooperative culture with their suppliers, commitment to supplier relationship and quality, usually develop integrative processes with the suppliers and try constantly to work on improvement activities with them. As a result from these linkages and actions with their suppliers, business excellence in the particular companies can be achieved.

Even though the above mentioned elements play an important role to achieving business excellence, there are additionally a number of factors that already play or will play a crucial role in achieving business excellence in the commercial road transport sector. These factors refer to the various areas for action and solutions that have been already mentioned in the last chapters and that can lead to efficient transportation in the coming years. These solutions present individual measures that, despite being full of potential, can only achieve the impact described and help companies of the commercial road transport achieve business excellence if they are combined with one another. Furthermore, the solutions and the areas for action can be classified into the three categories: digitization, technology and flexible management. Even though digitization enables optimized planning based on real-time information, the improvement of technology leads to optimized, energy-efficient and safe processes and flexible management supports cooperation within and between companies. These areas for action and the potential synergies between them can help firms in the commercial road transportation achieve business excellence nowadays and in the coming years. Finally, it can be also supported that important developments are being seeing in the road freight transportation sector but intensive and innovative research work is still needed in these fields and the interactions and synergies between the different areas must also be further developed.

## REFERENCES

- Acatech, (2006), *Mobilität 2020. Perspektiven für den Verkehr von morgen*, German Academy of Science and Engineering
- Baldauf A., (2010), *Grüne Logistik abseits von CO2-Emissionen: Nachhaltiges Management in der Logistikbranche*, WU Vienna University of Economics and Business
- BMVBS, (2008), *Masterplan Güterverkehr und Logistik*, German Federal Ministry of Transport, Building and Housing
- BMVBS, (2011), *Lkw-Parken in einem modernen, bedarfsgerechten Rastanlagensystem*, German Federal Ministry of Transport, Building and Housing
- BMWi, (2007), *FlexCargoRail. Moderner Einzelwagenverkehr*, German Federal Ministry of Economics and Technology
- BMWi, (2013), *Trends und Hintergründe zur Energieversorgung*, German Federal Ministry of Economics and Technology
- Bombardier, (2013), *Automated People Movers. The leading solution for urban and airport transportation*
- BP, (2013), *BP Statistical Review of World Energy*
- Brake, K.; Herfert, G., (2012), *Reurbanisierung. Materialität und Diskurs in*
- Brauckmann, J; Echterhoff, W., (2007), *Einflüsse auf Gesundheit, Verkehrssicherheit und Wirtschaftlichkeit von LKW-Fahrern im Güterfernverkehr*, Gesellschaft für Ursachenforschung bei Verkehrsunfällen e.V. im Auftrag von TÜV Rheinland
- Breitinger M., (2012), *Nicht alle Dinge benötigt man am nächsten Tag*, Zeit Online
- Brücker H., (2010), *Zuwanderungsbedarf und politische Optionen für die Reform des Zuwanderungsrechts*, Institut für Arbeitsmarkt- und Berufsforschung (ed.)
- Bundesvereinigung Logistik (BVL), (2010), *PR-Leitfaden für die Praxis. Investition in Kommunikation*
- Cavinato J. L., (1991), *Identifying total cost advantages for supply chain competitiveness*, International Journal of Physical Distribution and Logistics Management, 27, pp. 10- 15

- Christopher, M., (1992), *Logistics and Supply Chain Management*, Pitman
- Cooper M. C. & Ellram, L. M., (1993), *Characteristic of supply chain management and the implications for purchasing and logistics strategy*, International Journal of Logistics Management, 4(2), pp. 13- 24
- Daimler, (2012), *Alternative Kraftstoffe: Econic LNG setzt die Reichweite auf neues Niveau*
- DB Schenker, (2012), *Lokführerlos*, Customer Magazine, 2012
- DB, (2013), *Kurzbeschreibung zu den einzelnen ETCS Leistungsstufen. Was ist European Train Control System (ETCS)?*
- Deutsch M., (1973), *The Resolution of Conflict*, New Haven, CT, Yale University Press
- Deutsche Post, (2009), *Delivering Tomorrow. Kundenerwartungen im Jahr 2020 und darüber hinaus. Eine globale Delphistudie*
- *Deutschland*. Wiesbaden: Springer VS
- DVWG, (2009), *Der Verkehr im Jahr 2030*, Internationalen Workshops und Kongresses "Traffic and Transport 2030"
- Eberl U., (2011), *Wie wir schon heute die Zukunft erfinden*, Weinheim Basel: Beltz & Gelberg
- EffizienzCluster, (2010), *100 Innovationen für die Logistik von Morgen*
- Ellram L. M., (1991), *Supply chain management- the industrial organization perspective*, International Journal of Physical Distribution and Logistics Management, 21(1), pp. 13- 22
- Frankfurter Allgemeine Zeitung (FAZ), (2011), *Renaissance der Dampfmaschine. Voith-SteamTrac*
- Frankfurter Allgemeine Zeitung (FAZ), (2012), *Neues Verkehrskonzept. Lastwagen an der Oberleitung*
- Frankfurter Allgemeine Zeitung (FAZ), (2013), *Lastwagen mit LNG. Die Kühlkette darf nicht reißen*
- Gabler Wirtschaftslexikon, (2010), *Die ganze Welt der Wirtschaft: Betriebswirtschaft, Volkswirtschaft, Wirtschaftsrecht, Recht und Steuern*, 17th ed. Gabler 2010
- Giupipero L. C. & Brand R. R., (1996), *Purchasing's role in supply chain management*, International Journal of Logistics Management, 5, pp. 29- 38
- Handelsblatt, (2012), *Die fahrerlose U-Bahn hat sich bewährt*

- Holtbrügge, D.; Welge, M., (2010), *Internationales Management: Theorien, Funktionen, Fallstudien*, 5th ed. Wiesbaden: Schäffer-Poeschel Verlag
- Horvath, S., (2012), *Aktueller Begriff. Internet der Dinge*. Berlin: Deutscher Bundestag
- Houlihan L. B., (1985), *International supply chain management*, International Journal of Physical Distribution and Logistics Management, 15, pp. 22- 38
- Ifmo (Institute for Mobility Research), (2005), *Zukunft der Mobilität. Szenarien für das Jahr 2025*, 1st ed. Munich: BMW AG
- Jones Lang LaSalle GmbH, (2013), *Logistikimmobilien Report – 2012. Der Deutsche Logistikmarkt*
- Jones T. C. & Riley D. W., (1985), *Using inventory for competitive advantage through supply chain management*, International Journal of Physical Distribution and Logistics Management, 15, pp. 16- 26
- Kanji G. K. & Asher M., (1993), *Total Quality Management Process- A Systematic Approach*, Oxford, Carfax
- Kanji G. K. & Malek A., (1999), *Total quality management in UK higher education institutions*, Total Quality Management, 10, pp. 129- 153
- Kanji G. K. & Wong A., (1998), *Quality culture in the construction industry*, Total Quality Management, 9, pp. 133- 140
- Kanji G. K. & Yui H., (1997), *Total quality culture*, Total Quality Management, 8, pp. 417- 428
- Kanji G. K., (1996), *Implementation and pitfalls of total quality management*, Total Quality Management, 7, pp. 331- 343
- Kanji G. K., (1998), *Measurement of business excellence*, Total Quality Management, 9, pp. 633- 643
- Langley C. J. & Holcomb M. C., (1992), *Creating logistics customer value*, Journal of Business Logistics, 13, pp. 1- 27
- Malaka, R.; Butz, A.; Hußmann, H., (2009), *Medieninformatik*, Munich: Pearson Studium
- MAN Truck & Bus AG, (2013), *Sicher unterwegs: Elektronische Assistenzsysteme*
- McKinsey (2008), *Deutschland 2020. Zukunftsperspektiven für die deutsche Wirtschaft*, Frankfurt, 2008



- MWV, (2013), *Wahrnehmung und Realität. Ein Beitrag zur Versachlichung der Debatte um Rohöl, Raffinerien und Kraftstoffe. Öl im Transparenz-Check*, Association of the German Petroleum Industry
- Öko-Institut, (2012), *Hintergrundpapier Elektromobilität des Öko-Instituts. Zukunft Elektromobilität? Potenziale und Umweltauswirkungen*, Berlin, 2012
- Prognos, (2005), *Work-Life-Balance als Motor für wirtschaftliches Wachstum und gesellschaftliche Stabilität*, Berlin/Basel, 2005
- ProgTrans, (2007), *Abschätzung der langfristigen Entwicklung des Güterverkehrs in Deutschland bis 2050*
- ProgTrans, (2012), *World Transport Reports Edition 2012/ 2013*, Volume: Goods Transport, 2012
- SBB, (2009), *RFID für mehr Pünktlichkeit*, ECIN, 2009
- SBB, (2013), *ETCS Level 3*
- Schmidt, N.; Kille, C., (2008), *Wirtschaftliche Rahmenbedingungen des Güterverkehrs*, Nueremberg: Fraunhofer IRB Verlag, 2008
- Schoblick, R.; Schoblick, G., (2005), *Radio Frequency Identification. Grundlagen. Eingeführte Systeme. Einsatzbereiche Datenschutz. Praktische Anwendungsbeispiele*, Poing: Franzis Verlag, 2005
- Senge P., Kleiner A., Roberts C., Ross R. B. & Smith B. J., (1994), *The Fifth Discipline Field book: Strategies and Tools for Building a Learning Organization*, New York, Doubleday
- Siemens, (2012 b), *Wie funktioniert eine fahrerlose U-Bahn?*, Munich, 2012
- Spiegel Online, (2006), *Vollautomatisch im Untergrund: Nürnberg testet erste fahrerlose U-Bahn*
- Stopka, U., (2009), *Herausforderungen und Potenziale von Mobilfunk-, Ortungs- und Navigationsdiensten in Güterverkehr und Logistik*, TU Dresden, 2009
- Süderelbe, (2012), *Arbeitskräftemangel bringt Jobmotor Logistik ins Stottern*
- Sünderhauf, B., (2009), *Die Automatische Mittelpufferkupplung (AK). Voraussetzung für eine Automatisierung des Schienen-Güterverkehrs in Europa. Kosten-Nutzen-Analyse*, Cologne, 2009
- ten Hompel, M; Nagel, L., (2009), *In Zukunft Logistik*, Die Zukunft der Logistik für Audi

- Thomi, W.; Werner, R., (2001), *Regionale Innovationssysteme. Zur territorialen Dimension von Wissen und Innovation*. In: Zeitschrift für Wirtschaftsgeographie 45 (3-4), 2001
- Towill D. R., Naim M. M. & Wikner J., (1992), *Industrial dynamics simulation models in the design of supply chains*, International Journal of Physical Distribution and Logistics Management, 22, pp. 3- 13
- TU Berlin, (2008), *Voruntersuchung. Logistik im Produzierenden Gewerbe*
- TU Darmstadt, (2008), *Der Verkehr im Jahr 2030*, Das Wissenschaftsmagazin der Technischen Universität Darmstadt, 2008
- UBA, (2012), *Nachhaltige Stromversorgung der Zukunft. Kosten und Nutzen einer Transformation hin zu 100% erneuerbarer Energien*, German Federal Environment Agency
- United Nations – Department of Economic and Social Affairs, Population Division (UN/DESA), (2012), *World Urbanization Prospects: The 2011 Revision*, 2012
- VDA, (2012), *Produktion und Logistik in Deutschland 2025. Trends, Tendenzen, Schlussfolgerungen*, Association of German Engineers
- Verkehrsrundschau, (2010), *LKW-Technik steigert Effizienz*
- Verkehrsrundschau, (2012), *Fachkräftemangel im Transportgewerbe angekommen*
- Wietschel, M., (2008), *Die Wasserstoff-Technologie in der Anwendung: Alternative Antriebstechnologien für die Mobilität des 21. Jahrhunderts*, Hamburg, 2008
- Wong A., Tjosvold D., Wong, W. & Liu C. K., (1999), *Relationships for quality improvement in the Hong Kong- China supply chain*, International Journal of Quality & Reliability Management, 16, pp. 24- 41
- Zairi M., (1997), *Business process management: a boundary less approach to modern competitiveness*, Business Process Management Journal, 3, pp. 64- 80
- A. Ghobadian and H. S. Woo, (1996), *Characteristics, Benefits and Shortcomings of Four Major Quality Awards*, International Journal of Quality & Reliability Management, Vol. 13, No. 2, pp. 10-44
- G. A. Bohoris, (1995), *A Comparative Assessment of Some Major Quality Awards*, International Journal of Quality & Reliability Management, Vol. 12, No. 9, pp. 30- 43

- J. S. Oakland, (2003), *Total Quality Management: Text with Cases*, Taylor & Francis