Balancing Commonality and Differentiation within Product Platform Strategy

A Process Framework taking Business Context and Strategy into account

Submission for the Award of Doctor of Business Administration

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II Statement of Original Authorship

I, Erdem Yilmaz

Hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person nor material which to a substantial extent has been accepted for the award of any other degree or diploma at Charles Sturt University or any other educational institution, except where due acknowledgement is made in the thesis. Any contribution made to the research by colleagues with whom I have worked at Charles Sturt University or elsewhere during my candidature is fully acknowledged.

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IV Abstract

Platform strategy is one of the effective methods to achieve cost reduction across product portfolio. However, if not appropriately managed, there are also risks concerning loss of differentiation. Therefore, appropriate balance of commonality (which is the reason for cost reduction) and differentiation is one of the most critical success factors in order to gain from platform strategy. Various practices from different disciplines are developed to show how commonality and differentiation should be balanced.

In doing this, the approaches across disciplines vary concerning problem specification (what should be balanced concretely?) and solutions (how to balance commonality and differentiation within platform strategy?). Dependent on research aim and specified problem area, parameters and methods of research differ from each other across identified solutions to balance commonality and differentiation within platform strategy. Furthermore, the focus of current literature is to generate efficient scenarios for commonality and differentiation, but not on how to find out which of these efficient scenarios is the most appropriate for the company. In general, these approaches are developed theoretically and applied to cases in practice in order to determine benefits and limitations.

To complement the theory of platform strategy, this research aims to identify a strategic process for balancing commonality and differentiation in order to find the right platform strategy among efficient scenarios by changing the direction of the research from practice to theory and analyzing how good practice companies, already applying platform strategy for many years, perceive the tradeoff between commonality and differentiation and how to find the solution in terms of appropriate balance between commonality and differentiation. The research will capture how good practice companies define their specific problem concerning balancing commonality and differentiation, taking into account the complexity of the real world and how it solves it, as well as the underlying reasons for their approach. From these results derived from good practice, a process framework should emerge and be developed to balance commonality and differentiation within platform strategy.
Because of the complexity and necessary in-depth information level, qualitative research is applied to answer research questions. The qualitative study is two-fold: a) single case study of a good practice company already applying platform strategy successfully for many years in order to identify in-depth information about the processes behind balancing activities of commonality and differentiation within product platform strategy, and b) interviewing experts with experience in the field of product platform strategy across different business contexts to complement the perspective from single-case study by way of taking different business contexts into account.

The results show that the relationship between cost and differentiation is varied especially considering the sub-dimensions of cost and differentiation which are relevant to different degrees from the company’s perspective. Furthermore, commonality within platform strategy impacts products’ cost and differentiation. Different kinds of commonality have different impacts on cost and differentiation level of products based on the platform. Commonality does not automatically mean a negative impact on differentiation, but it depends on the kind of commonality and components. If it comes to a tradeoff between commonality and differentiation, which is reasoned by the necessity of commonality of components with an impact on differentiation, the generic rule is to “maximize commonality to maximize cost reduction by ensuring sufficient differentiation”, also mentioned in platform strategy literature. So, good practice companies increase their commonality degree by ensuring sufficient differentiation. Sufficient differentiation means there is a certain tolerance to loss of internal differentiation (cannibalization) and external differentiation (competitiveness). In addition to that, results of the research show that commonality and differentiation decisions within platform strategy are made holistically, taking the strategy of the company into account. It means the target of cost reduction and ensuring sufficient differentiation is always a result of various strategies within the firm, whereby platform strategy is one of them. Therefore, the decisions with regard to platform strategy are always aligned with other company strategies.

The emergent strategic process derived from good practice to balance commonality and differentiation within platform strategy consists of the following stages: preparation & plan-do-check cycle. In the preparation stage, there is a need to analyze the business context in order to define which sub-dimensions of cost and differentiation are relevant
from the company's perspective. Then, product positioning should be executed within a cost-differentiation matrix showing current and desired positioning. These steps assist in illustrating the gap that should be closed by platform strategy. After that, critical boundaries for internal and external differentiation should be defined in order to concretize “sufficient differentiation”. Then, component characteristics should be identified in terms of their relevance concerning cost and differentiation. In the planning/doing stage, according to the kind of components, different commonality steps should be executed. After each commonality step, impacts on cost and sufficient differentiation should be checked iteratively. If targets in terms of gaps can be closed by the commonality step, the process should be finished. Otherwise the next commonality step should be planned. If the last commonality step is achieved and there is still a gap in order to reach cost reductions targets, there is a need to refine the targets in the platforms strategy taking other strategies of the firm into account and the process begins again from the first step.
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1 Introduction

The thesis is structured as follows. The main chapters are: Introduction, Literature Review, Research Methodology, Results, Conclusions, Research Contributions and Implications, and Limitations. After some background information and the main topic of commonality and differentiation are introduced, research problems, research propositions, research methodology and justifications of the research and limitations are described shortly in the introduction chapter.

1.1 Background to the Research

Product platforms are physical elements shared by several products and a set of subsystems and interfaces developed to form a common structure, from which a stream of products can be efficiently developed and produced (McGrath & Michael, 2000; Meyer & Lehnerd, 1997; Qu, Bin, Huang, & Yang, 2011). High competitiveness in markets and cost challenges in the global economic world lead companies to search for innovation strategies. In this context “companies must optimize external variety with respect to internal complexity resulting from product differentiation” (as cited in Jiao, Simpson, & Siddique, 2007, p. 5). To manage this successfully, companies implement product platform strategies. Product platforms are one of the effective innovation and product development strategies to handle cost and variety successfully (as cited in Qu et al., 2011, p. 2198; Sköld & Karlsson, 2011, p. 206). Product platform strategy is applied in many industries (Sköld & Karlsson, 2011, p. 206). There are numerous examples of industries, which achieved significant benefits by implementing platform strategy (Kurtadikar, Stone, Van Wie, & McAdams, 2004, p. 2). The applications go back to the 1950s (GM with Chevrolet Corvair in 1956). Black & Decker already implemented their first product platforms in 1970 (Tucker & Simpson, 2010, pp. 74–75). Even if platform strategy is applied for many years, the estimation of benefits is evaluated differently by highly experienced managers. Prof. Dr. Piëch (formerly chairman of the supervisory board of Volkswagen AG and MAN SE) believes platform strategy across MAN and Scania will generate economies of scale and economies of scope amounting to 0.5 billion € - 1.0 billion € through savings in development costs of high-value complex components, such as the engine or gearbox and savings of purchasing costs, as already applied
successfully in the car-industry (Köhn, 2010). Opposed to this opinion, Leif Östling, the former CEO of Scania, believes that these benefits are hardly possible overall (Dalan, Hartmann, & Hildebrand, 2009). Concluded from various investigations, platform strategy leads to great benefits, but is also connected with high risks and substantial challenges.

In general, platform strategy is a general management task, since it has significant effects on the company. The main challenges for managers are to handle the interdependencies of technical and strategic/managerial approaches (Lundbäck & Karlsson, 2005, p. 170). The implementation and use of platform strategy differs across industries and companies. As described also by Gassmann & Sutter, the main idea of platform strategy is simple, namely to carry over development results across products and brands, but the implementation is complex and challenging, therefore only a few companies are able to benefit from the full potential of platform strategy (Gassmann & Sutter, 2010, p. 82). Despite a significant amount of investigations in academia and applications in practice, the implementation and use of platform strategies are still a highly challenging task. One of the main challenges and key success factors is the balance of commonality and differentiation within platform strategy which is described next.

1.2 Commonality and Differentiation within Platform Strategy

In general, there are different kinds and degrees of commonality and differentiation within platform strategy. According to type, commonality can be divided into: functional commonality, physical commonality and modularity of individual components (commonality of interfaces) (Wie, Stone, Thevenot, & Simpson, 2007). The degree of differentiation varies across different kinds of products. There are some products without variance, products with variance driven by the manufacturer, products with variance driven by the customer, and highly differentiated individual products (Schuh, Lenders, Nußbaum, & Rudolf, 2012, p. 130).

Independent from the various kinds and degrees of commonality and differentiation, “companies desire as much commonality as possible within the family without sacrificing the distinctiveness of the individual products in the family” (as cited in Simpson, Siddique, & Jiao, 2010, chapter 1). So, the goal of the product family is to make
architecture as common as possible across the whole family without compromising those particular individual characteristics of a single variant valued by the customer (Ohvanainen & Hietikko, 2012). The goal leads to challenges which are described by many researchers. The main challenges for engineers are the tradeoff between commonality and variety driven by performance, differentiation and brand identification (Alizon, Shooter, & Simpson, 2008, p. 188). The challenge increases for multi-brand companies in terms of securing cost-effective solutions and generating distinctiveness in order to optimize product value in multi-branded companies. In this context, product identity and long-term brand management are success factors for implementation of platform strategy. To avoid cannibalization, successful companies such as Volkswagen AG sharpen the brand profiles of each brand (Heikkilä, Karjalainen, Martio, & Niininen, 2002, pp. 16, 41).

In this context, “commonality management” is important within platform strategy to find the right ratio of commonality and differentiation (Schuh et al., 2012, p. 155). Too high a degree of commonality leads to a loss in performance and thus competitiveness. Too low a degree of commonality leads to a loss of cost reduction potential which will also lead to a loss of competitiveness (de Weck, Suh, & Chang, 2003, p. 3; Meyer, 1997, p. 20). Therefore, there is a need for a proper balance between differentiation and commonality (Ulrich & Eppinger, 2012).

1.3 Research Problem and Question

In general, research concerning the balance of commonality and differentiation within platform strategy can be divided in two main categories. While one stream of research derives challenges from multiple-case studies and mentions the necessity of the right ratio between commonality and differentiation without a concrete solution/approach with regards how to manage it, others try to show how to achieve optimum solutions. In this context, a huge range of tools and methods are developed which aim to show how to balance commonality and differentiation within platform-based product family design (Jiao et al., 2007; Simpson, Bobuk, Slingerland, Brennan, Logan, & Reichard, 2012).
Current literature about tools and methods for balancing commonality and differentiation can also be divided in two main areas: problem specification and problem solution. The problem specification consists of detailed descriptions of the tradeoff between commonality and differentiation. In problem specification, it is listed which parameters are considered and which parameters will be optimized. For example, there are some investigations trying to optimize development cost through commonality by an acceptable product performance. The product performance is quantified by the amount of differentiated parts. There are also some other investigations which consider a huge amount of parameters weighted by the company to provide a holistic solution which includes all relevant parameters. Obviously, dependent on research focus, problem specification concerning commonality and differentiation and considered parameters varies across investigations. Even if considered problems are relevant in practice, it is not clear how to identify relevant parameters to balance commonality and differentiation appropriately within product platform strategy to take business context into account. Therefore, there is a need for a generic process which shows how companies should define their specific problem concerning balancing commonality and differentiation within product platform strategy.

The problem solution in terms of tools/methods/approaches to balance commonality and differentiation are based on a pre-defined problem specification. Developed solutions applied to practical problems do not cover the problem and solutions holistically, which is the main reason why solutions derived from academia are still not accepted appropriately in practice. In most cases, previous theoretically developed solutions cannot be applied in practice, which is also confirmed by various papers and conferences, such as the report about two industry-focused conferences with the emphasis on platform design, development and deployment, whereby twenty companies shared their successes and frustrations concerning platform design and deployment, platform-based product development and product family planning. One of the findings of these conferences is: “application of academic efforts to real-world problems exposed limitations and needs for further research” (Simpson, Marion, de Weck, Hölttä-Otto, Kokkolaras, & Shooter, 2006, pp. 1-2). This is emphasized by further statements such as: “low-level of applications can be seen, for example how papers on platforms tend to revert to the same, already dated”, “many techniques and tools from
academia are not being applied in industry because they often do not scale well to complex or "messy" situations”, and “companies experience more challenges during implementation process than they expected” (Simpson et al., 2006, p. 7).

Summarized, problem specification in terms of identification of conflicting objectives between standardization and differentiation is based on the researcher’s perspective which is theoretical and simplified without any considerations of business context. Consequently, problem resolution in terms of approach/method to balance commonality and differentiation is based on simplified problem specification with low acceptance in practice. Therefore, there is a need for a change in research direction in terms of understanding how good-practice firms specify their conflicting objectives between commonality and differentiation depending on their business context. In addition, based on this understanding, there is also a need to know how good-practice firms find solutions to balance commonality and differentiation for their business context. In opposition to current theoretical solutions, there is a need to capture good-practice solutions in order to complement theoretical perspective. To be able to generate a framework to obtain this perspective taking the company-specific situation into the account, it is necessary to analyze good practice solutions to capture the solutions from a practice perspective. Therefore, complementing prescriptive solutions from literature review, an empirical study will be executed to capture solutions from good-practice descriptively in order to generate a generic framework as a support for balancing commonality and differentiation within platform strategy appropriately. The expression of “good-practice” is selected consciously, since the typical term of “best-practice approach” is difficult to define in terms of how to know if a case represents best practice. This will require knowledge of all practices and approaches and evaluation of them concerning which is the best amongst them. Therefore, the focus was on capturing good-practice solutions from practice acknowledged by theory and practitioners/experts.

Derived from the above considerations, the research problem addressed in this research is: how to specify and balance the tradeoff between commonality and differentiation within platform strategy taking business context and strategy into account?
1.4 Research Propositions

The following research propositions derived from literature review and rival propositions are formulated to guide data collection and data analysis described in later chapters:

- **P1:** Balancing commonality and differentiation within platform strategy can be achieved by orientation of platform strategy decisions on superior objective of competitiveness. Therefore, good practice companies make platform strategy decisions systematically based on competitive strategy. Rival P1: Conflicting objectives will be balanced intuitively and not systematically and are independent from competitive strategy, since competitiveness is not the main objective of platform strategy.

- **P2:** Due to the fact that competitive strategy is a relative position to competitors’ and one’s own current and desired position in the dimensions of cost and differentiation and is dependent on customer expectations, good practice companies make their platform strategy decisions based on these factors. Rival P2: The main competitor has no role in balancing commonality and differentiation within platform strategy; the satisfaction of the customer is the main target balancing commonality and differentiation decisions within platform strategy.

- **P3:** Because of the fact that cost and differentiation dimensions can also be influenced by other strategies of the company, good practice companies fit their platform strategy decision making to further strategies of the company in order to know which cost and differentiation level should be achieved by platform strategy. Rival P3: There is no strategic fit to other strategies to balance commonality and differentiation within platform strategy.

- **P4:** The kinds of cost and differentiation dimensions considered are dependent on business context. Rival P4: The business characteristic has no impact on commonality and differentiation decisions, since there are always the same dimensions of cost and differentiation balancing commonality and differentiation within platform strategy.
1.5 Research Objective and Methodology

The main research objective was to understand in-depth how good practice companies identify their problem concerning conflicting objectives between commonality and differentiation and how they balance them optimally dependent on their specific business context. The research aim of detailed understanding of good-practice for balancing commonality and differentiation within platform strategy taking business context into the account requires an in-depth understanding of the process behind them across different business contexts. Therefore, the challenge in this research was: how to obtain an in-depth insight into the perception of problem specification describing the tradeoff between commonality and differentiation, and at the same time to get an understanding of the balancing-process dependent on different business contexts. For this aim of the research, qualitative research is most appropriate, since it allows an understanding of the process from the participant’s point of view in terms of how they balance commonality and differentiation and an understanding of their behavior in this context (Hennink, Hutter, & Bailey, 2011, p. 10; Patton, 2002, p. 59ff.). This requires detailed descriptions of how people engage within the process, the different experiences amongst participants and capturing the dynamics within the process and participants’ perceptions. Therefore, research is based on the “Verstehen” tradition rooted in qualitative phenomenology to understand the problem specification and problem solution concerning the balancing process of commonality and differentiation within platform strategy from the participant’s/expert’s own perspective (Taylor & Bogdan, 1984, pp. 1–2). The research can be aligned to qualitative process study which aims to define how a program operates by describing and understanding the details and dynamics of program process and critical elements essential to program success (Patton, 2002, p. 160).

The ontological perspective of the research is based on multiple truths. The researcher believes that multiple solutions/methods/frameworks for identification of good-practice solutions are possible, depending on interpretations of problem specification, problem solution and business context. This ontological perspective is rooted in the interpretivism paradigm. This research shows one possibility for a process of identification of the conflicting objectives of commonality and differentiation. This
research also shows one possibility for a process to balance commonality and differentiation optimally taking business context into account. Because of solution-orientation of the research, from an epistemological point of view, all knowledge is relevant which makes a contribution to identifying the problem of conflicting objectives between commonality and differentiation and which makes a contribution to the solution to balance them optimally taking business context and strategy into account. Hence, the necessary and desired complementary view of problem specification and problem solving for a complex real-world issue leads to the conclusion that the research should be based dominantly on the interpretivism paradigm with partly pragmatism elements with inductive and deductive reasoning based on existing literature according to the concept of Hennink, Hutter and Bailey (2011). In other words, from the research paradigm’s point of view, the research is based on the combination of interpretivist design research and the pragmatism paradigm which produce knowledge about successful applications of tasks and situations in order to create effective artefacts - in this case a good practice approach balancing commonality and differentiation within platform strategy (March & Smith, 1995).

On the one hand, there is also a need for case and criterion sample strategy (Patton, 2002, pp. 236, 238) to identify in-depth how a typical good-practice company, which acknowledged by experts and theory, balances commonality and differentiation within platform strategy. On the other hand, there is a need for a purposeful sampling based on heterogeneous business context (Patton, 2002, p. 235) in which the phenomenon of balancing commonality and differentiation within platform strategy should be investigated. To gain an in-depth understanding of balancing commonality and differentiation within platform strategy within a typical good-practice company leads to the selection of a single-case study approach. The single case study allows gaining of knowledge about good practice in terms of how the company identified their tradeoff between commonality and differentiation and how they balance them dependent on their business context. The results of the single-case study were complemented by expert interviews which allowed capturing of good-practice approaches dependent on different business contexts. Even if in-depth knowledge about the process is not possible, it allowed gaining of in-depth information about different good-practice approaches depending on different business contexts.
The research is based on grounded theory methodology which allows being creative and systematic at the same time within qualitative research (Patton, 2002, p. 127). Through a grounded theory process it was possible to generate a theory of good-practice process balancing commonality and differentiation within platform strategy (Patton, 2002, p. 125). The research process was cyclical in nature, which involved linkages between research design (design cycle), data collection (ethnographic cycle), and data analysis (analytic cycle) which are also cyclical within. The result from literature study within the design cycle leads to a deductive theory and has influenced the data collection within the ethnographic cycle, especially in terms of selection of appropriate research instruments and cases/study participants. The gap of detailed understanding of good-practice concerning balancing commonality and differentiation successfully within platform strategy leads to the selection of single-case study with a highly complex business context to obtain an in-depth view into successful process. The necessity of capturing good practice dependent on different business context leads to the selection of interviewing experts/consultants to capture their experiences from different good-practice approaches in different business contexts. The analytic cycle consists of developing codes, describing and comparing codes, categorizing codes and conceptualizing data and developing inductive theory. To obtain a holistic perspective, the inductive theory was again linked to deductive reasoning in the design cycle (Hennink et al., 2011, p. 4 fig. 1-1, pp. 24-26).

1.6 Justifications for the Research

This research allows identifying of good-practice process for the purpose of identification of conflicting objectives between commonality and differentiation and balancing them within platform strategy taking business context and strategy into account.

Most theoretically developed solutions are developed from the researcher’s point of view, but not from the user’s point of view; in this case: general managers, who want to implement and use platform strategy within their company, have to consider the whole company from a holistic view and not an engineer’s isolated view. Therefore, there is a need for more practice-oriented approaches to fill the gap between theory and academia. The generated theory developed from this research will complement
methods in theory and support companies to balance commonality and differentiation within platform strategy. Through this research framework, real-world complexities were able to be identified appropriately and now good practice companies balancing commonality and differentiation within their embedded business context could be identified. Thus, from a theoretical perspective, the solutions for balancing commonality and differentiation within platform strategy literature will be completed by a good-practice approach derived from practice. The identified good-practice approach also contributes significantly to practice. Inexperienced firms with not much experience in platform strategy can use this good practice as a guideline to balance commonality and differentiation optimally depending on their business context. Furthermore, experienced organizations and their management and consultants can also reflect their approaches and arrive at better solutions in terms of appropriate balance of commonality and differentiation within platform strategy. Summarized, the research contributes to platform strategy theory and platform strategy practice.

1.7 Limitations of the Study

The main limitation of qualitative research is that it allows no statistical generalization rather than theoretical/analytical generalization. Thus making general statements about larger populations is not possible (Veal, 2005, p. 33). Therefore, there is a need for longitudinal studies to capture/to prove good practices of balancing commonality and differentiation within platform strategy.

A further significant limitation of this research is the unreliability of human nature. The limitations of in-depth interviews are that there is no feedback because of one-to-one interview, necessary skills and flexibility to follow interviewee’s story as well as the transcription being highly time-consuming (Hennink et al., 2011, p. 31). The interviews are based on open questions, however bias always exists (e. g. interviewee tells what interviewer wants to hear). On top of this, the selected documents and archival records are not the complete data base, so this research instrument, too, is an underlying bias (Yin, 2008, p. 102). Each of the research steps involves people, and as people also reconstruct the process of balancing commonality and differentiation, it is not possible for the information to be unaffected. This human factor eliminates the possibility of pure objectivity, as humans are subjective beings by nature.
The aim of the research was not a ready solution for firms, rather it was to generate a first framework of a good practice approach to optimally balance commonality and differentiation within platform strategy by taking business context and strategy into account. Thus, if firms propose to apply the approach to their business, there is always tailoring necessary, depending on the specific objectives and context of companies.

2 Literature Review

2.1 General Issues of Platform Strategy

2.1.1 Definitions

There are various kinds of definitions concerning platform issues, which can be divided into the following main categories (see figure below):

![Figure 1: Main perspectives of platform strategy definitions](image)

While some authors describe product platforms, others treat platform strategy and platform thinking. Considering different commonality strategies and their degree of commonality and risk for brand differentiation, platform strategy is aligned to the middle of both (see figure below) (Grube, 2006). According to this definition, platform strategy has a standardization degree of 30-60% across brands with a relatively high risk of loss of brand profile. The assumption for this kind of definition is that different brands are based on the same platform which is a set of physical components.
This perspective of product platform is also supported by other researchers. Independent of various definitions, product platforms are seen as a common base for all manner of variants across product and brand portfolio. The difference between definitions concerns the kind of common base. McGrath in this context mentions that there are two different perspectives for the definition of product platforms and thus for the kind of common base: 1) physical elements shared by several products (Qu et al., 2011, p. 2198) and 2) a set of subsystems and interfaces developed to form a common structure (Meyer & Lehnerd, 1997, p. xii) from which a stream of products can be efficiently developed and produced (McGrath & Michael, 2000).

Figure 2: Degree of commonality (see above in percentage %) and loss of brand differentiation (Grube, 2006)

A similar definition for the first perspective is that platforms are a relatively large set of product components, which are physically connected as a stable sub-assembly and are common to different final models (as cited in Muffatto, 1999, p. 449). A further similar definition from the automobile industry is: the physical implementation of a technical design that serves as the base architecture for a series of derivative products, e. g. common technical designs between Skoda, Audi A3, and Golf VI (Lundbäck & Karlsson, 2005, p. 161; Meyer & Lopez, 1995). The main common idea behind these definitions is the mentioning of common physical elements with the main consequence of product
cost reduction by way of economies of scale (Hölttä-Otto, Suh, & de Weck, 2005). The other main definition for product platform is that the common base also includes design variables, design rules and interfaces. Simpson defines product platforms as standardization across products within the product family and ex ante planning of variants as a means to generate individual products based on the product platform by addition/substitution/subtraction of one or more modules or by stretching one or more of the design variables (Simpson, 2004). Baldwin and Clark define the product platform concerning its underlying logic of: 1) its modular architecture, 2) the interfaces (the scheme by which the modules interact and communicate); and 3) the standards (the design rules that the modules conform to) (Baldwin & Clark, 1997, 2000). So, this definition is based on the assumption that the main aim of product platform is to reduce time not only through common parts, but also through common interfaces and scaling of design variables for development of variants across products and brands. Schmieder and Thomas also mention the extended view of product platforms as a sharing process of collected assets across products and brands (Schmieder & Thomas, 2005, p. 95). Of course, time reduction in product development also means a reduction of development cost. Hence, different definitions for product platforms are connected with the assumed main aim of the product platform. Further definitions of product platform are listed by Wortmann & Alblas who differentiate between the external view and internal view. From an external perspective, product platforms are the range of offered and anticipated products in terms of functionality and performance, including choice features, customized options and external interfaces. From an internal view, product platforms are the variety of end products offered and the interfaces between generic components (Meyer & Lehnerd, 1997; Meyer, Tertzakian, & Utterback, 1997; Muffatto & Roveda, 2000; Wortmann & Alblas, 2009).

The product platform is the result of platform strategy which is the plan behind product platforms. Platform strategy is a plan which describes the structure of the platform as well as which components have to be included. The plan also includes the knowledge about relative market segments (the potential for differentiation, expanding and thus for value), the knowledge about the current product platform and competitors’ platform, knowledge about one’s own potentials concerning new technologies, new processes and supply chains. Hence, the platform strategy plan includes the
consideration of market and competency (Völker, Voit, & Müller, 2001). In a strategic context, platform strategy is a means to achieve cost leadership and differentiation at the same time (Grant & Nippa, 2006, p. 369). Further definitions consider platform strategy even as the foundation for product strategy because it defines the cost structure, capabilities and differentiation of developed product variants (McGrath & Michael, 2000). The prerequisite for platform strategy is company culture, which is anchored in platform thinking. Platform thinking is “the process of identifying and exploiting commonalities among a firm’s offerings, target markets, and the processes for creating and delivering offerings, appears to be a successful strategy to create variety with an efficient use of resources (cost, time)” (Meyer & Lehnerd, 1997; Meyer, Tertzakian, & Utterback, 1997; Robertson & Ulrich, 1998; Sawhney, 1998; Ulrich & Eppinger, 2012). The distinction between mass customization and platform-based product family thinking is that while mass customization’s target is the individual customer, platform-based product family thinking tries to meet the expectations of customer segments. Thus, platform-based product family thinking involves bundling individual customer requirements to segmentation (Ohvanainen & Hietikko, 2012).

Moreover, there are further important definitions which are in an in-depth relationship with platform strategy (Bowman, 2010, pp. 20–21):

- strategy: “the array of options and priorities with which one elects to compete and to survive” by Steele (as cited in Ratamäki, 2004, p. 44).

- product architecture: the sum of product structure and function structure as well as the relationship between these structures (Schuh et al., 2012, p. 117). The definition of product architecture according to Henderson and Clark is the way components are integrated and linked together to form a coherent whole (i.e. system). Product architecture influences: 1) the system complexity and 2) the design and flexibility of a product family (as cited in Hofer & Halman, 2005, p. 240). A further definition for architecture is: the combination of major physical elements and interfaces that provide the essential functionality of the product platform, e.g. all-wheel drive (Lundbäck & Karlsson, 2005, p. 161; Meyer & Lehnerd, 1997; Robertson & Ulrich, 1998; Ulrich & Eppinger, 2012). Moreover, there are more general definitions such as: a concept that defines the product
structure at generic level, respectively a general layout of the product (Heikkilä et al., 2002, p. 14).

- modularity: is the essential concept in constructing product architectures (Ulrich, 1995; Ulrich & Eppinger, 2012), and is determined by the constituent elements and interfaces (Mikkola & Gassmann, 2003).

- product family design: is a way to achieve cost-effective mass customization by allowing highly differentiated products to be developed from a common platform while targeting products to distinct market segments (as cited in Ki Moon & McAdams, 2012, p. 1)

- market: “A large group of customers who have a common set of problems/needs, and who purchase a common group or class of products to solve those problems” (Bowman, 2010, pp. 20–21)

- market segmentation: homogenous groups of customers’ preference (as cited in Moon & Simpson, 2010, p. 6)

- portfolio: “Groups of projects funded from a common investment pool and managed by a common management team” (Bowman, 2010, pp. 20–21)

- product: “Products are specific instances of a platform that may have minor or major deviations from the basic platform” (Bowman, 2010, pp. 20–21)

- product concept: the description of what the product does for the customer, e. g. SUV Systems as structures of systems and subsystems which are capable of performing a task for a specific purpose, e. g. wheel suspension. In addition for components as the part design of a product, e. g. shock absorbers, brake block (as cited in Lundbäck & Karlsson, 2005, pp. 159–161).

- product line: “A grouping of products that share similar features, functionality, or lineage to help reach a larger share of the market” (Bowman, 2010, pp. 20–21)
- elements: “Building blocks of a platform that can be varied within certain platform constraints” (Bowman, 2010, pp. 20–21)

Summarized, in this research, platform strategy is the long-term plan for re-use of sub-systems, interfaces, design variables, assets, processes across products, brands and firms which is driven by a platform thinking company culture and leads to reduction of product cost, development cost and time.

After these definitions for platform strategy and related terms have been shown, kinds of platforms are listed in the next chapter in order to understand platform strategy in context.

2.1.2 Strategic and Organizational Placement of Platform Strategy

Platform strategy is a business strategy and requires investigation from different perspectives. Product family design has been investigated from various perspectives such as business strategy, marketing, manufacturing and production, customer engineering, IT and general management (Jiao et al., 2007, p. 6). In this context, platform approaches can be divided into: component-based, function-based and the managerial/business approach (Kurtadikar et al., 2004). Platforms are not only engineering concepts, but also business concepts which enable the entry into new markets through leveraging in business and cost reduction in production and procurement. In a strategic context, platform strategy is a winning business strategy for both R&D function and the entire company (Meyer & Mugge, 2001, pp. 25–26). Some investigations emphasize the linkage between platform strategy and corporate strategy. Generally, at corporate level, platform strategy is not only an engineering issue, but also has strategical relevance and is connected to various corporate strategies. Sköld & Karlsson define product platform development as “a corporate strategy that affects business units and functional unity thoroughly” (Sköld & Karlsson, 2007, p. 554). Further investigators also confirm that platform strategy is not a stand-alone strategy, but has to be linked to the overall corporate strategy (Hofer & Halman, 2005, p. 252). Furthermore, some investigations concretize the linkage between platform strategy and corporate strategy as competitive strategy. Product positioning relative to the competitor should be connected to the decisions within platform strategy which is not
executed systematically by many firms. The suggestion is to derive the necessary product properties from product positioning and to link it to the components. The decisions regard which differentiation attributes are important from a product positioning perspective, and which kind of cost is important can be identified. The steering of a company with platform strategy is to decide on commonality and differentiation. In some cases, decisions make sense from group perspective, however, are disadvantageous from brand perspective, concretely overdesigning of low-end products (Klink & Gänzle, 2010). The connection between corporate/competitive strategy and complexity strategy consists of product structure and platform strategy. The linking of the platform strategy with market segments and competitive strategy at company level is important, since failures will lead to poor competitive position and high engineering costs (Hofer & Halman, 2005, p. 244).

Furthermore, there are linkages between platform strategy and product, brand, and market segmentation strategy. Cohesive market segmentation strategy is important for platform-based product development (Tucker & Simpson, 2010, p. 73) and “overall product strategy is derived from the platform....” (Tucker & Simpson, 2010, p. 77). In addition to that, some aspects which should be considered in the project order are described. The main conclusion in this context is that pre-occupation on technical decisions is not sufficient, process planning (consideration of product engineering demands in order to improve efficiency in creating variants) and marketing effectiveness (how well product concepts are developed and the execution of positioning and differentiation strategies) also play a decisive role in platform and derivative projects (Kim, Wong, & Eng, 2005, p. 1011). In addition to strategic issues, the platform strategy has a deep impact on operational corporate issues. Moving away from the engineering view to a strategic perspective including strategic decisions and business thinking is seen as one of the key success factors for implementation of platform strategy. In this context, commonality decisions should be made at system level rather than at component level. They mention that product strategy decisions should be made in the early phases to increase the stability in the engineering phase (as cited in Gawer, 2011). Hierarchical levels of product strategy are described as: vision, product platform strategy, product line strategy and individual product strategy (McGrath & Michael, 2000).
Product platform developments are simultaneous approaches to strategic, technical and organizational issues (Muffatto, 1999, p. 451). The organizational issues are a further fact in the context of platform strategy in companies. In some investigations, the necessity of separation of technology, product and platform development are mentioned, whereby the platform links the technology to the product (as cited in Völker et al., 2001). Further investigations concern organizational issues such as interdependencies between platform, portfolio and pipeline management and organizational benefits of introducing cross-functional teams (Meyer & Mugge, 2001, pp. 29–35). Another result was that “lower organizational levels are more focused on physical elements and not on strategic and visual dimension”. The essential result of platform dimensions was that if there is no clear top-down strategic approach, organizational issues are preprogrammed (Karlsson & Sköld, 2007, p. 137). In addition, there are organizational impacts, e. g. sales have to be considered platform conformity and cannot only be focused on revenue (Gassmann & Sutter, 2010, p. 87).

As a result, “platform strategy is not one general type of strategy - ...product platforms are applied in various contexts, distinguished by distinctive characteristics influencing strategy in general...” (Sköld & Karlsson, 2011, pp. 211–217).

2.1.3 Kinds of Platform Strategy

In the end, according to definitions, platform strategy means commonality. The kind of commonality and thus kind of platforms could be on different levels such as: product, process, customer, brand and global. While product platform is a set of common components across products and brands, process platform is a set-up of the production system. Customer platform is the first selected customer segment as its first point of entry into a new market. Brand platform is the core of a specific brand system. Global platform is the core standardized offering of a globally rolled out product (Sawhney, 1998). Considering the literature on platform strategy, investigations are primarily on product platform which is also the basis for process platforms within manufacturing (e. g. production platform of VW based on product platform). Therefore, the variety in nature of product platforms is subsequently described in more detail (see figure below, framed in red).
The first category on how product platform is clustered is based on a scope across product and brand portfolio. The following four generic platform strategies are dependent on number of platforms and brands: Single platform - single brand: which is appropriate for niche companies and includes the risk of smaller synergy potential. Single brand - multiple platforms: suitable for experienced companies. The main risk of this strategy is that future growth through expansion is restricted. The main target is the synergy among products within the same platform. Single platform - multiple brands: which consists of one common platform across brands, whereby synergy across brands should be realized. The main risk is the technological difference among products, which leads to complexity and limits synergy, and also leads to product and brand cannibalization through lack of differentiation. The fourth strategy is multiple brands - multiple platforms: which can be found within large companies and is appropriate for technologically related products (Sköld & Karlsson, 2011, p. 215). The main risk for this strategy is that platforms become too large.

They also define different strategic moves and necessary requirements (Sköld & Karlsson, 2011, pp. 211–213, 216). The second concept in the category of extension across product, and brand portfolio is described by Meyer and Lehnerd’s platform
leveraging strategies. Meyer and Lehnerd’s platform leveraging strategies across multiple market segments are the basic concept. They developed four generic strategies, namely 1) niche-specific platforms with little sharing of subsystems and manufacturing processes, 2) horizontal leverage of key platform subsystems and manufacturing processes, 3) vertical scaling of key platform subsystems, and 4) beachhead strategy with horizontal leverage and vertical scaling (Meyer & Lehnerd, 1997, pp. 52–63). Considering these two main concepts, the following conclusion can be drawn. The niche-specific platform strategy is the same as the single platform-single brand of Sköld & Karlsson. The horizontal leverage platform strategy is a platform across brands within one product segment. Therefore, the horizontal leveraging platform strategy can be aligned to single platform - multiple brands. The vertical platform leveraging strategy is a platform across product segments for single or multiple brands and thus can also be aligned to single platform - single brand and single platform - multiple brands. The beachhead leveraging platform strategy is a combination of both and can be aligned to multiple platform - multiple brands. Platform leveraging is the ability of platforms to be easily modified and adapted to alternative markets (Meyer & Lehnerd, 1997). Connected to the idea of flexibility degree for adaption of product platform to different market segments, there are different categorizations of product platforms based on product architecture characteristics, which are listed subsequently.

There are different expressions for flexibility degree. There are some general classifications of product platforms such as narrow, broad and flexible for the nature of platform strategies in Japanese companies. Narrow means conservative approach and basic traditional structure of vehicle and no major changes in organization. Broad means "aggressive" approach with significant changes. Flexible means flexible concerning technical features such as different length because of different wheelbase; flexible platforms can lead to tradeoffs, since variants can bring more technical analysis and consideration (Muffatto, 1999). Another expression is integral and modular while modular platforms are more flexible to react faster to market requirements (Gassmann & Sutter, 2010). Further expressions for different flexibility degree of product platforms are modular, embedded within a specific structure, abstract, one or multi-directional, complete and incomplete, and open/closed platforms (Schuh et al., 2012, p. 134).
Modularity of product platforms is also mentioned by most of the investigators. According to Gao et al., there are three types of product platforms: module based, scale-based and module-scale-based product platforms (Gao, Xiao, & Simpson, 2009, pp. 129–131). Complementing modularity and scalability by additional kinds of platforms such as commonality and postponement is shown in (Huang, Jiao, & Tseng, 2004). A further complementation of modularity and scalability by generational platforms is also shown (as cited in Wortmann & Alblas, 2009, p. 191). In other words, modularity and scalability is the common thread across different considerations. Therefore, modular and scale-based platforms are described in detail. One definition for module-based platform is described as a set of shared function elements, whereby shared function elements have to be identified. Methods to identify shared modules are family of function structures and customer requirements with function correlations in order to increase the number of common modules (as cited in Gao et al., 2009). A further definition for module-based product platforms is: a common structure of a group of shared parts, subsystems, accordant interfaces and similar manufacturing processes. Module-based platforms allow quick derivation of products from platform through decrease of product development cycle and consideration of variant demands in future (Gonzalez-Zugasti, Otto, & Baker, 2000; Meyer & Lehnerd, 1997). The criteria for modular platforms are: 1) forms a meaningful part of a product or process, 2) serves as a basis for long-term development work, and 3) is based on a modular structure (Heikkilä et al., 2002, p. 13). Volkswagen AG as one of the most successful companies applies platform strategy with co-existing module strategy to allow more flexibility (Heikkilä et al., 2002, p. 40). The scale-based product platform is composed of several parameters and features. Platform parameters were shared and remained constant from product to product within a given product family. Products are partly different in their individual parameters. The methodology for the combination of both, as module-scale-based product platforms, is as follows: 1) planning product modules considering customer needs, function structure and geometrical/physical correlations between parts, 2) choosing design parameters as platform parameters, 3) determining values of platform parameters. While most investigators consider modularity and scalability for physical elements, there are also other considerations focused on non-physical elements such as layout platform and construction plan platform (Völker et al., 2001, p. 137). These kinds of platforms have low effects on costs of direct material and labor costs, but are
appropriate for redesigning product architectures for existing products by supporting the re-use of developed elements within a structured layout, and reducing costs in whole chains of order processing by way of reducing complexity (Hofer & Halman, 2005, p. 255).

A further categorization of platforms depending on the target is as follows: technology-driven, market-driven, and profit-oriented (Riesenbeck, Herrmann, Heitman, & Algesheimer, 2006, p. 789). This categorization also describes the kind of commonality and thus the kind of cost reduction parameters which should lead to more profit in the end. Exemplarily, technology-driven product platform leads to commonality at technology level which will lead to cost reduction in technology development cost and in the end to an increase in profit by providing more technology on the market and thus more revenue. As a result, this categorization of product platform is a mix of kind of commonality and linked targets driven by product platforms.

Summarized, product platforms can be categorized differently based on their scope across product and brand portfolio and flexibility degree dependent on platform architecture. Which kind of these product platform options is appropriate depends on targets which should be followed by product platform strategy. Considering the target of various kinds of product platforms, there is a difference. The main difference between module based and scale-based product platforms is that module-based is appropriate for identifying shared modules and generates economies of scale. In addition, scale-based platforms are appropriate in order to improve product performance and economies of scope. Pasche & Magnusson mention two different platform strategies based on the following targets, namely to achieve economies of scale and thus stability through centralized decisions or economies of substitution through modular and flexible platforms in order to react quickly to market requirements (Pasche & Magnusson, 2011). To obtain more insight, targets and benefits followed by platform strategy are described in more detail in the subsequent chapter.
There are various popular examples, especially from the automobile industry, which show significant economic benefits realized through platform strategy. The case of VW is listed as an important example and evidence to make significant improvements for business by platform strategy (Schuh et al., 2012, pp. 156–158). Also in the commercial vehicle industry: Daimler Trucks shows through its worldwide platforms strategy that 600 million € can be saved per year. Daimler Trucks has achieved this result by multi-brand management in combination with platform strategy based modular product architecture (Fisch & Roß, 2008, pp. 12–13). Furthermore, there are some papers which also show different cases within the automobile industry with cost reduction effects of about 30% (Klink & Gänzle, 2010). Not only on the cost side, but also on the revenue side, there are some results showing that companies which apply platform strategies can achieve better results in terms of market share increase than other providers with differentiation strategies (as cited in Cornet, 2002, p. 79). Considering profitability, one study shows an improvement of 3-5% for EBIT driven by platform strategy (Schuh et al., 2012, p. 156).

There are many advantages to platform-based product families, however, most of them stem from increased commonality among the set of products (as cited in Simpson et al., 2012, pp. 141–142). Considering cost reduction of products, commonality across products and brands leads to higher quantities of platform components (e.g. VW: increasing of carry-over parts through A-platform: 600%) which leads to scale effects (Cornet, 2002, p. 87). The average product cost reduction realized by platform strategy is 11.5% (Cornet, 2002, p. 88). The reduction in product line complexity, the reduction in setup and retooling time, and the increase in standardization and repeatability improve processing time and productivity (Collier, 1981; Kim & Chhajed, 2000). The product cost reduction through platform strategy is driven by scale effects based on higher quantities and decreasing of manufacturing process time.

In addition to that, there are also significant benefits on the investment side (Cornet, 2002, p. 86). The average reduction in development costs amounts to 23.1% (Cornet, 2002, p. 88). The benefits on investment reduction can be driven by product platform
and process platform. Through commonality driven by product platform, fewer components need to be tested and qualified, which reduces cost (Fisher, Ramdas, & Ulrich, 1999). Inventory and handling costs are also reduced due to the presence of fewer components in inventory (Collier, 1981; Kim & Chhajed, 2000). Investigations show that a significant reduction of investment in production/manufacturing which is based on standardized processes (process platforms see above kinds of platform) can achieve approximately 85% decrease in investment (Cornet, 2002, p. 86).

Associated with the reduction of development cost is the reduction of development time and thus time to market (Fisher et al., 1999). Platforms promote better learning across products, and the use of common components and modules can decrease lead time and risk in the development stage, since technology has already been proven with other products (Collier, 1981). Module-based platform strategy reduces complexity because of standardized interfaces which allow substitute modules quickly (Alizon et al., 2007, p. 188). The time to market improvement is especially significant for market-related issues. As Robertson & Ulrich point out, “by sharing components and production processes across a platform of products, companies can develop differentiated products efficiently, increase the flexibility and responsiveness of their manufacturing processes, and take market share away from competitors that develop only one product at a time” (Robertson & Ulrich, 1998).

Furthermore, benefits of product platforms are innovative ability, flexibility especially in product design, responsiveness, and improved ability to upgrade products, test reduction and promotion of better learning across products and thus higher product performance by using standardized and pre-tested components (Gao et al., 2009, p. 129; as cited in Hofer & Halman, 2005, p. 238; Völker et al., 2001; Wortmann & Alblas, 2009). Because of pre-tested common components, risks concerning failures within the development process can be reduced. Development looping, especially in new product launches, and quality improvement can be avoided (Cornet, 2002).

In summary, there are some hard facts and soft facts according to the benefits of platform strategy. However, the target of the company is based on hard economic facts. The listed soft effects of platform strategy such as flexibility, time to market, quality improvement, lower development risk are also connected to economic targets because
the achievement of these in the end leads to economic benefits. While flexibility, time to market and quality improvement contribute to revenue increase, lower risk in development and thus avoiding of development looping is a contribution to investment reduction. Thus soft effects such as flexibility, time to market, quality improvement and lower development risk are not an end in themselves, but effects which lead to economic benefits in revenue and on cost side. Therefore, in the end, the main objective followed by platform strategy is achieving more profit, based on cost reduction and revenue increase. Platform strategy aims for cost reduction especially in development and manufacturing and time reduction by maximum commonality across products and brands which lead to economies of scale and economies of scope (as cited in Sköld & Karlsson, 2011, p. 206). Also minimum differentiation of elements which can be combined to a maximum of product configurations and thus more external variety and effectiveness in market positioning to increase the market share and thus the revenue to ultimately achieve maximum profit (Alizon et al., 2007, p. 187; Halman, Hofer, & Van Vuuren, 2003; Krishnan & Gupta, 2001; Meyer & Lehnerd, 1997; Mikkola, 2006; Muffatto & Roveda, 2000; Pine, 1993; Robertson & Ulrich, 1998; Sawhney, 1998; Sköld & Karlsson, 2011, p. 208). As a complementation of economic benefits, the competitor-related target of platform strategy can be summarized as: “to reduce the cost relative to the competitor without weakness of the brands and additional cost” (Klink & Gänzle, 2010).

As shown in this chapter, the commonality by platform strategy leads to various benefits. In contrast to this, some investigators also show risks and challenges driven by platform strategy which are described in the following chapter.

**2.1.5 Risks & Challenges of Platform Strategy**

Considering the engineering stream, platform-based product family design is a difficult task—“it involves all of the complexities of product design compounded by the challenges of coordinating the design of multiple products (Simpson et al., 2012, pp. 141–142).” “Successful development of a platform and deployment of a product family require input from multiple disciplines (e.g., marketing, engineering, manufacturing as discussed in Jiao et al., 2007)”. The challenges to develop and implement platform strategy are obvious, since success, amongst other things, depends on convinced CEOs
who want to implement it for their organizations. In this context, Klink & Gänzle emphasize that platform strategy requires individual interests to be subordinated to superior company targets (Klink & Gänzle, 2010). In general, platform strategy means multi-disciplinary work across products, brands, firms and divisions which leads to organizational challenges.

Furthermore, there is a need for high investment in platform strategy, so the balance between investment and value is seen as a huge challenge (Shamsuzzoha & Kekale, 2010, p. 189). Platform development costs much more (2-10 times) than individual product development because of the complexity, whereby the costly and risky design process leads to success only around 60% (Ulrich & Eppinger, 2012). Therefore, it can take considerable time to gain financial benefits from platform strategy (Pasche, Persson, & Löfsten, 2011, p. 1146). As a result, commonality across products and brands is needed to realize cost reduction. Because the initial platform requires more investments and development time, this can affect ROI negatively (Halman et al., 2003, p. 159; Hofer & Halman, 2005, p. 239). Because of high investment in platform strategy at the beginning, the amortization point of these investments through commonality is long-term. Therefore, platform strategy requires long-term planning and careful management (Muffatto, 1999, p. 458).

The long-term characteristic of platform strategy is connected with risks concerning the ability of forecasting future customer needs. Therefore, long-term success will only be achieved if the platform is continuously reworked with innovations (Hofer & Halman, 2005, p. 239). The continuous platform renewal allows for competitiveness (Meyer & Lehnerd, 1997). However, companies can fail to find the right time for platform renewal (Lundbäck & Karlsson, 2005; Sköld & Karlsson, 2011). The failing of platform renewal can lead to loss of market revenue, as seen in the example of Bombardier and Siemens (Schubert, 2007, p. 132). Wortman and Alblas mention that “platforms must be designed for several product generations and this life cycle must be managed“ and came to the conclusion that there is a distinction between the product platform life cycle concept (PPLC), the product development life cycle (PDLC) and the product life cycle (PLC) which are linked in the corporate context (Wortmann & Alblas, 2009, p. 197). One of the main issues in the life cycle phase of a platform is the changes and their management within organizations. Volkswagen, one of the experienced companies concerning product
platforms, has steering committees to direct the changes concerning platforms; the purpose is: to ensure the application of platform components and structured change process (as cited in Völker et al., 2001).

Because of the high risks of platform strategy, some companies search for alternative innovation strategies. As an example, outsourcing in simple consumer products is one of the reasons why companies are moving away from product platforms (Marion, Thevenot, & Simpson, 2007, p. 5285). In contrast to some investigations which connect platform strategy with high risk for product and platform development, the investigation by Klink & Gänzle mentions that risk is especially reduced by platform strategy if a high number of products and brands are based on the product platform and thus share the risk (Klink & Gänzle, 2010).

Considering the implementation of platform strategy, managing of complexity through globalization and corporate networks such as mergers & acquisitions is a huge challenge. From a strategic point of view, combining competitive strategies in order to manage corporate brand strategy from single to multi-brand is complex (Lundbäck & Karlsson, 2005; Sköld & Karlsson, 2011). Moreover, corporate strategy in terms of necessary organizational structures and the choice of technologies is a further fact for complexity (as cited in Sköld & Karlsson, 2007, p. 555). Summarized, challenges within platform strategy are as follows: technology management (commonality in architecture), brand management (differentiation in terms of brand portfolio management and whether brands have opposite generic competitive strategies), corporate management (new and multi-branded organizational structures are needed and the platform strategy affects the corporate and portfolio strategy) (Sköld & Karlsson, 2007, pp. 563–564 figure 4).

“Identifying ways to leverage a platform and reuse common “elements” within a product family is not trivial” (Simpson et al., 2012, pp. 141–142). This risk that every division thinks in their own interest is high (Jiao et al., 2007, pp. 7–9; Meyer & Lehnerd, 1997; Robertson & Ulrich, 1998), especially in multi-branded companies with high brand identity (Hofer & Halman, 2005, p. 239). In particular, within multi-branded companies, different competitive and brand strategies lead to huge challenges for the organization to balance the commonality and distinctiveness across products and brands (Karlsson & Sköld, 2007, pp. 557, 561).
Balancing of commonality and distinctiveness has different impacts on cost and revenue. There is a risk to increase the cost by commonality. Through sharing subsystems, the platform can lead to over-designed low-end variants in a product family (Halman et al., 2003, p. 152; Sköld & Karlsson, 2011, p. 208). In contrast to that, further investigations show that increasing of cost because of overdesign will be compensated by cost decrease because of improved manufacturing efficiency (Desai, Kekre, Radhakrishnan, & Srinivasan, 2001). Considering the revenue side within economic effects of platform strategy, commonality could lead to lack of differentiation of products and thus revenue decrease. In this context, investigation of a duopoly model with horizontal platform sharing lower product differentiation and saving of procurement costs is shown (as cited in Ghosh & Morita, 2008, p. 166). Based on theoretical models, there are consequences of horizontal and vertical platform strategy from the consumer’s point of view. The results show that platform sharing horizontally leads to a reduction of the firm’s profitability because of lower willingness to pay from the customer’s point of view, and will be intensifying the competition and therefore will also lead to lower profitability of firms. In addition, compared to lower product variety, this effect will not be as dominant as the positive effect of the higher intensity of competition. In the vertical platform sharing within a company, platform sharing will lead to a lack of product differentiation between high-quality and low-quality product which is also confirmed by other research results and known as cannibalization (Desai et al., 2001, p. 50). From the customer’s point of view, vertical platform sharing will be positive from the perspective of consumers of low-quality products (as cited in Ghosh & Morita, 2008, p. 166). Considering the car industry, risks concerning lack of differentiation and thus negative impacts on revenue through high commonality degree are underestimated (Cornet, 2002, p. 93). The unsystematic redundancy in functions and options through commonality is unhealthy and creates self-competition (Ramadan & ElMaraghy, 2014, p. 105). In addition to the failing of the balance between differentiation and commonality, this can lead to cannibalization. Summarized, the lack of differentiation through high commonality degree will lead to market risks. Therefore, companies are over-challenged in choosing the right platform as well as considering product performance issues (Hofer & Halman, 2005, p. 239).
Concluded from investigations, amongst other things, one of the most critical success factors is the right balance of commonality and differentiation within platform strategy. Considering the main target of profit maximization, commonality is needed to generate cost reduction through platform strategy and amortize necessary high investments for platform strategy, while differentiation is needed for product and brand performance and thus to ensure or increase revenue.

2.1.6 Impact of Business Context on Platform Strategy

In general, most researchers emphasize the necessity of analysis of product characteristics in the context of platform strategy (Sköld & Karlsson, 2007, p. 560). In the past, product characteristics or product family characteristics were not deeply elaborated on in the context of platform strategy (Alizon et al., 2008, p. 95), meanwhile, however, diverse papers deal with business characteristics in their case studies and show dependencies between business context and platform strategy. The most investigated industry is the car industry, especially Volkswagen’s platform strategy, which belongs to the core part of the group strategy and includes 51 models based on 4 product platforms (Heikkilä et al., 2002, p. 36; as cited in Völker et al., 2001). In addition to investigations within one industry, there are also some studies across industries such as transportation, communication equipment, semiconductor, electrical and electronic engineering, and medical and precision instruments (Kim et al., 2005, p. 1001). The comparison of industries shows that various attributes relevant to product and platform development differ significantly from each other (Ulrich & Eppinger, 2012, p. 5 figure 1-3). Despite the increased implementation and use of platform strategy, today’s companies have different degrees of experiences with platform strategy and apply platform strategy in practice differently. There are some companies with a high maturity level in dominant design industries that focus on platform projects and gain from platform strategy projects (Burgelman, 2008, p. 1097), others with difficulties based on business characteristics. A further difference exists concerning meaning of platform concepts and contents depending on industry and product-specific factors (Heikkilä et al., 2002). While some investigations consider product and platform level, other considerations reach from product concepts over architectures and systems to components.
Which business parameters impact platform strategy and how big the impact is, is shown in comparison studies. The use and comparison of platform strategy across companies in different technology industries is investigated by Halman et al. Three technology-driven companies from the semiconductor manufacturing industry, power tool industry, and digital printing industry are compared to each other according to criteria definition, motivation, and implementation of platform thinking in order to identify how and why companies are adopting, developing, implementing and monitoring platform and product family concepts in practice. The field study shows that companies involved in the study use a homogeneous concept of platform-based product families and that they have similar reasons to turn to platform thinking and to encounter comparable risks. However, they differ concerning kind of commonality within platform strategy. While one firm was technology-driven and focused on re-use of common interfaces within platform architecture, others were market-driven and focused on re-use of components (Hofer & Halman, 2005, p. 240). Thus the kind of commonality and therefore the kind of platform strategy differs amongst technology companies.

Further investigations stem from the car industry whereby different companies are compared to each other. The main difference identified is also according to the kind of platforms and commonality. One example is an in-depth comparison of 3 companies concerning balancing of commonality and differentiation. The investigation aims to show how each of them treats the issue of part commonality within their product line. While some are focused on process commonality, others aim for parts commonality. The criteria for differentiation also vary across companies, e. g. Chrysler arguments for differentiation only if there is an added value from the customer perspective (as cited in Kurtadikar et al., 2004). Furthermore, Muffatto investigates the implications of a platform strategy in the car industry from both technical and organizational points of view and discovers that companies implement platforms to different degrees based on their different evaluations of the possible advantages. Even if automobile architecture is relatively stable, companies use platform strategies in significantly different ways (Muffatto, 1999, pp. 449–451). A further investigation within the automobile industry is based on 4 different natures of product architectures: functional-modular, modular, integral and physical-modular with different impacts on platform strategy (Schmieder & Thomas, 2005, p. 35).
In addition to the car industry, there are also some in-depth investigations in further industries such as railway, washing machine, and house-building industries, showing significant potentials of platform strategy (Hofer & Halman, 2005; Schubert, 2007). As an example, the railway industry is characterized through heterogeneous product portfolio and thus heterogeneity of technical facilities, project-oriented business, long life cycles (up to 20-30 years), small lot sizes, low degree of re-use and high engineering efforts (too high engineering costs per locomotive). The washing machine industry is investigated concerning the identification of customer preferences by developing a joint model of adaptive conjoint measurement and platform concept using an example from the washing machine industry with high volumes, two brands and two different product positions (Riesenbeck et al., 2006). The investigations for the house building industry is about how product architecture, interfaces and standards (rules in product design) can be defined in the specific context of the house building industry based on product platform structure theories. Distinctive of this methodology toward common methodologies was the consideration of the spatial use of houses. The aim was to develop practical guidelines for developing product architecture in the house building industry (Veenstra, Halman, & Voordijk, 2006).

Complementary to industry-related investigations, there is also a range of research based on the single company. In this context, there is an investigation about a single company with low product complexity (powerpacks consisting of 9 parts) following commonality of interfaces and modular product platform architecture beginning with lowest product positioning and scaling it to high-price segments in order to fulfil different requirements within and across market segments (Ohvanainen & Hietikko, 2012). Furthermore, a general description of how Cetetherm practices platform strategy is shown by Holqvist, Persson, & Uller (as cited in Simpson et al., 2012, p. 513). In this research, they show the firm’s motivation and targets for platform strategy: improvement in time to market and decreasing cost to the acceptable disadvantage flexibility and distinctiveness by more commonality based on functional perspective (interaction of components to fulfil functions). The start of the platform project was to answer the question of which variety is needed to cover 80% of the total market demand, then they started with an investigation on how this variety could be created with as few different and varying components as possible. As a result, they also show
that it is sometimes necessary to exclude markets in order to achieve platform efficiency and effectiveness, so appropriate determination of limits is a success factor for product platform strategy in practice (as cited in Simpson et al., 2012, p. 513).

Companies not only differ concerning targets and process for platform strategy, but also cost issues are treated differently across companies. As an example, Black & Decker considers tooling costs, assembly costs and purchasing costs for the implementation of platform strategy (Marion et al., 2007, p. 5292). Development and production cost is considered as the sum of production costs and transaction costs. However, the paper is focused on the largest transaction cost, namely purchasing of production tooling and non-recurring engineering, which are the costs associated with the design, test and qualification performed during the development stage of a product and production costs of the components (as cited in Marion et al., 2007, pp. 5286–5287).

Summarized, the investigation across industries and companies shows that there is a different approach, and there are different underlying reasons and targets for platform strategy. The main reason for this is the difference of business characteristics driven by different business parameters and its impact on platform strategy. Subsequently, important business parameters and their impact on platform strategy are described in detail.

The first of the business parameters defining business context impact platform strategy is the necessary differentiation across products and brands. The differentiation degree is described differently, such as market diversity, customer specification, etc. The required differentiation has consequences for functional heterogeneity and homogeneity, and thus also has an impact on commonality and distinction issues within platform strategy (Alizon et al., 2008). Also, as a consequence of its impact, in some cases researchers came to the conclusion that platform strategy is not suitable for industries with high market diversity and non-platform scale economies (Krishnan & Gupta, 2001; Robertson & Ulrich, 1998), because cost improvement by part commonality for low-volume product is difficult (Farrell & Simpson, 2010, p. 3303). Furthermore, a high differentiation degree in high customer-specific industries requires a high level of flexibility with the aim of reducing time to market by platform strategy (Gassmann & Sutter, 2010, p. 87). While some industries such as railway, commercial
vehicle and the farm machinery industry are more focused on function, in other industries such as consumer good/car industry, soft facts are relevant for product differentiation. There is some clustering of products according to their differentiation degree and drivers in terms of: products without variance, products with variance driven by the manufacturer, products with variance driven by the customer, and individual products (Schuh et al., 2012, p. 130). The differentiation degree is aligned to different price and cost levels of products, therefore architectural structures have to consider different product performances. While high-priced products depend more on performance-oriented interfaces of platforms, low-cost products need interfaces with maximum commonality in order to reach their product strategies and price positioning on the market (Lundbäck & Karlsson, 2005, p. 170). The differentiation degree is also correlated with technology requirements. Therefore, technology is also a decisive business characteristic for platform strategy. In dominant design industries, the technologies are matured (e.g. car industry with platform consisting of powertrain, suspension, steering and electrical systems vs. print and PC industry with platforms based on technologies or machine tool industry platform strategy, which is based on a scalable construction plan which enables different customer modifications (as cited in Völker et al., 2001). The main purpose of the platform is to reduce the costs (e.g. car industry: 60% of the whole value of the products) (Mahmoud-Jouini & Lenfle, 2010, p. 10), while in high technology industries, the main target is to cover market segments and create product variants through technological advantage (as cited in Völker et al., 2001). If the technological level between products is too different, there is low potential for synergies at component or system level, in this case the aim of the synergy was focused on the supplier (Sköld & Karlsson, 2011, p. 214).

The dynamic of differentiation degree during life cycle is a further important business characteristic for platform strategy, especially for necessary platform renewal. In this, different life cycles of platforms in various industries such as machinery, aerospace, automotive, airplanes, ships and military systems are mentioned in some investigations (Wortmann & Alblas, 2009, p. 188). While lifecycles of platforms in consumer products are stable (initiation-prototype-frozen), there are several state transitions with many iterations in the industrial machinery industry. Considering the appropriateness of platforms strategy, some results show that especially for long-life products, platform
renewal is needed and should be planned in the pre-phase. Products with a long life cycle are appropriate for platform concepts, and platform strategy should take the whole life cycle into account (Marion et al., 2007, pp. 5306–5307). The speed of obsolescence of the platform depends on market characteristics and in some cases, an update of the platform is coupled to legislation changes (Ohvanainen & Hietikko, 2012).

A further business parameter discussed in literature is product complexity. Typical examples for platforms with complex products are ship building, oil rig production, industrial machinery and aerospace. Complex products and systems are defined as 1) requiring additional engineering after release, 2) having long life cycles, 3) product development often being highly complex (Alblas, 2011, pp. 1–3). Further characteristics of complex products are the “complete decoupling of sub-systems rarely feasible, and the variety of sub-system combination can cause high levels of uncertainty and risk in system design production, and integration. Complex products are characterized by multiple levels of hierarchy, require high resource expenditures, time consumption and are connected with project risk (as cited in Hofer & Halman, 2005, p. 253).” The main difference between complex products and mass products is the high customization with dynamics of innovation (as cited in Hofer & Halman, 2005, pp. 253, 259). A further fact concerning complex products was that the relationship between customers’ needs and functional requirement is not a one to one relationship, since some needs may impact many functional requirements (acoustic requirements in an automobile may impact many components such as structure, isolation, engine, etc.) (Alizon et al., 2007, p. 191).

In industries with complex products, product designers have to continuously develop a variety of new designs that fulfil customer requirements (Alblas & Wortmann, 2012, p. 112; Wortmann & Alblas, 2009, pp. 192–195). Modular product and platform architectures are recommended to manage complexity, especially for small lot sizes to compensate for their disadvantages (Hofer & Halman, 2005, pp. 239–252). In contrast to the investigation of complex products, Marion et al. investigate consumer products which are characterized through simplicity (Marion et al., 2007, p. 5285).

Furthermore, volumes and thus scale effects by commonality within platform strategy is a further important business parameter. There are different product and platform types for different industries dependent on volumes: industrial machinery (one-of-a-kind), aerospace (engineer-to-order), automotive (assembled-to-order), software
(commercial off-the-shelf products which sell millions of times) (Wortmann & Alblas, 2009). The volumes based on the platforms in the car industry are high. For example, Volkswagen’s platform PQ35 was built 2,140,295 times, another example from the car industry is the platform B of Renault/Nissan with 2,423,225 units (as cited in Renner, 2007, p. 75). While the car industry is a mass production industry, others mentioned above are low-volume industries. Therefore, motivation for commonality and thus cost-reduction by scale effects is more in high-volume industries than in low-volume industries. However, considering the low-volume cases, there are other drivers for applying platform strategy. For example, the spacecraft industry is characterized by low volume, extreme operating environments, long development cycles, short technology cycles, long project life cycles, high costs, great product variety, and only a few customer-significant technical, organizational and strategic benefits driven by platform strategy are shown (Caffrey, Simpson, Henderson, & Crawley, 2002).

So, the motivation, requirements and implementation of the platform strategy seem to be different across industries and companies (Renner, 2007, pp. 88–89). This is driven by different business contexts consisting of various business parameters such as kind and degree of differentiation, product complexity, product life cycle, and volumes. Even if there is a huge range of investigations showing the relationship between platform strategy and business context, a standardized process to decide on commonality and differentiation within platform strategy by taking business context into account is systematically missing.

2.1.7 Conclusions

Platform strategy is the plan for re-use of sub-systems, interfaces, design variables, assets, processes across products, brands and firms which is driven by a platform-thinking company culture and leads to reduction of product cost, development cost and time.

Derived from the main benefits cost reduction and time reduction for development of product variants based on common interfaces for modules, the ultimate main objective followed by platform strategy is to achieve more profit, in other words: to reduce the cost relative to the competitor without weakness of the brands and additional cost. Platform strategy aims for minimum internal variety by maximizing external variety. In
other words, platform strategy aims for maximum commonality in order to reduce cost by way of economies of scale and economies of scope (as cited in Sköld & Karlsson, 2011, p. 206) and to reduce time whilst also allowing maximization of product configurations to increase external variety. Cost reduction and increase of revenue by external variety leads to maximum profit (Alizon et al., 2007, p. 187; Halman et al., 2003; Krishnan & Gupta, 2001; Meyer & Lehnerd, 1997; Mikkola, 2006; Muffatto & Roveda, 2000; Pine, 1993; Robertson & Ulrich, 1998; Sawhney, 1998; Sköld & Karlsson, 2011, p. 208). In contrast to the benefits, platform strategy means organizational challenges because of required balance commonality and differentiation across products, brands, firms during the product and platform development phase and during the life cycle.

The kind and degree of differentiation, life cycle, product complexity and volumes are important business characteristics which form the target for platform strategy and thus the platform strategy itself in terms of product platform architecture (modular, integral) and kind of commonality (interfaces, scaled parameters, physical elements).

Summarized, the main recognitions from general issues are: 1) the definitions and kinds of platforms vary, 2) there are many benefits which can be followed by platform strategy, 3) there are, however, also high risks and challenges for companies, and 4) business context has an impact on targets followed by platform strategy and thus on platform strategy itself. These facts are also confirmed in management science (Wortmann & Alblas, 2009, p. 190).

Thus, companies can achieve huge benefits from platform strategy. Some requirements listed by Gassmann & Sutter therefore are: 1) management focus, since platform strategy is more than product architecture and has a deep impact on the organization, therefore the management focus is needed (VW: CEO himself leads the platform committee) 2) sustainable roadmaps, 3) optimum balance of commonality and distinctiveness to enable a clear product profile, 4) changing of product and architecture, 5) qualified system architects, 6) effective platform life cycle management, 7) avoiding mega platforms, and 8) time schedule and capacity: platform strategies can only be implemented step by step and over a long period of time, therefore clear time architecture and required resources have to be provided (Gassmann & Sutter, 2010, pp. 89–95). Other success factors are strategic planning of the sequence of products to
transfer component technologies as well as the harmonization of product plan, differentiation plan and commonality plan (Cusumano & Nobeoka, 1998; Robertson & Ulrich, 1998).

The main issue for the success of platform strategy mentioned in platform strategy literature is the appropriate balance of commonality and differentiation. Therefore, commonality and differentiation within platform strategy is described in-depth in the next chapter.

### 2.2 Commonality and Differentiation within Platform Strategy

In general, there are different kinds of commonality within platform strategy: functional commonality, physical commonality and modularity of individual components (Wie, Stone, Thevenot, & Simpson, 2007). On the one hand, commonality is the reason for cost reduction. On the other hand, the opposite of commonality, differentiation, is important for performance and in addition to that, product variety is necessary to ensure revenue addition within a competitive market. Therefore, within platform strategy “companies desire as much commonality as possible within the family without sacrificing the distinctiveness of individual products in the family (as cited in Simpson et al., 2010, chapter 1)”. The goal of the product family is to make architecture as common as possible across the whole family without compromising those particular individual characteristics of a single variant, valued by the customer (Ohvanainen & Hietikko, 2012).

Even if the generic goal of platform strategy concerning commonality and differentiation is clear, significant challenges are described by many researchers. The main challenges for engineers are the balance between commonality and variety, commonality versus performance, and thus differentiation and brand identification (Alizon et al., 2008, p. 188). In addition to that, ensuring of product identity and thus long-term brand management are success factors for implementation of platform strategy. The challenge increases for multi-brand companies in terms of securing cost-effective solutions and generating distinctiveness in order to optimize product value in multi-branded companies. As an example: to avoid cannibalization, successful companies such as
Volkswagen AG sharpen the brand profiles of each brand (Heikkilä et al., 2002, pp. 16, 41).

Because of the mentioned challenges, there is a need for a proper balance between differentiation and commonality (Ulrich & Eppinger, 2012). Schuh et al. also mention how important it is to have a “commonality management” (in other words: platform strategy management) to find the right ratio of commonality and differentiation (Schuh et al., 2012, p. 155), since too high a degree of commonality can lead to a loss in performance and competitiveness (de Weck et al., 2003; Meyer, 1997). In general, most papers mention the necessity of the right ratio between commonality and differentiation without a concrete process for how to achieve it, while others try to show the process for attaining the right balance of commonality and differentiation. In this context, a huge range of tools and methods are developed to support platform-based product family design (Jiao et al., 2007; Simpson et al., 2012). Subsequently, the focus is on processes, tools and methods to support the balance of commonality and differentiation, which is one of the most critical success factors within implementation of platform strategy in organizations.

2.2.1 Processes for Identification of Product Platform in general

Some of the developed methods show how product platforms could be identified at all. There are two main processes to identify product platforms: bottom-up and top-down. While the bottom-up process is based on redesigning existing products with the aim of identifying commonality amongst them in order to identify the platform, the top-down process is based on development of the platform first from which products are derived in the second step (Simpson, Maier, & Mistree, 2001, p. 3). Methods belonging to the category of the bottom-up process are: a) product family reasoning system (PFRS) which supports identifying product platforms from a set of existing similar products, and b) modular product platforms to take advantage of the re-use of modules across products based on functional models (as cited in Kurtadikar et al., 2004, p. 2).

Furthermore, there is a method which allows platform identification in very early phases of the design cycle (before any physical architecture is developed) based on an analysis of customer needs/functional model (Kurtadikar et al., 2004). The main support of these
methods is identifying product platform in general, with modular product architecture, in the early phases, rather than balancing commonality and differentiation within platform strategy.

2.2.2 Methods for Modular Product Platforms

This stream of research supports the identification of common interfaces to create flexible modular platform strategy. The main aim of this stream of research is profit maximization while considering uncertainty using robust design techniques to maximize profit through balancing commonality and variants (as cited in Simpson et al., 2010, p. 154). Fulfilling the requirement of cost reduction and at the same time serving individual market requirements is made possible by modular product platforms based on modular product architecture (Schuh et al., 2012, p. 118; Wie et al., 2007, p. 86). Modular product platforms consist of modular architecture, interfaces and design rules (standards) (Baldwin & Clark, 1997). Interface management is the underlying process for development and finalizing of physical interfaces between the platform and end product unique sub-systems (Sundgren, 1999). Derived from these considerations, on the one hand there is a generic recommendation that platforms should consist of modular components (Völker & Voit, 2000, p. 137). On the other hand and in contrast to that, some studies hand that modular product architecture is not always possible and advantageous (Hölttä-Otto et al., 2005).

To identify modular product platforms with common interfaces, some methods are developed. Martin and Ishii (1997, 2000) developed 2 indices: Generational Variety Index (GVI) based on the QFD tool, and Coupling Index (CI) (Ishii & Martin, 1997; Martin & Ishii, 2000). The Coupling Index is based on the Component Design Structure Matrix for identifying modules within product architecture (as cited in Kurtadikar et al., 2004, pp. 2–3; Simpson et al., 2012, pp. 142–143). GVI is the redesign effort dependent on necessary future designs of products and allows an indication of which components will be changed over time. CI measures the coupling amongst components which indicates the probability of a change in a component because of the change of the coupled component. The target is to identify elements which will have a huge impact on the redesign of the system and therefore to standardize the interfaces in order to minimize
redesign efforts of the product platform (Huang & Kusiak, 1998; Helmer, Yassine, & Meier, 2010; Kusiak & Larson, 1995) to measure the product’s architecture.

Taking the uncertainty into account, the methods and design process are developed to allow flexible product platforms. The approach is based on: 1) identifying a critical subset of vehicle elements, 2) integrating flexibility into these platform elements, and 3) evaluating the flexible design in various uncertain scenarios. The case study showing the method is based on body-in-white of three vehicle variants, including midsize to large passenger sedans in different market segments based on different requirements such as styling, production volume and system-level design variables such as wheelbase. The final result of the process for flexible product platforms is based on seven steps: 1) identify market segments, product variants, uncertainties, 2) critical attributes and design variables, 3) optimize product platform bandwidth, 4) identify critical elements, 5) create flexible design alternatives, 6) determine cost of platform alternatives, and 7) uncertainty analysis (Suh, Weck, & Chang, 2007, p. 76).

The main research aim of this stream of research is to minimize redesign efforts by developing a method identifying the probability for change and coupling indicator. The higher an element affected by customer requirements, the higher the probability to change, and the higher the coupling index, the higher its influence on other systems, which will also change and thus increase redesign efforts, therefore common interfaces are needed. The research supports identifying potential interfaces needing standardization in order to minimize redesign efforts. However, this stream of research is focused mainly on interfaces and not on physical commonality. Even if redesign efforts should be avoided, considering the main target of profit maximization by platform strategy, physical commonality until redesign is maybe more profitable because of scale effects. Therefore, in a holistic context it is necessary to also consider physical commonality of components.

2.2.3 Optimization Methods balancing Commonality and Differentiation in Parameter Detail Design

Optimization methods try to provide support to find optimum (efficient) solutions for commonality and differentiation according to pre-defined optimization targets under
pre-defined circumstances and with a focus on a specific discipline such as (as cited in Simpson et al., 2012 (p. 144): a) engineering-centric methods (Bhandare & Allada, 2009; Dai & Scott, 2007), b) manufacturing considerations (Fujita, 2002; Rai & Allada, 2003), and c) market-oriented analysis (Li & Azarm, 2002; Michalek, Ceryan, Papalambros, & Koren, 2006).

There is a huge range of research in the area of optimization methods within the engineering design community which is reviewed and analyzed in-depth by Simpson (as cited in Simpson et al., 2010, pp. 151–156). The optimization is used to identify the Pareto frontier for the tradeoff between commonality and differentiation. Assumptions underlying these optimization methods are: 1) maximizing each product’s performance maximizes its demands, 2) maximizing commonality among products minimizes costs, and 3) resolving the tradeoff between 1) and 2) yields the most profitable product family. Optimization methods are clustered according to kind of optimization method and algorithm, kind of product platforms (module or scale-based or both), considered parameter (single or multiple objectives; model of market demand (yes/no), consideration of uncertainty (yes/no), pre-selection of the platform and number of stages, which is explained subsequently. There are some benchmark studies concerning optimization methods (as cited in Simpson et al., 2010, pp. 134-150). For example, Kumar et al. (2004) use ant colony optimization (Kumar, Allada, & Ramakrishnan, 2004), Hernandez et al. (2002) defined the problem as an access in a geometric space (Hernandez, Allen, & Mistree, 2002), Dai & Scott (2004) used preference aggregation and sensitivity and cluster analysis to identify the problem (Dai & Scott, 2004). Which algorithm to apply depends on the complexity of the formulated problem. As mentioned by Simpson et al., the product platform design problem is of combinatorial nature. So, more flexibly applied algorithms are needed in order to achieve a more realistic problem formulation based on different parameters which improve the applicability in real-world conditions. Within optimization methods, there are different algorithms used such as 1) linear and non-linear programming 2) pattern search, simulated annealing and genetic algorithms, and 3) newer algorithms such as ant colony optimization, however, the predominant algorithm is based on genetic algorithms (GAs) because of the flexibility in problem formulation to handle multi-objectives and the ability to run in parallel computing environments, which is more appropriate for complex real-world problems.
Multi-objective optimization approaches allow combining of other tools and methods such as market segmentation grid (Kumar, Chen, & Simpson, 2009) and integrate engineering design, customer value and production cost to establish profitable portfolios of products and platforms (Simpson et al., 2012, p. 144). This is the reason why genetic algorithms (GAs) are used more than others.

Furthermore, the formulations of optimization problems, and as a consequence the solutions for optimization problems vary. While some research is executed to benchmark one’s own developed optimization methods on the same case, other research papers try to integrate more model parameters such as market demand and manufacturing costs to consider more real-world conditions as far as possible. The reason underlying approaches considering more real-world conditions is based on the fact of different solutions derived from optimization method and practitioners. In other words, the conclusion was that excluding market demand and manufacturing costs to enable application of optimization method will lead to sub-optimal solutions. In this case, the research shows different criteria for the practitioner’s decision (manufacturing costs) which was not considered in the problem formulation of the optimization method. Further variations exist in terms of single or multiple objectives. While there are some optimization approaches that consider a single objective, others consider multiple objectives reasoned by the researcher derived from the studied case. Moreover, the process for optimization in terms of single-stage or two-stage varies across the mentioned optimization methods. There are some considerations in which the platform extent is known or selected before, and others in which the platform extent is determined by the optimization.

As already reviewed by Simpson et al., the main aim of these optimization methods is to support parameter detail design: “only a few, if any, of these optimization methods are in industry” (Simpson et al., 2012, p. 152). The reasons for the low application of these methods in practice are various. Firstly, the underlying assumption to optimization methods seems not applicable in practice. The product performance is certainly one important factor, but it is not the exclusive reason for demand increase. The probability of increasing demand by product performance is reasonably likely, but it also depends on other factors such as the competitors in the market. The assumption 2 whereby commonality leads to maximum cost reduction is also very simplified, since variation or
individual development can also lead to minimization of costs: if components are designed exactly for a special application, the minimizing of costs is more achievable if the component should also be designed for higher product requirements (see risk of platform strategy by over-designed low-end variants). Therefore, the minimizing of costs by commonality depends on how the commonality is executed across products. Secondly, the main research aim in this stream of research is to find out which of the optimization methods and algorithms perform better in order to improve operational capability in terms of allowing a problem definition which is as similar as possible to real-world problems. Therefore, the perspective considered here is an instrumental one. However, considering real-world challenges identified in platform strategy literature, a further main issue of balancing commonality and differentiation is a strategic one (and not only an instrumental one). Therefore, complementing the instrumental view, a further relevant question from a practical point of view is for example to understand how firms find out their acceptable performance loss to balance commonality and differentiation within platform strategy. Furthermore, considering multi-objective optimizations allows to consider conflicting objectives and supporting decisions is also an instrumental perspective focusing on the performance of methods based on the pre-defined problem specification of the researcher. Therefore, problems such as multi-objective ones and the developed multi-objective based optimization are pre-defined by the researcher and applied to practice in order to prove its operational capability. To complement this view, there is a need to understand how a multi-objective problem is reached, when a multi-objective problem is reached and how to formulate the right problem. Furthermore, the main recommended optimization methods allow a comparison of different scenarios and compare each other according to defined criteria such as cost reduction and differentiation. So, through application of optimization method, users know which scenarios are better than others. However, the consideration and definition of “better” is made according to defined criteria. For example, looking at the Pareto curve, the scenarios on the curve are more effective than the scenarios which are not on the curve, since for the same differentiation degree, more commonality and a cost reduction effect are possible (see fig. 4 below: scenario 3 is better than scenario 1, or scenario 4 is better than scenario 5), or for a certain commonality and cost reduction more of a differentiation degree is possible (scenario 1 is better than scenario
5, and scenario 2 is better than scenario 1). However, which of the effective scenarios (2, 3, 4) is most appropriate and should be recommended remains unanswered.

Figure 4: Pareto curve to optimize scenarios of commonality and differentiation

Summarized, the review of this huge range of research shows the high variety and low applicability of developed optimization methods. Therefore, there is a need for an in-depth understanding of how, in a good practice approach, commonality and differentiation are balanced to support companies holistically. In order to do that, there is a need for an in-depth understanding of how and why good practice companies formulate their commonality and differentiation problem, in other words how they solve the tradeoff between commonality and differentiation when it comes to such conflicting situations. At the second stage, there is also a need for an in-depth understanding of how they solve this identified problem under real-world conditions and assumptions and why it is handled so. This will generate an insight of methods and perspectives from a practical point of view which will contribute to and complement theory.

2.2.4 Negotiation Behavior Framework balancing Commonality and Differentiation

To complement methods at product level, a further method is developed at behavioral level in order to balance commonality and distinctiveness (Arnoscht, 2011, chapter 6.6). These introduced methods at organizational level describe how teams in R&D should
negotiate and find the tradeoff, since there are different perspectives on the platform strategy issue. The question is how the negotiation behavior of the stakeholder should be within the decision process of platform strategy in order to find a global optimum. The solution is based on the Engineering Collaborative Negotiation paradigm (ECN). The ECN generic method is applied to the tradeoff between commonality and differentiation within platform strategy beginning with 1) understanding the different perspectives, 2) understanding the different interpretations of the problem and identifications of the tradeoff between targets, 3) finding a fair solution which considers all stakeholders at the same level development of a superior target in terms of maximum net benefit through commonality, and 4) deciding on the base of a commitment of the stakeholder. The developed method is applied to a single case and shows positive effects.

Even if this process is important and will support the decision-making process, its aim is to find a fair solution from different perspectives without describing in detail what exactly is meant by fair. In other words: it is not stated whether this solution is the best possible for the company. Therefore, this framework should be complemented by an in-depth understanding of good practice companies and how they find their optimum within commonality and differentiation decisions within platform strategy.

2.2.5 Evaluation of Product Platforms

In addition to the already mentioned methods, evaluation methods are developed to support platform development regarding how to evaluate the effectiveness of a platform and thus support the decision-making process in terms of which platform alternative is the best or whether the evaluated platform should be reworked. There are various ranges of methods based on different views and targets. Some of the methods are based on indices and some of them are based on cost. While some measure commonality, others are focused on differentiation. Furthermore, there are cost estimation methods to evaluate product platforms. These kinds of methods should support the post-assignment of product platforms in terms of the defined criteria rather than finding the optimum platform strategy in terms of appropriate balance of commonality and differentiation during development.
2.2.5.1 Evaluation regarding whether Platform Strategy is needed at all

There are methods which prove that platform strategy is more profitable than product family development without platform strategy. In other words: to evaluate “if” platform strategy makes sense at all, and if so, under which circumstances it makes sense. A generic approach is shown by Schuh (2015). The process consists of 4 phases: 1) capturing internal and external requirements, 2) definition of platform strategy (here called “Baukasten”) standards, 3) definition of platform strategy configuration, and 4) definition of implementation of processes for platform strategy. The evaluation method which is executed parallel to the phases should answer the question of whether platform strategy is more profitable for the firm in comparison to not implementing platform strategy. The evaluation method is an iterative process based on the net present value method to obtain data roughly at the beginning and in more detail in the later phases. In the last section, so-called “best-practice companies” are compared to each other to show how they execute each phase (Schuh, 2015). In a similar way, Krishnan & Gupta (2001) investigate the generic consequences of platform-based product family development by development and application of a mathematical model to compare the cases with and without platform strategy, for example. The aim was to better understand appropriateness and the impact of platform strategy. This paper concludes that platform strategy is only appropriate under certain market diversity conditions. If market diversity is too low or too high, standardized products or niche products will be better than platform strategy. An interesting result of the research is that managers are focused on decreasing fixed costs of development even if these costs are small compared to other kinds of cost in order to achieve profit. What is also interesting is that platform strategy could result in overdesigned low-end products or under-designed high-end products which are compensated for by beneficial effects of platform strategy. In the end, they came to the conclusion that platform strategy is more profitable than individual product development if economies of scale increase and overdesign costs decrease. Based on the combination of conjoint analyses each containing a core of common attributes, they developed a method to help design product platforms and to show that product platforms are more profitable than isolated line extensions (Moore, Louviere, & Verma, 1999). Further investigations indicate whether platform strategy will maximize profit by reducing the costs significantly.
(Riesenbeck et al., 2006). The difference concerning profitability is shown in a comparison of two cases: without platform and with platform strategy on the basis of real option theory (Völker et al., 2001, figure 8).

This stream of investigations shows that platform strategy is not an “if” question rather than a “how” question. In opposition to this view, there is also an investigation which mentions that platform strategy should be substituted by outsourcing strategies to allow cost reduction with low risk. Because of the high risks of platform strategy, some companies search for alternative innovation strategies such as outsourcing strategy in simple consumer products, which is one of the reasons why companies are moving away from product platforms (Marion et al., 2007, p. 5285).

2.2.5.2 Evaluation of Platform Strategy by means of Commonality and Differentiation Degree

There is a broad range of methods to evaluate platform strategy using the criteria of commonality and differentiation degree. The range of evaluation methods reaches from economic evaluation, part and parameter commonality to differentiation with an impact on market share.

The solution to balance commonality and differentiation is described as being able to fix an appropriate level of differentiation and evaluate the scenarios based on cost parameters such as: product cost consisting of material cost and manufacturing cost and development cost (Schuh, 2015, p. 173). The most popular economic evaluation of product platforms is based on platform efficiency and platform effectiveness (Meyer & Lehnerd, 1997, pp. 153, 163; Meyer et al., 1997). Platform efficiency is the degree to which a platform allows economical generation of derivative products (R&D cost of derivative products/R&D of platform), and platform effectiveness is the degree to which products based on the platform produce revenue relative to development cost (net sales of derivative products/development costs of derivative products). A further evaluation based on economic criteria is the General Variety Index (GVI) which measures the amount of redesign effort required for future designs of a product based on the Coupling Index (CI) (measure of the coupling among products) (Martin & Ishii, 2002), and other metrics that include direct and indirect costs of production (Maupin & Stauffer, 2000).
An evaluation based on differentiation values is based on potential impacts of product platform on brand differentiation and market share. In this context, Hüttenrauch & Baum show an interesting evaluation approach of platform modules concerning their contribution to brand profile. The aim is to identify modules which contribute to brand differentiation (Hüttenrauch & Baum, 2007, p. 104). Moreover, the evaluation of platform strategy on market share is shown by the Platform Diversification Index (PDI). It evaluates the diversification based on features, functions and related attributes to assist decision-makers and designers to understand and improve bandwidth diversification of current and future product platforms in order to maximize market share by reviewing and analyzing the market share of each platform. The focus is to determine the ultimate number of platforms and products of existing and prospective products (Ramadan & ElMaraghy, 2014).

Furthermore, various commonality indices are developed to evaluate the product family from different perspectives such as design, fabrication, assembly (Thevenot & Simpson, 2006). Some of the evaluations are based on counting parts (Kota, Sethuraman, & Miller, 1998) and others assess the parametric variety (Khajavirad & Michalek, 2007). A simple index allowing ranking of the components concerning their attractiveness for commonality is developed by Desai et al. (2001). Further various commonality indices are: DCI (Degree of Commonality Index) by Collier (1981), TCCI (Total Constant Commonality Index, a modified version of DCI) (Wacker & Treleven, 1986), Component Part Commonality Index CI(C), which is also an extended version of DCI developed by Jiao & Tseng (2000), and PLCI (Product Line Commonality Index), which, if this just refers to the last index, then should be singular – measures the level of part commonality in a product family and penalizes the differences that should ideally be common given the product mix (Kota et al., 1998). Further indices are Percent Commonality Index (%C), which is based on three main viewpoints: 1) component, 2) component-component connections (measures common connections), and 3) assembly measures common assembly sequence (Siddique, Rosen, & Wang, 1998). Complementary to part commonality, Product Family Penalty Function (PFPF) measures the dissimilarity of different parameter settings for each design variable with the aim of reducing the PFPF during product family optimization and thus reducing the parametric variation in the
family which is equivalent to maximizing the commonality in the product family (Messac, Martinez, & Simpson, 2002).

2.2.5.3 Comprehensive Evaluation of Platform Concepts according to Interdisciplinary Criteria

In order to steer platform projects, targets and priorities have to be clarified, whereby the corporate strategy, revenue mechanism and market changes are the starting point of the project (Gassmann & Sutter, 2010, p. 87). Therefore, more comprehensive evaluation of product platforms based on interdisciplinary criteria also exists.

One of the managements’ issues is the assessment of platform concepts during project execution. An assessment tool for preliminary screening of platform concepts with 19 criteria in the architecture phase was developed by Otto & Hölttä-Otto (Otto & Hölttä-Otto, 2007). Using the example of a cordless drill, these 19 criteria were divided into six groups: customer satisfaction, variety, after sales, organization, flexibility, and complexity. This assessment tool should enable consideration of more criteria than the typical two dimensions of commonality and differentiation. Defining the criteria was based on expert interviews and literature research in order to derive weights concerning contribution to long-term corporate profit using Hauser’s corporate metrics method. The aim of the investigation was to identify what makes a good platform by evaluating two alternative platform concepts or replacing the existing one. This method allows not only maximizing but also evaluation of commonality whilst trying to achieve high product performance rather than other factors such as flexibility, reliability, etc. and therefore there is a transparency enabling identification of issues which may exist for managing risks by an awareness of the criteria in the concept analysis phase. Thus, the scope is more realistic to industrial practice (Otto & Hölttä-Otto, 2007, pp. 59–60).

A further assessment tool to evaluate platform concepts is based on a multi-objective form of real-options-based platform selection enabling a comparison of systems with technical and economic goals including uncertainty by representing the unknown factors during the subsequent development process with probability distributions. The method also includes the assessment of non-measurable aspects and is divided into the following steps: 1) technical design phase, 2) generation model of the development of each of the identified technically feasible designs, 3) assignment of uncertain inputs to
the development based on the current knowledge of these factors, 4) calculation of the values to compare the designs, and 5) qualitative comparison of the competing designs and selection of one or exploring new platform concepts (Gonzalez-Zugasti, Otto, & Whitcomb, 2007, pp. 89-94).

2.2.5.4 Cost Evaluation of Platform Strategy

Companies implement platform strategies to reduce cost by increasing their commonality across product and brand portfolio. Therefore, cost is the most important decision criteria, since platform strategy is not a self-purpose rather than a means of reducing cost by providing enough distinctiveness to the market. Therefore, some cost estimation methods are developed to support decision-makers in terms of providing them with transparency about cost impacts of platform-based product family design. The methods differ concerning kind of costs and different kind of methods which are developed and applied across cases.

Commonality-based cost estimation methodology (CCDM) (Marion et al., 2007, p. 5289, figure 2) helps to evaluate the pros and cons of sharing components (Marion et al., 2007, p. 5307). Another method is the comprehensive metric for commonality (CMC), which is a useful assessment and decision tool for the evaluation of the cost of developing a series of new products (Marion et al., 2007, p. 5289). The method enables determination of the impact of each component in the family on the overall level of commonality (Marion et al., 2007, p. 5290). This method is extended by activity-based costing (ABC) to capture manufacturing costs in the product line. The method supports the creation of the most cost-effective platform portfolio from a set of component platforms and allows leveraging which is not based on the traditional market segmentation grid or on traditional vertical, horizontal, or beachhead strategies. The ABC is conceptualized for low-volume products which consider fixed costs and variable costs (Farrell & Simpson, 2010, pp. 3299–3311). Further methods are developed to capture production costs such as production cost framework with manufacturing activities and an optimization framework depending on critical design variables. The framework is founded on activity-based costing (ABC), which helps to model the relationship between activities required to produce products and the resources they consume in a structured way. The production costs are directly linked to design variables, through which direct costs can
be influenced. The framework is based on two stages: allocation and estimation. The allocation stage consists of production activities from the raw material to the finished products to delivering them to customers. Both cost drivers and product family information (includes information on components/variables to be common or variant in a family in addition to the product information) are combined into a product information structure where production data and production costs are allocated. The estimation stages consist of the estimation of production costs by assigning costs to activities using cost drivers that consume the main resources (Park & Simpson, 2005).

Moreover, there is a method to investigate the relationship between product architecture and cost assessment (Fixson, 2005) and cost of variety within the context of mass customization and traditional costing approaches (Galsworth, 1994; Pine, 1993). In addition to this, total cost of product variety is developed (Fujita, 2002) as well as a quantitative tool to estimate production time, material cost and inventory cost represented as a function of design variables (Hernandez et al., 1998). A further cost model to approximate development cost and financial effects to implement a product family approach is shown in Siddique & Repphun (2001, p. 285). The underlying concept is based on postponement of differentiation as much as possible. Estimating costs for a new product family based on the platform approach is associated with uncertainty, which is modeled as fuzzy numbers. To determine the costs caused by uncertainty, the Monte Carlo simulation provides a solution (Siddique & Repphun, 2001, p. 286).

There are also some integrated models to assess cost and time savings by platform approach. With regard to this, a 5-step approach is developed by Siddique: 1) identify platform strategy, 2) develop activity hierarchy associated with platform approach development, 3) identify associated cost distribution and time distribution for each activity, 4) perform cost and time model simulation, 5) determine financial gains and reduction of development time, 6) move decision towards platform approach) and applied to a case scenario (as cited in Simpson et al., 2012, pp. 359–376). Another cost estimation method is development of a roadmap for product architecture costing to capture the relationship between product architecture/modularity and costs to support the decision process for new products, so conducting of an analysis of the cost consequences of product architecture differences (Fixson, 2005).
2.2.6 Holistic, Integrated and Interdisciplinary Considerations, Methods and Frameworks

Complementary to the methods mentioned above, there are also integrated methods and approaches combining methods, considering a broader decision scope and holistic process with all phases, and with an interdisciplinary view on the platform strategy issue.

A broader decision scope in terms of a more holistic consideration of issues is defined by 21 decision criteria within product platform development which represent a greater scope (Harland & Yörür, 2014). An integrated model across engineering and marketing considering conceptual engineering, development cost, marketing decisions and their interdependencies is developed by (Zacharias & Yassine, 2007). The optimization model for maximizing market coverage is developed theoretically in order to apply it to the well-known ice scraper case. The theoretical assumptions underlying the model are that only cost of development is restricted by a given budget and that there is a link between the distinctiveness and market coverage. The assumptions are relaxed to allow solutions by simulation and iterative application for more realistic scenarios. However, despite the relaxing of the assumptions for more practicability, the application is still limited (Zacharias & Yassine, 2007, p. 146). The underlying assumptions are very simple: more development effort leads to more market coverage (Zacharias & Yassine, 2007, pp. 131–132).

A semi-prescriptive and descriptive research paper is based on the investigation of systematic methods to achieve profitable product families (minimum cost and maximization of variety, thus revenue and market share) based on platforms and applied to various kinds of products such as commodity-like and custom-manufactured products. Nidmarthi and Karandikar show how outside knowledge of platform research was being brought into the company and which challenges were being raised by implementing these methods (descriptive). The method is based on 1) determining functional variety, 2) determining profitable product variety by using cluster algorithms to compute changes in profit margins with changes in product family and modeling revenues and cost as a function of variety-profit/variety-business rationale. 3) Based on the first two methods, design changes are determined to maximize the product family’s scope of meeting customer functionality at minimum cost. Challenges are identified by handling complex data which can be improved by information systems such as Sales

An integrated framework which combines different methods is developed by (Simpson et al. (2012). The method allows identifying what to make common, what to make unique and what parameter settings are best for each component and/or subsystem in the product family. The framework is based on: 1) the market segmentation grid which results in product plan and platform leveraging strategy and initiates the differentiation plan and commonality plan, 2) GVI and DSM which identify differentiating elements, GVI is used to identify common elements, 3) verification of the results with commonality indices and multi-objective optimization, and 4) multi-dimensional data visualization tools (Stump, Lego, Yukish, Simpson, & Donndelinger, 2009) which can be used to display results. Even if the method allows a more holistic approach, the main focus is on common interfaces to minimize redesign efforts driven by potential future changes. This framework is especially useful in a business context with high redesign efforts which cannot be amortized through scale effects driven by commonality. So, a business with high scale effects driven by commonality which allows an appropriate amortization period from the perspective of the company is a business context in which the framework is not really useful, since from an economic point of view, future redesign efforts are justified by amortization and by commonality.

Furthermore, a holistic process perspective for platform-based product family design is described by many investigators. However, there is no generic and universal platform-based product family design process as cited in Ohvanainen & Hietikko (2012). The process frameworks differ concerning their aim, number of process steps and how these steps should be executed. In this context, Jiao et al. show an integrated approach of the front-end phase, design phase and back-end phase (see fig. 5 below) (Jiao et al., 2007).

Furthermore, there are some different processes based on the 11-step approach (Zha & Sriram, 2006, pp. 531–532). In addition, the Product Platform Concept Exploration Method (PPCEM) is developed based on a five-step approach (Simpson et al., 2001, pp. 4–6). Moreover, methodology to redesign heterogeneous product portfolio into homogenous product families is also shown in literature (Salhieh, 2007, p. 1066). The process to show how strategic incorporation of product platforms into design process
can leverage the design effort of individually customized products (=R&D cost) consists of: market segmentation grid, selecting a targeted segment, creating a product platform and defining the product family (Farell & Simpson, 2003).

**Figure 5: Holistic view of product family design and development (Jiao et al., 2007)**

Considering in particular the front-end phase, various process frameworks concerning platform planning are developed. The model is based on building product platforms for products with the same functions structure including the voice of the customer and environment restrictions (Zhang, Zhao, Li, & Runhua, 2006). Bowman defines the front-end phase as a definition of overall product strategy. Identification of potential elements of the new platform and product, an alignment between key markets, customer requirements and underlying platform capabilities exists (Bowman, 2010, p. 19). Product and platform planning cannot be decoupled since platform should support products and the platform plan enables the deriving of value from leverage, especially in costs (re-use of product technology through similar parts, processes, materials, interfaces, and subsystems across product lines reducing costs) and on market (re-use of product technology across market and market segment boundaries: focus on commonalities in customer needs in order to reduce time to market through
modular/flexible systems). Further benefits of platform planning are customization while maximizing economies of operation, benefits in costs and market leverage to provide competitiveness and reduction of costs and complexity. The lack of platform planning will lead to failure of product success, since in this case there is no ability to evaluate the technical feasibility at an early stage and thus lack of product/platform leverage, which means inefficient platform leverage, and limited view of platform investment (Bowman, 2010, pp. 19–23). The five-step methodology consists of: 1) establishing a common language and terminology, 2) defining a product strategy and value proposition, 3) tapping the voice of the market, namely identification of customer requirements, 4) identifying the vector of differentiation, and 5) developing product/platform roadmaps. These process steps are illustrated by an example within the automotive supplier industry. The process steps found there were: 1) development of a core strategic vision (comprehensive assessment of market and internal competencies), 2) definition of product platforms based on market requirements and organized by vector of differentiating within product portfolio, and 3) development of platform and product migration plan to balance strategic priorities, short-term commitments and headcount constraints (Bowman, 2010, p. 20). Shamsuzzoha & Kekale describe the elements of the pre-phase of platform development as follows: determination of market segments, product roadmaps/product strategy and product architecture performance (Shamsuzzoha & Kekale, 2010, p. 182). Simpson et al. define front-end issues mainly from the customer perspective (Simpson et al., 2010, pp. 11–12). Meyer and Lehnerd (1997) developed the market segmentation grid to help marketing and engineering identify potential platform leveraging strategies for product family, in other words how commonality should be realized within a given price/performance segment (horizontal), sharing commonality within market segment by scaling down or up (vertical) or both of them (beachhead approach) (Meyer & Lehnerd, 1997). Gao et al. show a 4-step platform planning consisting of 1) identification of product modules, 2) choosing of platform strategy parameters, 3) determining the value of platform parameters through optimization models, and 4) application of the methodology, in this case to motorcycle hydraulic disc brakes (Gao et al., 2009). The platform planning method by Robertson & Ulrich is based on aligned product plan, differentiation plan, and commonality plan within an iterative process. This iterative
process consists of two main activities: 1) identify market segments and what customers want in each market segment, and 2) design a product architecture which allows realizing of different products while simultaneously uses sharing parts (platform) and production process. The product plan describes which variants will be delivered at what times and to which customers. The differentiation plan is based on differentiation attributes which help differentiate one model from another. Differentiation attributes are determined by importance from the customer’s point of view or in other words level of distinctiveness as seen by the customer. The main aim of the framework is achieving a considerable reduction in development cost (Robertson & Ulrich, 1998). The platform planning process in dominant design industries is an iterative process of the definition of product and market strategy and determines the potential for differentiation and potential for commonality (Völker et al., 2001). Furthermore, de Weck examined the optimal number of platforms for a given number of product variants according to the following process-steps: 1) product architecture, 2) engineering performance, 3) product value, 4) market demand, 5) manufacturing cost, and 6) investment finance in order to compare competing platform strategies (de Weck, 2010, pp. 242–248).

Summarized, there are different definitions and perspectives of the front-end phase and platform planning process in general. One main result of the front-end phase will be the platform roadmap which shows product family, platform and derivatives over time and includes more generations in order to determine the guideline for the future (as cited in Tucker & Simpson, 2010, pp. 77–78, figure 5-4). Common across different process descriptions in the front-end is the translation of customer requirements into functional requirements by market analysis and methods such as QFD matrix (Ohvanainen & Hietikko, 2012).

Integrating brand issues in product platform strategy is a further main issue investigated. The dependencies of platform strategy with brand strategy and cooperation strategy are shown by Sköld & Karlsson. The cooperation strategy is based on platform strategy and should be evaluated in the front-end, since “the technology and technology levels appear to be a very important perspective when determining possibilities of realizing synergies in multi-branded product platform strategy” (Sköld & Karlsson, 2011, p. 216). They also mention the differences between single-brand and multi-brand strategy. While single-brand strategy is created at functional level, multi-brand strategy is a result
of changes in corporate strategy. The focus in single-brand strategy is the focus on commonality vs. distinction and in multi-brand strategy on product differentiation across brands (Sköld & Karlsson, 2011, p. 207). There are different complexity levels regarding investigations at company level. They range from a single small company to an industrial group with global multi-products in a multi-brands industrial group. One example therefore is the case study by Karlsson & Sköld based on a merger of three independent manufacturers with three distinctly different brand positions, whereby common product architecture was developed as an initial project. The explorative approach combined theories from single-branded and multi-branded product platforms and considered the three companies in the dimensions of product, business strategy, market scope and product price (Karlsson & Sköld, 2007, p. 135). Further investigations concerning integration of platform and brand strategy are executed concerning modularization rules to build a brand platform and rules for differentiation among brands within a portfolio, while simultaneously utilizing a common product platform using a modularity matrix with brand aesthetic specifications (Sudijanto & Otto, 2001).

Summarized, even if some frameworks try to build the bridge between disciplines to show a more holistic view on platform strategy, there are still significant differences between them concerning the aim of the framework, considered parameters and the kind of framework (see table below). So, a generic approach to guide companies step by step in order to identify their specific aim of platform strategy, and based on this, to consider specific parameters, is still missing.

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<th>Variants / Parameter / Approach</th>
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<td>Evaluation Methods</td>
<td>process-oriented</td>
<td>proving if product platforms are more profitable than isolated line extensions</td>
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<td>mathematical model</td>
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<td>real-option theory</td>
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<td>Counting Methods</td>
<td>Part commonality and parameter commonality to differentiation</td>
<td>differentiation degree</td>
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<td>differentiation values</td>
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<td>commonality indices</td>
<td>evaluation of commonality within product family</td>
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<tr>
<td>Cost and Time Evaluation of Platform Strategy</td>
<td>comprehensive metric for commonality (CMC)</td>
<td>assessment and decision tool for the evaluation of the cost of developing a series of new products</td>
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<td>activity-based costing (ABC)</td>
<td>to capture manufacturing costs in the product line</td>
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<td>product architecture and cost assessment</td>
<td>identifying the impact of product architecture to cost</td>
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<td>total cost of product variety</td>
<td>identification cost of variety</td>
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<td>Production time, material cost and inventory cost, design variables</td>
<td>Identification of manufacturing cost, material cost and inventory cost, depending on design variables</td>
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<td>Development cost and financial effects</td>
<td>Financial impact of product family in comparison to isolated products</td>
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<td>5-step approach</td>
<td>Identification of cost and time savings by platform strategy</td>
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<td>Product architecture/modularity and costs</td>
<td>Analysis of the cost consequences of product-architecture differences</td>
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<td>Commonality-based cost estimation methodology (CCDM)</td>
<td>To evaluate the pros and cons of sharing components</td>
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<td>21-decision criteria</td>
<td>Consideration of greater scope within product-platform development</td>
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<td>Assessment tool for preliminary screening of platform concepts, with 19 criteria</td>
<td>Evaluating two alternative platform concepts, or replacing the existing one</td>
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<td>Integrated model across engineering and marketing considering conceptual engineering, development cost, marketing decisions and their interdependencies</td>
<td>Optimization model for maximizing market coverage</td>
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<tr>
<td>Integrated framework which combines different methods: market segmentation grid, GVI &amp; DSM, commonality indices and multi-objective optimization, multi-dimensional data visualization tools</td>
<td>Common interfaces to minimize redesign efforts, driven by potential future changes</td>
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<tr>
<td>Integrated approach of the front-end-phase, design-phase and back-end-phase</td>
<td>Connection of phases within product platform development</td>
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<td>Different processes based on the 11-step approach</td>
<td>Product platform development</td>
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<td>Product platform concept exploration method (PPCEM) is developed, based on a 5-step approach</td>
<td>Exploration of product platform</td>
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<td>Methodology to redesign heterogeneous product portfolios into homogenous product families</td>
<td>Strategic incorporation of product platforms into design process, to leverage the design effort of individually customized products</td>
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<td>Multi-objective form of real-options-based platform selection</td>
<td>Comparison of systems with technical and economic goals, including uncertainty</td>
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<td>Product platform strategy considering brand strategy</td>
<td>Integrating brand issues in product platform strategy</td>
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**Holistic, Integrated and Interdisciplinary Considerations, Methods and Frameworks**
Table 1: Comparison of methods and frameworks

| Integration of platform strategy, and brand strategy by using modularization rules | Building a brand platform, while simultaneously utilizing from commonality of product platform |

2.3 Summarizing Gaps in Current Literature

The literature review shows consistency in terms of the results of benefits and risks of platform strategy, but much variety in terms of definition, understanding of strategic alignment of platform strategy and considered relevant kind of platforms, which are driven primarily by different business contexts. As mentioned by Muffatto: “Nonetheless, companies implement platforms to different degrees based on their different evaluations of the possible advantages” (Muffatto, 1999, p. 451). Furthermore, research balancing commonality and differentiation within platform strategy can be divided into two main categories. While one stream of research derives challenges from multiple-case studies and mentions the necessity of the right ratio between commonality and differentiation without a concrete solution/approach with regards to how to manage it, others try to show how to find optimized scenarios within balancing commonality and differentiation. A huge range of tools, methods and process frameworks is developed aiming to show how to balance commonality and differentiation within platform-based product family design (Jiao et al., 2007). The developed methods for balancing commonality and differentiation can be further divided into problem specification and problem solving, whereby the problem solving stream can also be divided into methods/tools and process frameworks.

The problem specification includes the problem framework which describes: what is the balancing-problem, which parameters are considered and which assumptions are made. The literature is dominated by theoretical and prescriptive research which aims to develop methods and tools for practice and simultaneously makes a contribution to current theory. These methods and tools are based on a pre-defined problem specification to balance commonality and differentiation under certain assumptions. The problem specification consists of the detailed description of the tradeoff between commonality and differentiation. In this context it is listed which parameters are considered and which parameters will be optimized. For example, there are some
investigations trying to optimize development cost through commonality by an acceptable product performance, whereby product performance is quantified by the amount of differentiated parts. Other examples show how to maximize market coverage with limited resources. There are also some other investigations considering a huge amount of parameters weighted by the company to provide a holistic solution which includes all relevant parameters (e.g. a multi-objective problem whereby the objectives are also selected by the researcher). As a result, the specification of the problem concerning commonality and differentiation and considered parameters varies across investigations. Thus, problem specification in terms of considered parameters and optimization parameter within balancing activities of commonality and differentiation is different and is mostly derived from current existing theory. Therefore, the question that is derived from considerations about problem specification is why problem specification varies and how a generic approach should be to identify relevant business parameters for the tradeoff between commonality and differentiation.

The problem solving research describes how defined problems are solved, specifically how exemplarily a certain parameter is optimized and by which method (e.g. optimization, process framework and so on). Considering the problem solving stage, a different kind of methods/tools is developed (e.g. decision support problem, optimization algorithms and so on) in order to solve the problem. These different kinds of methods are developed for supporting different kinds of interest groups such as engineering, manufacturing, marketing and so on. Some research is also based on the combination of tools and methods to support a wider range of interest groups. Beginning with the problem which is pre-defined by the researcher and developing a theoretical solution which is applied to practice, the aim of the research is to learn how it works and how it should be improved, which is addressed as future research. This stream of research makes a contribution to the problem areas defined by the researcher and tries to improve the methods and tools in order to improve their operational capability in practice. Therefore, the tendency is that tools and methods become more and more complex or that researchers develop other methods and tools in order to improve operational capability in practice. Even if the solution is applied to practical problems it does not cover the problem and solutions holistically, which is the main reason why solutions derived from academia are still not appropriately accepted in
practice. This is also confirmed by various papers and conferences, such as the report about two industry-focused conferences with an emphasis on platform design, development and deployment, whereby twenty companies shared their successes and frustrations concerning platform design and deployment, platform-based product development and product family planning. One of the findings of these conferences is: “application of academic efforts on real-world problems exposed limitations and needs for further research” (Simpson et al., 2006, pp. 1-2). Emphasized by further statements such as: “low level of applications can be seen, for example how papers on platforms tend to revert to the same, already dated”, “many techniques and tools from academia are not being applied in industry because they often do not scale well to complex or "messy" situations”, and “companies experience more challenges during implementation process than they expected“ (Simpson et al., 2006, p. 7). In addition, Halman et al. mention that there is a lack of practical guidelines and decision rules to help them in their decision-making process (Halman et al., 2003). The reason for dominating theoretical solutions is the challenge to obtain an in-depth insight into the complete process according to the platform strategy approach, as also mentioned in Simpson et al. (2010 p. 459). Therefore, there is a need for solutions to balance commonality and differentiation which are accepted in practice. To achieve acceptance for solutions to balance commonality and differentiation in practice, the solution has to consider real-world conditions appropriately. Therefore, in opposition to current theoretical solutions, there is a need for solutions from practice in order to complement the theoretical perspective. Moreover, considering optimization methods in-depth allows for a comparison of commonality and differentiation scenarios to identify more efficient solutions in terms of either higher differentiation degree to the same commonality degree or higher commonality degree and cost reduction to the same degree of differentiation. However, how to find out which of these efficient scenarios is most appropriate for the company taking business context and strategy into account, is not considered. So, there is a need for an approach allowing for identification of the most appropriate commonality and differentiation degree taking business context and strategy into account.

In addition to optimization methods, one process framework is focused on the appropriate balance of commonality and differentiation. The process framework from
Ulrich & Robertson is based on the product plan, differentiation plan and quantification of commonality across products with the aim of reducing development costs (Robertson & Ulrich, 1998). According to this process framework, cost and differentiation dimensions should be analyzed for each sub-system and it is recommended that sub-systems with high cost reduction potential and low differentiation potential should be common, and with high differentiation potential and low cost reduction potential be different based on portfolio technique. Also, if there is a tradeoff in terms of high cost reduction potential and high differentiation potential, product architecture should be modified in later phases so that this tradeoff can be solved by engineering. So, the solution for not so obvious and challenging decisions underlying the tradeoff between commonality and differentiation is postponed to later phases. The solution should be developed in engineering, which opposes those platform strategy decisions, in particular in critical cases, which is the case for this kind of decision, it should be made strategically. Engineering is a very important part, but cannot solve a strategic problem to decide between commonality and differentiation in order to select the best possible platform strategy amongst considered scenarios. So, if there is a top-down platform strategy, engineering is able to find how this strategy can be engineered most effectively, but not vice versa. Therefore, the process framework from Ulrich & Robertson is important and useful, however, although it supports critical decisions regarding how to deal with cases with high cost reduction potential which at the same time have a high differentiation value, it is not in-depth. It is mentioned that an “appropriate level of differentiation should be achieved”, however, there is no further concretization of “appropriate level”. So, the process framework does not support the locating of concrete boundaries for commonality and differentiation and selecting the most appropriate scenario, taking business context and strategy into account. As a result, there is a need for concretization and detailing of the process frameworks in terms of commonality and differentiation boundaries within platform strategy.

Considering strategic alignment of platform strategy within the overall company strategy, there are different results across investigations. Even if it is mentioned many times that platform strategy should be a part of the company’s overall business strategy (Simpson et al., 2006, p. 8), there is a gap in terms of a generic alignment of platform strategy within the overall company strategy. So, there is a need for an in-depth
understanding of the relationship between commonality-distinctiveness decisions within platform strategy and other firm strategies.

Considering the main aim of the DBA to make a contribution to practice in any case and theory, the conclusion can be drawn that theoretically developed methods and tools should be complemented in terms of a practice guide which describes the whole process, beginning from how to specify the relevant problem concerning the tradeoff between commonality and differentiation within platform strategy by taking the business-specific situation into account and how to balance commonality and differentiation in real-world complexity. Exemplarily, theoretical methods describe their solution as maximizing commonality while simultaneously achieving acceptable performance loss by optimizing pre-defined objectives. There is a need to understand how good practice companies define their objectives, how the process to decide on commonality and differentiation is and how they define acceptable performance loss concretely.

As a result of the above-mentioned requirements, there is a need for a holistic process, accepted in practice by considering the business-specific context and real-world complexities in order to specify how the tradeoff between commonality and differentiation within platform strategy should be explained and how it should be balanced successfully. Furthermore, to complement theoretical and prescriptive research, there is a need for a change in research direction in terms of developing good practice solutions empirically from practice.

These necessities lead to the research problem addressed in this research as follows: “how to specify and balance the tradeoff between commonality and differentiation within platform strategy taking business context and strategy into account”. A summary of literature review results is shown in the figure 6 below:
To address the research question, the selected research methodology is described in the next chapter.

3 Research Methodology

The chapter of research methodology is structured as follows. Firstly, research methodologies in platform strategy literature are reviewed. Secondly, research philosophy and research methodology for the targeted research is justified. In addition to that, the argumentation for selection of literature, cases and experts is listed. Finally, data collection and analysis methods, as well as scientific criteria underlying the research are described.

Tackling the question: “How is it possible to specify and balance the tradeoff between commonality and differentiation within platform strategy, taking business context and strategy into account?” entails the necessity to find out how good practice companies balance commonality and differentiation within platform strategy, taking their business
context and strategy into account. In addition to this, it is necessary to determine why it is handled this way. In this context, the research should answer the following questions: how do good practice companies define their problem concerning the tradeoff between commonality and differentiation, how do they solve the problem and why do they solve it in this way? The underlying reason, therefore, is “that application of academic solutions to real-world problems exposes limitations and needs for further research”, as mentioned in industry-focused conferences (Simpson et al., 2006). The theoretical and practical research aim is to generate knowledge, in terms of developing a good practice solution, which complements existing theory, as well as supporting companies in appropriately balancing commonality and differentiation.

3.1 Research Methodologies in Platform Strategy Literature
The research paradigms, research methodologies and research designs applied within the research area of platform strategy should be critically reviewed, analyzed and synthesized. This step will allow gaining insights regarding which research approaches are accepted and will present appropriate methodologies for knowledge generation.

3.1.1 Design-Based Research with Developing Case Study based on Pragmatism Paradigm

The dominant literature for platform strategy is based on the engineering perspective. The engineering-focused research can be divided into the following categories: a) identifying commonality and product platforms in general (Kurtadikar et al., 2004; Siddique et al., 1998; Stone, 1997; Zamirowski & Otto, 1999) or identifying flexible platforms with standardized interfaces (Huang & Kusiak, 1998; Helmer et al., 2010; Ishii & Martin, 1997; Martin & Ishii, 2002; Suh et al., 2007), b) optimization methods to balance commonality and differentiation within platform strategy (as cited in Simpson et al., 2010, chapter 8), and c) methods to evaluate product platforms (Desai et al., 2001; Hüttenrauch & Baum, 2007; Khajavirad & Michalek, 2007; Kota et al., 1998; Krishnan & Gupta, 2001; Maupin & Stauffer, 2000; Messac et al., 2002; Meyer & Lehnerd, 1997; Meyer et al., 1997; Moore et al., 1999; Ramadan & ElMaraghy, 2014; Riesenbeck et al., 2006; Siddique et al., 1998; Thevenot & Simpson, 2006; Wacker & Treleven, 1986).

Common characteristics of this kind of research are that they follow the steps of design-based research. The design-based research starts with the analysis of relevant practical
problems with researcher and practitioners collaborating. Then solutions are developed based on existing solutions and technological innovation which is the creativity process. The iterative testing and refinement of the solution is the next step in order to establish design principles and enhancement of solution implementation. The differences in design-based research are shown below in figure 7.

Considering this stream of research, the kind of problems are different in terms of: a) identification problem, b) optimization problem, and c) evaluation problem. The solutions of identification problems should support companies regarding how to find commonality in general. The solutions of optimization problems should support companies with how they optimize pre-defined parameters/objectives by balancing commonality and differentiation within platform strategy. And solutions of evaluation problems should support companies within platform strategy to identify how good a platform is according to pre-defined criteria. Within these categories, there are also different problem definitions and consequently different solutions to the problems.

For example, while some investigations try to optimize redesign efforts, others optimize market coverage or product cost. Logically and in addition, solutions in terms of developed algorithms differ from each other. There are different algorithms such as 1) linear and non-linear programming, 2) pattern search, simulated annealing and genetic algorithms (Simpson et al., 2010, pp. 133–156), and 3) newer algorithms such as ant colony optimization (Kumar et al., 2004), whereby the predominant algorithm is based on genetic algorithms (GAs) because of the flexibility in problem formulation, to handle multi-objectives and the ability to run in parallel computing environments, which is more appropriate for complex real-world problems with some uncertainty. Further varieties exist concerning problem specification.
As an example, multi-objective optimization approaches allow other tools and methods to be combined, such as the market segmentation grid (Kumar et al., 2009) and integrate engineering design, customer value and production cost to establish profitable portfolios of products and platforms (as cited in Simpson et al., 2010, pp. 241–295). Further clustering is executed according to focused discipline areas. There are some engineering-centric methods (Bhandare & Allada, 2009; Dai & Scott, 2007), manufacturing considerations (Fujita, 2002; Rai & Allada, 2003), and market-oriented analysis (Li & Azarm, 2002; Michalek et al., 2006). Considering category b), there are also different kinds of evaluations. While some papers evaluate the profit increase by platform strategy (Krishnan & Gupta, 2001; Moore et al., 1999; Riesenbeck et al., 2006), others evaluate the commonality degree in order to increase commonality or, in other words, find the best possible platform strategy among the alternatives (Hüttenrauch & Baum, 2007; Khajavirad & Michalek, 2007; Kota et al., 1998; Siddique et al., 1998; Thevenot & Simpson, 2006) or allow ranking of the components concerning their attractiveness for commonality (Desai et al., 2001; Maupin & Stauffer, 2000; Messac et al., 2002; Meyer & Lehnerd, 1997; Meyer et al., 1997; Ramadan & ElMaraghy, 2014; Wacker & Treleven, 1986).
In summary, problem specification and problem solution is different depending on research area. Therefore, problem specification concerning their relevance is different and depends on business context. Because of generic characteristics of problem-solving with the aim to improve practice (Holmström, Ketokivi, & Hameri, 2009, p. 81), this stream of research can be assigned to design research. The aim of this kind of research is to find out what is effective rather than what is true (Hevner, March, Park, & Ram, 2004). Therefore, from an epistemological point of view, relevant knowledge is determined by functionality of the method regarding how good its ability to solve the problem is. In other words, the main aim of this stream of research is to develop methods theoretically within platform strategy based on literature and to apply it to real cases in order to test its operational feasibility in practice. Therefore, from an epistemological point of view, the research is assigned to pragmatism which recognizes knowledge as relevant only if it supports action.

From an ontological point of view, pragmatics “recognize that there are many different ways of interpreting the world and undertaking research, that no single point of view can ever give the entire picture and that there may be multiple realities” (Saunders, Lewis, & Thornhill, 2012). Therefore, considering the multiple problem specification and multiple solutions in literature, this stream of research can also be aligned to the ontological position of pragmatism. The aspect of multiple solution alternatives shows that there are multiple realities defined by humans/actors (researcher/practitioner) through creative development of the method. Considering derived knowledge in those cases, the solution consists of an innovative development process based on designs and algorithms. So, reality is subjective in terms of creating alternative solutions to the problem rather than one solution and thus one truth. The variety of the solutions for the same specified problems shows that creation of solution process is ontological based on multiple realities and epistemologically subjective, since the researcher is a part of the research object, in this case finding the solution for the specified problem. Therefore, generalization of solutions is restricted to the specified problem area and context.

Considering multiple realities, this stream of research can also be assigned to the constructivism paradigm. However, in contrast to the constructivism paradigm, the research is focused not only on „understanding and theory generation”, but also on “problem-solving and consequences of actions in practice”. Further interpretations
about ontological differences in design-based research within the pragmatism paradigm towards the constructivism paradigm are a concerning phenomenon. While in the constructivism paradigm the phenomenon can be studied out there with the aim of understanding this phenomenon, design sciences, in contrast, require the phenomenon to be created before it can be evaluated (Holmström et al., 2009, p. 68). Concluded from these considerations, the parent paradigm in this stream of research is pragmatism with constructivism elements. According to Niehaves (2007, p. 11), this stream of research can be described as design science research within the pragmatism paradigm (e.g. solutions to important and relevant business problems) (Hevner et al., 2004) with interpretivist/constructivism perspectives (Klein & Myers, 1999), interpretivist principles on design science research since pragmatism can combine both, positivist and interpretivist/constructivism positions within the scope of a single research study according to the nature of the research question (Wilson, 2013).

Considering methodological aspects, research is based on the case study method. The developed solutions are applied to real cases to improve its operational feasibility in practice. Therefore, this stream of research is based on developing case study. In contrast to extracting case study which aims to uncover technological rules/good practice approaches as already used in practice, the developing case study is based on the development and testing of technological rules/approaches by the researcher in close collaboration with the people in the field (van Aken, 2004, p. 342).

3.1.2 Explorative and Extracting Case Study Research with Qualitative Research Methodology based on Post-Positivism Paradigm

The second main research stream is based on explorative/extracting case study methodology within platform strategy. The main aim of this stream of research is to identify challenges and issues by comparing and analyzing cases in-depth from approaches concerning activities within platform strategy.

The how and why research questions are answered through explorative case study methodology, and in one case through a descriptive case study methodology (Alblas & Wortmann, 2012; Caffrey et al., 2002; Halman et al., 2003; Hofer & Halman, 2005; Lundbäck & Karlsson, 2005; Mahmoud-Jouini & Lenfle, 2010; Meyer & Mugge, 2001; Muffatto, 1999; Pasche & Magnusson, 2011; Sköld & Karlsson, 2007, 2011; Wortmann
The ratio of single and multiple case studies is almost equal. The application of single case studies is used if the selected company is a typical representative of the investigated field (Alblas & Wortmann, 2012, pp. 116–117). The selected cases are justified in most papers, e. g.: “technology-driven, substantial experience in new product development, applying the platform and product family concepts, operating in highly competitive markets, collectively representing a diversity of product and market needs, different application of product platforms” (Halman et al., 2003, p. 153).

The explorative character of this research stream aims at gaining insights by in-depth and rich data rather than creating statistically validated generalizations, e. g. in Sköld & Karlsson (2007, p. 558). As mentioned in representative papers, the research is based on inductive reasoning by case studies according to Eisenhardt (1989a). The epistemological analysis shows that this kind of research is based on objectivity, because the research setup of Eisenhardt follows generating theories which are novel, testable (generated hypotheses can be proven false), and empirically valid (Eisenhardt, 1989a, p. 532). Therefore, the epistemological foundation is based on the fact that objective knowledge is relevant and legitimated.

The investigations show that there is a phenomenon (cases) which is independent from the researcher and which can be captured objectively, e. g. the managerial challenges of multi-branded platform development. The ontological position is that there is an objective reality. However, the research setup consists of elements from hypothesis-testing research, but also the inductive case-oriented process. This is an indication that the research field is a complex phenomenon which should be better understood by theory-generating through insight rather than deducing it from existing theory. So, there are unknown dimensions which should be captured inductively. This is typical for the post-positivism paradigm. As anticipated, most heterogeneity exists in the specific research design. Some research questions were investigated through the longitudinal approach. This allows studying the case at two or more different points in time (Yin, 2008, p. 49). The data collection is realized in most cases through triangulation which includes interviews, data from meetings, observation, archival resources, databases, site visits and documents. Moreover, pre-studies, current literature studies and clinical study approaches used to collect data from daily interventions are further sources. In some
papers, data is reduced or structured before analyzing. There are diverse approaches in data analyzing. The main aim is to identify different positions, especially in multiple case studies; the other reason for the different approaches is the recognition of patterns to build, or in other words, to add to existing theory. Content analysis is also one of the applied methods for analyzing data in order to standardize the outcome, generalize the research results and draw conclusions.

3.1.3 Quantitative Methodologies based on the Positivism Paradigm

The third group of literature includes research papers with quantitative methodologies to solve research problems (Farell & Simpson, 2003; Kim et al., 2005; Tatikonda, 2003; Zacharias & Yassine, 2007). This kind of methodology is applied for two main reasons: a testing hypothesis in order to detect interdependencies and to answer quantitatively interesting questions such as “how much of total funds should be invested in platform development?”. It is obvious that most papers have dealt, as mentioned before, with engineering-focused questions such as “how strategic incorporation of platform into the design process can leverage design efforts of customized products”. The research paradigm is positivism, the research looks for knowledge in terms of a general law through verified hypotheses. In doing this, the data collection is cross-sectional, applied through self-administered questionnaires. The data analysis will be executed by way of multivariate data analysis methods such as regression analysis.

3.1.4 Conclusions

The two predominant research methodologies are design-based research on the pragmatism paradigm and explorative case studies based on the post-positivism paradigm. Because of the low number of quantitative methodologies, this kind of research can be neglected for the platform strategy research area. Thus, summarized, it is remarkable that the research area is first of all practice and solution-oriented rather than only generating theoretical insights. The low number of quantitative approaches based on the positivism paradigm shows that platform strategy in general is a complex phenomenon which cannot easily be described and tested by hypothesis, rather are solutions/methods developed to test it in case studies or case studies are used to capture issues underlying platform strategy. The research field of platform strategy,
especially in management-oriented literature, is characterized by way of some established theories which consist of qualitative and unobservable variables (and not only quantitative variables) and thus seems to be unsuitable for quantitative testing. While logical positivism refuses the existence of unobservable variables, the post-positivism (critical realism) paradigm believes that statements about the truth value of theories contain unobservable variables (Godfrey & Hill, 1995, p. 520). This is probably the main reason why this paradigm is applied in only a few cases within the reviewed literature.

Another main issue is that the applied methodologies show a significant real-world context relationship. Both design-based research on the pragmatism paradigm and explorative case study based on the post-positivism paradigm have a strong context relationship which is also clearly mentioned in the limitation section of each research paper. So, generalization in terms of established laws cannot be found within platform strategy.

The reason for clear and predominant clustering shows that platform strategy is a complex phenomenon which is also described in many papers. Sköld & Karlsson justify in their approach that a longitudinal and explorative field study allows obtaining insights into an as yet incompletely documented phenomenon, since platform strategy is described as a difficult strategy with many variables and intangible effects to the organization. It also allows uncovering of areas of research and theory development (Sköld & Karlsson, 2011, pp. 205–211). The methodology allows them to recognize insights of a company within its realistic environment, whereby such complex issues can be captured (Sköld & Karlsson, 2007, p. 558). Wortmann & Alblas also apply a single case study with explorative character to develop a theory, especially for the later stages, such as production and maintenance (Alblas & Wortmann, 2012, pp. 116–117).

Even if such a high practice orientation and solution-driven research is executed, the limited applications of the developed method show how complex the platform strategy research area is. There are some expressions from academic conferences which confirm this: “application of academic efforts on real-world problems exposed limitations and needs for further research” (Simpson et al., 2006, pp. 1–2). Emphasized by further statements such as: “many techniques and tools from academia are not being applied
in industry because they often do not scale well to complex or "messy" situations”, and “companies experience more challenges during the implementation process than they expected” (Simpson et al., 2006, p. 7). Therefore, the necessity for more practice-oriented solutions/models remains a gap in platform strategy research.

3.2 Research Philosophy and Justification

The use of research results from reviewed platform strategy literature in practice is limited (see literature review). So, methods developed within platform strategy academia to balance commonality and differentiation have a utilization problem. The question which derives from this situation is: “how narrow is the theory-practice gap?” (Holmström et al., 2009, p. 79). The suggestion complements description-driven research with prescription-driven research based on design sciences research with research products field-tested and grounded technological rules (van Aken, 2004, p. 219) or in other words: the complementing of problem-solving research and theory-oriented academic research as recommended by Holmström et al. (2009, p. 65). Therefore, the main aim of the research should be the development of scientific knowledge to solve the management problem (van Aken, 2004, p. 220): how to balance commonality and differentiation within platform strategy. An understanding is the first step to use this knowledge in designing solutions to problems (van Aken, 2004, p. 225). Therefore, the aim of the research is to uncover the mechanism of balancing commonality and differentiation and the context in which it occurs and which defines the outcome. The research question aims for an in-depth understanding of how and why good practice companies balance commonality and differentiation within platform strategy. Therefore, the research aims at obtaining an in-depth understanding of how a specific problem (balancing commonality and differentiation) is solved in good practice.

As shown in the previous chapter, case study research based on the post-positivism paradigm seeks problem understanding in terms of “challenges within platform strategy implementation in organizations” and solution description in terms of “how companies differ in their approaches within platform strategy”. The design-based research within the pragmatism paradigm is a solution-driven research on a predefined problem specification. Thus, relevant knowledge about the phenomenon of “balancing commonality and differentiation within platform strategy” consists of problem
specification and resolution. Considering current literature, even if the phenomenon of “balancing-process of commonality and differentiation” is the same, the problem specification, and therefore the solution to this specified problem is different amongst various research. There is no objective knowledge in terms of one specific problem specification and one solution which is established rather than multiple perspectives to the same phenomenon. Considering the problem specification as relevant knowledge, it seems to be that amongst researchers, there is a constructed knowledge which is relevant and valuable to capture the multiple perspectives of the phenomenon of “balancing-process of commonality and differentiation within platform strategy”. Therefore, there is a need to capture multiple perspectives which are grounded on constructivism epistemological foundation. According to Schön’s argumentation that relevant problems in a real-world context will be messy, problematic situations, the constructivism paradigm will allow a better understanding of the impact of design artifacts – the process for balancing commonality and differentiation – in a real-world context (Schön, 1983). This is also supported by Holmström et al. (2009, p. 82): “..subjectivism is abhorred and categorized as unscientific. In design science, however, the notion of subjectivism is one of the driving forces. But we need to understand the kind of subjectivism that is relevant and acceptable.” Thus, relevant knowledge is always constructed by subject which means that multiple, contradictory, but equally valid accounts of the world can exist (Weber, 2004).

Considering current literature where primarily either the problem specification (problem understanding) or the problem solving (e.g. in terms of an optimization framework) to predefined problems are treated, this research is based on a complementary view of problem understanding and problem solving rather than separating them from each other (Hevner et al., 2004). The complementing is achieved by acquiring knowledge in an organizational context. There is a necessity to understand real-world problems and solutions in practice (as cited in Niehaves, 2007, p. 5). The main argumentation for this complementary view is that the research aim is not just to find out “what is true” (problem-understanding research based on the post-positivism paradigm) or “what is effective” (design-based research within the pragmatism paradigm), but rather to find out “what is true about what is effective”, whereby there is no objective truth, rather it is constructed within research dependent on context. Thus, considering the epistemological issues of the research, it is dominantly based on
constructivism and pragmatism: which works in terms of a good practice approach for balancing commonality and differentiation within platform strategy.

In opposition to one point of view that positivism and interpretivism do not share ontological assumptions (Moran, 2000; Varey, Wood-Harper, & Wood, 2002), this research follows the point of view that there is a real world existing which can be captured (Weber, 2004), in other words, the research follows “being-ontology” rather than “becoming-ontology” (as cited in Gray, 2009, p. 20), so there is no difference to positivism. The main difference is that interpretivism based on the epistemological foundation of constructivism emphasizes that knowledge is always multiple, possibly contradictory and at the same time provides equally valid accounts of the world (as cited in Gray, 2009, p. 20; Weber, 2004). In addition, the pragmatism paradigm “recognizes that there are many different ways of interpreting the world and undertaking research, that no single point of view can ever give the entire picture and that there may be multiple realities” (Saunders et al., 2012).

The necessary and aimed-for complementary view of problem understanding and problem solving and the fact of a complex real-world issue leads to the conclusion that the research should be dominantly based on the interpretivism paradigm with partly pragmatism elements and deductive reasoning based on existing literature according to the concept of Hennink et al. The pragmatism paradigm used is seen as instrumental for interpretive study (Goldkuhl, 2012) and not vice versa, since the main aim is capturing good practices rather than developing methods and apply them to cases. As recommended in Goldkuhl (2012), it means that this research aims to broaden the focus besides the beliefs of experts to capture knowledge directly from participants/decision-makers and indirectly from experts who participated in such decision-making processes to balance commonality and differentiation within platform strategy. In this context, the interpretivism study allows exploring of peoples’ experiences and their views or perspectives on these experiences about the process and how and why companies establish the boundaries for commonality and differentiation by balancing them through qualitative research. Thus, the research deals with actions of participants within this process. The pragmatism paradigm emphasizes the solution orientation capturing what works and is named good practice. From an epistemological point of view, the combination of interpretivist design research with the pragmatism paradigm produces knowledge about successful applications of tasks and situations in order to create
effective artefacts, in this case: a good practice approach balancing commonality and differentiation within platform strategy (March & Smith, 1995). Summarized, the aim of the research, based on the “Verstehen” tradition rooted in qualitative phenomenology, is understanding the balancing process of commonality and differentiation within platform strategy from the participant’s own perspective (Taylor & Bogdan, 1984). The research philosophy followed in this research is shown in table 2 below.

<table>
<thead>
<tr>
<th>Postpositivism</th>
<th>Constructivism</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Determination</td>
<td>• Understanding</td>
</tr>
<tr>
<td>• Reductionism</td>
<td>• Multiple-participant meanings</td>
</tr>
<tr>
<td>• Empirical observation and measurement</td>
<td>• Social and historical construction</td>
</tr>
<tr>
<td>• Theory verification</td>
<td>• Theory generation</td>
</tr>
<tr>
<td>Advocate/Participatory</td>
<td>Pragmatism</td>
</tr>
<tr>
<td>• Political</td>
<td>• Consequences of actions</td>
</tr>
<tr>
<td>• Empowerment issue-oriented</td>
<td>• Problem-centered</td>
</tr>
<tr>
<td>• Collaborative</td>
<td>• Pluralistic</td>
</tr>
<tr>
<td>• Change-oriented</td>
<td>• Real-world practice-oriented</td>
</tr>
</tbody>
</table>

Table 2: Research paradigms (Creswell, 2009, p. 6)

After the research philosophy for this research is explained and justified, the selected research methodology and the argumentation for this will subsequently be described.

### 3.3 Research Methodology

The main aim of the research is to understand how good practice organizations balance commonality and differentiation within platform strategy, taking their business context and strategy into account, and in addition to this, why they handled it in the way they did. Thus, the research should provide an in-depth insight into processes of good practice companies in order to capture how they balance commonality and differentiation decisions, and should also provide an in-depth insight into decision-makers’/participants’ underlying principles for such kinds of commonality and differentiation decisions in order to understand why the organization handles them in this way. As mentioned before, to be able to thoroughly understand how they deal with the balancing process of commonality and differentiation, first of all there is a need to establish how they specify the problem of balancing commonality and differentiation followed by how they solve it. The “how questions” concerning problem specification
and problem solving can best be answered by participants involved within the balancing process of commonality and differentiation. The “why questions” will also be best explained by actors and participants in the balancing process of commonality and differentiation. Therefore, to answer the research questions, there is a need for methodology which enables the capturing of the balancing process from the actor’s/participant’s point of view. This requires detailed descriptions of how people engage within the process, the different experiences from participants and capturing the dynamics within the process and participants’ perceptions, made possible by qualitative research (Patton, 2002, p. 159). This was the main reason for the qualitative process study, which allows capturing of how a program operates by describing and understanding the details and dynamics of the program process and critical elements to the program’s success (Patton, 2002, p. 160). Qualitative research is appropriate to understand the process regarding how participants manage the balancing act of commonality and differentiation, in other words to understand their behavior in this context (Hennink et al., 2011, p. 10; Patton, 2002, p. 59ff). The necessity to understand the process of balancing commonality and differentiation within a certain business context from the participants’ point of view is also appropriately possible by way of qualitative research, since qualitative research seeks to embrace and understand contextual influences on the research issue (Denzin & Lincoln, 2008, chapter 1). To understand contextual influences requires a methodology close to the real world, so that results and findings are grounded in the empirical world and are systematic and creative at the same time according to scientific criteria. Therefore, grounded theory, which is focused on the process of generating theory (Patton, 2002, p. 125) and allows being creative and systematic at the same time (Patton, 2002, p. 127) is selected for this research.

The qualitative research is cyclical in nature (Flick, 2009; Maxwell, 2005; Spradley, 1980). Cyclical in nature means that rather than there being a step-by-step approach, one phase of the research influences the following phase and vice versa. It is an iterative process to progressively delve into data in order to improve the quality of the research. The suggestion of a cycle process and thus overlap of data collection and data analysis to improve the quality of the case study is also made by Vissak (2010, p. 383, figure 1). Therefore, this research is based on the framework of Hennink et al. (2011, pp. 4, 24–26). The cyclical process involves linkages between research design (design cycle), data
collection (ethnographic cycle), and data analysis (analytic cycle), which are also intrinsically cyclical (see fig. 8 below).

![Figure 8: Research methodology (Hennink et al., 2011, p. 4, figure 1.1)](image)

The design cycle consists of formulation of research questions, literature review, conceptualization and the selection of fieldwork approach. The design cycle influences the ethnographic cycle especially in terms of the design of research instrument and the selection of cases and study participants. The ethnographic cycle consists of designing of research instrument, selection of participants, data collection and making inferences which allow an interlink to the analytic cycle as a first step of the analysis. The analytic cycle consists of developing codes, describing and comparing codes, categorizing codes and conceptualizing data and developing inductive theory. In addition, the inductive theory is again linked to deductive reasoning in the design cycle.

Moreover, despite some qualitative approaches which emphasize ignoring pre-existing ideas about what social reality looks like (Denzin & Lincoln, 2005, p. 486; Garfinkel, 1967), in this research the researcher believes that this is not possible and useful and therefore follows the idea of involving deductive reasoning to integrate the pre-existing theory of platform strategy to make it transparent regarding which theories guide the research and selection of particular qualitative methods (Liampittong & Ezzy, 2005, p. 1; Maxwell, 2005, p. 46). However, inductive reasoning is the main reasoning approach.
influenced by deductive parts. To make it clear, the deduction is not applied with the aim of developing hypotheses from literature/theory in order to test them for truthfulness empirically as is typical for positivist research. This logic goes against qualitative research as is the aim in this research, since the aim of the research is to understand behavior of actors/participants concerning balancing commonality and differentiation, rather than to develop a hypothesis (Hennink et al., 2011, p. 42). Therefore, the only function of deduction is no more than to guide the data collection analysis from a pre-existing theoretical point of view. Therefore, pre-existing ideas cumulated to a deductive theory are shown explicitly which guide data collection (Hennink et al., 2011, pp. 32–33). The deductive part of the research is dominant in the research design cycle, by capturing theories from literature review and conceptualizing them in order to develop deductive codes and to know where to look in qualitative research in later cycles of data collection and data analysis which are based on inductive reasoning. Derived from the literature review, the following propositions and rival propositions are formulated to guide the data collection and data analysis described in the later chapters:

- **P1**: Balancing commonality and differentiation within platform strategy can be achieved by orientation of platform strategy decisions on the superior objective of competitiveness. Therefore, good practice companies make platform strategy decisions systematically based on competitive strategy. Rival **P1**: Conflicting objectives will be balanced intuitively and not systematically and are independent from competitive strategy, since competitiveness is not the main objective of platform strategy.

- **P2**: Because of the fact that competitive strategy is a relative position to the competitor’s and one’s own current and desired position in the dimensions of cost and differentiation and is dependent on customer expectations, good practice companies make their platform strategy decisions based on these factors. Rival **P2**: The main competitor has no role in balancing commonality and differentiation within platform strategy; the satisfaction of the customer is the main target of balancing commonality and differentiation decisions within platform strategy.
• P3: Due to the fact that cost and differentiation dimensions can also be influenced by other strategies within the company, good practice companies fit their platform strategy decision-making to further strategies of the company to establish which cost and differentiation level should be achieved by platform strategy. Rival P3: There is no strategic fit to other strategies to balance commonality and differentiation within platform strategy.

• P4: The kind of considered cost and differentiation dimensions are dependent on business context. Rival P4: The business characteristic has no impact on commonality and differentiation decisions, since there are always the same dimensions of cost and differentiation balancing commonality and differentiation within platform strategy.

After the research methodology and framework have been introduced and justified in this chapter, research design is subsequently described in detail in the next chapter.

3.4 Research Design & Research Methods

There is a huge amount of literature concerning platform strategy which considers different aspects of it. To reduce the literature appropriately to the investigated research issue, the literature study was divided into the following main segments: definitions and general understanding of platform strategy, problem specification concerning balancing commonality and differentiation, solutions concerning balancing commonality and differentiation, and influence of business context on balancing commonality and differentiation.

Furthermore, from a methodological point of view, the solution part was divided into sub-categories such as: a) identification of product platforms/commonality, b) optimization methods, c) evaluation methods, and d) integrated methods to obtain a more holistic view of the platform strategy issue. The identified gap captured good practice solutions for balancing commonality and differentiation within platform strategy. This research should close the gap between the lack of practicability of theoretically developed solutions, since the solution is already grounded in practice and already existing. This approach should allow capturing of perspectives of actors/participants/experts involved in good practice companies regarding balancing commonality and differentiation successfully.
As mentioned in literature many times, platform strategy is complex and dependent on business context. One significant indicator for complexity is: even if the platform strategy has been investigated and already applied in practice for many centuries, there are no established theories. Definitions are used differently, and in addition, problem specification and resolution is also different across this research field. The dependency on context is one of the important influencing factors regarding why such established theories have not already occurred until now. The reason for the low applicability of theoretically developed methods is that current research tries to over-simplify the complex issue of balancing commonality and differentiation into a manageable few factors which allows for the development of a method. However, the complex system as a whole is more than the sum of its parts. Therefore, there is a need for a holistic understanding of the complex issue of: how good practice companies balance commonality and differentiation taking their business context into account through capturing experiences from actors/participants/experts involved in the process. Thus the challenge in this research was: how to get an in-depth insight into the complex issue of balancing commonality and differentiation within platform strategy and at the same time how to get a holistic understanding depending on multiple perspectives and different business contexts. To generate a holistic theory, there is a need for in-depth insight into the complex issue of platform strategy depending on multiple perspectives (with different relationships to the investigated issue) and different business contexts. So, on the one hand, there is a need for a purposeful sampling based on heterogeneity concerning different contexts (Patton, 2002, p. 235), in which the phenomenon (balancing commonality and differentiation within platform strategy) should be investigated, to capture and describe in a centrally themed way whilst also cutting across a great deal of variation. On the other hand, there is also a need for case and criterion sample strategy (Patton, 2002, pp. 236, 238) to identify in-depth how a typical good practice company, acknowledged by experts and theory, balances commonality and differentiation within platform strategy.

The research is based on the “Verstehen” tradition rooted in qualitative phenomenology and aims for an understanding of the balancing process of commonality and differentiation within platform strategy from the participant’s own perspective (Taylor & Bogdan, 1984, pp. 1–2) whereby the balancing process in organizations is a whole complex system, because its parts influence each other.
To meet these challenges of gathering information in-depth and at the same time across different business contexts for a complex issue, the research is based on two research methods: single case study and expert interviews. The extracting of a single case study with a highly complex business context allows obtaining an in-depth view into a successful process. To complement the results, interviews with experts with many years of experience in platform strategy across industries and firms allow capturing good practice within different business contexts across industries and companies. These methods are described in figure 9 below and in more detail in the next chapter.

Figure 9: Research methodology and research methods
3.4.1 Case Study

Case study is a commonly selected research method in business research (Benbasat & Goldstein, 1987; Bonoma, 1985; Ghauri & Grønhaug, 2005; Gibbert, Ruigrok, & Wicki, 2008; Voelpel, Leibold, Tekie, & von Krogh, 2005). Subsequently, it is explained in detail why the method is appropriate for this kind of research.

The decision for case study as the research method is mainly based on the necessity of “identification of good practice for balancing commonality and differentiation within platform strategy” to find out how an organization works and why the organization works as it does.

Considering the nature of the research question and aim – to find out how a good practice approach concerning the balance of commonality and differentiation is characterized, and why the process is the way it is that there isn’t any investigator’s control of the events within the process. But rather, this process is a contemporary event without control by the investigator, or in other words, which cannot be manipulated, because the balancing process of commonality and differentiation taking business context and strategy into account is a contemporary event within a real-life context. The capturing of a good practice approach concerning balancing commonality and differentiation should be executed under real-life conditions. Case study methodology enables this kind of research and is appropriate to capture process details (Yin, 2008, p. 2). The case study allows retaining of the holistic and meaningful characteristics of organizational and managerial processes (Yin, 2008, p. 4), in this case the contemporary process of balancing commonality and differentiation within platform strategy. The required information about the contemporary process requires data collection techniques such as interviews, documents and artifacts which show that the case study method is more appropriate in this kind of research than the experiment (is manipulated within a laboratory setting) or history-related research methods which exclude techniques such as interviews involved in contemporary events (Yin, 2008, pp. 9–14).

The extracting case study allows uncovering of technological rules from good practice companies in terms of balancing of commonality and differentiation within platform strategy (van Aken, 2004, p. 232) based on analysis of decisions concerning commonality and differentiation, why they were taken, how they were taken and with which result (Schramm, 1971). Considering the fact that platform strategy is a complex process...
whereby many aspects are interwoven, case study is especially useful for deeply investigating complex processes (Arenius, 2002; Gilmore & Carson, 1996; Ghauri, 2004; Gummesson, 2003; Halinen & Törnroos, 2005; Palakshappa & Gordon, 2006; Zalan & Lewis, 2004) as is the case in this research gaining an in-depth understanding of the process of balancing commonality and differentiation within platform strategy (rather than mere frequencies) (Yin, 2008).

Furthermore, the aim of the research is theory-refining, to complement the theoretical perspectives already driven by platform strategy literature. Case study research is useful for theory refining (Gummesson, 2005; Hillebrand, Kok, & Biemans, 2001; Tsoukas, 1989; Voss, Tsikriktsis, & Frohlich, 2002; Woodside & Wilson, 2003; Yin, 2008), which is aimed for in this research.

In addition to theory refining, there is a need for practical insights which can also be captured ideally by case study research (Eisenhardt, 1989b; Eisenhardt & Graebner, 2007; Ghauri, 2004; Glaser & Strauss, 1967; Stuart, McCutcheon, Handfield, McLachlin, & Samson, 2002; Tsoukas, 1989; Voss et al., 2002). From a methodological point of view, the research is based on deductive and inductive reasoning, as mentioned in the chapter before. Case study research is a very useful method, as it allows expanding on and generalizing of theories by combining the existing theoretical knowledge (deductive part of the research) with new empirical insights (inductive part of the research) (Yin, 2008).

Subsequent to case study method justification, the selected single case is also reasoned. To identify good practice solutions for balancing commonality and differentiation, there is a need for a highly challenging environment to identify how good practice meets the challenges of balancing commonality and differentiation. Therefore, the single case selected in this research is critical (Yin, 2008, p. 47) in terms of a highly challenging environment, characterized by multi-brand, multi-platforms, highly complex products, a highly competitive environment, in order to capture practices regarding how the large conflicting potential concerning commonality and differentiation decisions of platform strategy across brands, companies and localizations is solved. The second requirement was to find a case which is typical in terms of where the tradeoff between commonality and differentiation occurs and should be handled in an interdisciplinary way (Yin, 2008, p. 48). Furthermore, the additional requirement is that the case is an example of good practice. The criteria for “good practice” are verified by experts found in neutral documents (not company-specific documents) and from independent experts with a
long experience in the field of platform strategy. A further criterion for good practice was experience in managing platform strategy issues. As shown in the literature review, a good practice balancing commonality and differentiation within platform strategy is not self-evident.

In summary, the following criteria were important for the case study selection:

- Challenging environment where the necessity of balancing of commonality and differentiation occurs (enabling to capture a holistic insight)
- Good practice example (evaluated by experts)
- Many years of experience in application of platform strategy
- Accessibility to organization

Of course, there are various companies to fulfill these criteria. However, because of the sensitivity of data, the selection procedure was, for the most part, driven by accessibility of the researcher to organization.

Based on these criteria, the unit of analysis is the balancing/decision-making process of commonality and differentiation within platform strategy of an anonymous good practice company identifying how actors/participants perceive the balancing/decision-making process on commonality and differentiation issues from their points of view.

The relevant business context of the single case study to the balancing processes (unit of analysis) is as follows:

- Multi-brand company with more than 10 brands and 200 models
- Business units: car, commercial vehicle and financial services
- Platform strategy as a main successful corporate strategy for more than 10 years (see sources below):
  - “Our 2nd focus: We develop our modular platform strategy continuously. Experts confirm to us that our platform XXXX is streets ahead of our competitors. The economic benefits will be generated successively. For although with increasing of volume the benefits will also increase”
  - The ___’s broader principle is the same as COMPETITOR’s ___ platform and both platforms are huge industrial projects. The only differentiator between the both is scale and flexibility in terms of body styles and variants. While the COMPETITORS focus on SUV, MUV and Pick-ups, the ____ can accommodate anything from a little ____ to a luxury sedan such as ____. The COMPETITOR has already proven with the ____ that
largescale flexible platforms can be immensely successful. Now that ___ is a step or two ahead in terms of operations, the success of it will depend largely on the implementation and the platform’s extensive use in emerging regions. If the ___’s commercial implementation succeeds, _____’s plans of becoming the world’s leading automaker by 2018 doesn’t seem to be a stretch.

o “Generating competitiveness by product architecture— The example of the modular platform strategy of XXX_company ….by introducing of vehicle platforms in the 1990s and 2000s allow significant scale effects….The evolution of the platform strategy moves to modular platform strategy which allows more reuse-degree of common parts and reuse of common product-, and process technologies ....The modular platform strategy is used across brands....and across vehicle segments.”

o Typical for the importance of product architecture in terms of modular platforms is recognizable as seen by following expression of the CEO: “The technical backbone for our profitable growth is our modular platforms”

o Based on the example of XXXX, it is clear which fundamental importance and influence modular platform strategy can be for company’s success.

- Competitive Strategy: differentiation and cost leadership at the same time. In each market segment, the target is differentiation with competitive prices while cost reduction is driven by scale effects:
  - “We invest more in R&D (in 2014: 11,5 bn. €) compared to our competitor.”
  - “The________ is certified again as the most innovative company within the automobile industry. “
  - “With this way we will increase our innovation pace for focused future areas.”
  - “The importance of modular platform strategy and realized innovation for new product-, and production architecture is recognizable by nomination for certification of innovation.”

- Economic competitiveness
- 2014 > 10 million vehicles produced, four years earlier than planned
- 200 billion Euros in revenue
- EBIT: 18 billion Euros
- Rate of return +1% increased to 7.3%
- More than 90 production locations

- Business characteristics:
  - Increased number of competitors
  - Market segment will become granular
  - Increasing number of licensed vehicles
  - Increasing number of variants

- Modular Product Platforms:
  - 4 vehicle modular product platforms:
    - BK1: for small product family
    - BK2: for mid-range product family
    - BK3: for big product family
    - BK4: for sport product family
  - 4 platforms for main modules:
    - Powertrain
    - Cab
    - Chassis
    - Electric/Electronic

To capture good practices in detail and at the same time looking from various perspectives dependent on business context leads to the question of how it can be achieved most effectively and efficiently. The one alternative to come to this solution is to execute a multiple case study. The other option was to execute expert interviews with participants who have many years of experience in platform strategy across industries and companies. The advantage of expert interviews is three-fold. Firstly, complementing the case study, it allows a more objective and neutral perspective without being
superficial, meaning they are outside of the system of the company and at the same
time deeply involved in the organization, because they consult and develop issues for
platform strategy together with participants from the company. Secondly, expert
interviews allow an insight into more than one company and industry, and thus allow
obtaining a perspective which is very valuable because experts have the possibility to
compare between the practices and have a clear view on good, and bad practices. In
principle, the comparison is also possible by way of multiple case study, but it requires
more time and resources and the access to case organizations for such a competitive
topic is difficult. Thirdly, to attract participants for research is easier in the case of expert
interviews, since they are interested to invest their time for investigations which, at the
end of the day, are also interesting for their daily business. According to the results, they
have the possibility to reflect on their practices. Therefore, the added value of expert
interviews is higher, thus expert interviews were selected as the second research
method and described in more detail in the next chapter.

3.4.2 Expert Interviews

From a methodological point of view, guided qualitative interview is a good source to
generate qualitative data based on solid methodological ground (Helferrich, 2014,
p. 559). Furthermore, direct observation of a complex and long-term issue, such as
platform strategy, is impossible. Therefore, getting the necessary information about
how different industries and companies handle the balancing act of commonality and
differentiation was possible by way of expert interview qualitatively to obtain a broad
(in terms of the different context) and in-depth (in terms of the balancing process) view
at the same time. So, this method allows the expert’s perspective to be entered in order
to gather information on how good practice companies handle the balancing of
commonality and differentiation within platform approaches (Patton, 2002, p. 341). So
as to obtain a broad and holistic view into the complex topic of how good practice of the
balancing process of commonality and differentiation within platform strategy in
different business contexts is, there is a need for a second source to compare and
complement the results from the single case study.

The research aims to capture good practices concerning balancing commonality and
differentiation within platform strategy taking business context and strategy into
account. This requires gaining information from a source which is able to compare between different practices and evaluate them in terms of good, or bad practice. Therefore, the required source should have expert knowledge about platform strategy issues. To capture good practices concerning research issue, it was necessary to gain an insight into expert knowledge (Helferrich, 2014, pp. 559–560), which can be achieved by expert interviews.

The expert interview is defined by a purposeful selection of interviewees who have the status of experts. Concerning the criteria for expert status, there are different definitions in science. While some definitions are open in terms of everyone being an expert of his own life, other definitions are based on the fact that expert status is only for the elite from a functional perspective (Meuser & Nagel, 1991), or in other words, for people who have a special knowledge because of professional practice (Bührmann, 2004). In this research, experts have a role knowledge which is confirmed by others, while the role knowledge consists of insider knowledge about the process and context and is based on experience (Przyborski & Wohlrab-Sahr, 2008, p. 133). Because of this different range of definitions it is important that researchers justify their definition regarding why selected interviewees are experts within the research context (Franz & Kopp, 2004, p. 52).

Considering the fact that complementary to knowledge driven by the single case study through inside experts, there is a need for experts who also have an outside and more objective/neutral perspective on platform strategy issues, however, at the same time have an in-depth knowledge about platform strategy, especially about how good practice organizations balance commonality and differentiation within their organizations. This challenging profile can be fulfilled appropriately by consultants. Consultants have different experiences across business contexts and are able to compare between practices for balancing commonality and differentiation within platform strategy. Therefore, consultants have knowledge generated by his/her in-depth insight into different organizations which make this knowledge interesting for the research aim to identify good practice solutions and their underlying reasons. Thus, consultants are outsiders and at the same time insiders who have accompanied good practice companies handling commonality and differentiation issues within platform strategy. Therefore, selecting consultants who are experts in the field of platform strategy because of their knowledge and long-term experience (Bogner & Menz, 2002,
p. 37) is appropriate to achieve the desired research results. The consultants have insider knowledge regarding process, since they support the company to implement platform strategy in their organizations. Therefore, they know under which business context commonality and differentiation decisions within platform strategy are made. Furthermore, they have long-term experience in the field of platform strategy across industries and firms. In other words, consultants are able to deliver both specific knowledge about platform strategy and context knowledge regarding how commonality and differentiation decisions are made in this context (Franz & Kopp, 2004, p. 52). Therefore, the interviewer expects knowledge creation by consultants, which is also a criterion defined by Düring & Bergmann (as cited in Franz & Kopp, 2004, p. 53).

So, quality of data depends largely on experts. Consultants as experts with more than 10 years of professional experience who were known by the researcher from his professional practice were purposefully selected. Each of them has many years of experience in the field of platform strategy. They have insights into different industries and companies. This allows obtaining a holistic picture of the phenomenon of balancing commonality and differentiation within platform strategy within different contexts. Therefore, 13 consultants with experience in platform strategy were contacted, and 10 consultants accepted the invitation to participate in the research (see appendix A). For ethical reasons, each interviewee was informed about the research before. Based on the information (see information sheet in appendix B), each interviewee signed a consent form agreeing to participate (see consent form in appendix C). The detailed information about expert level and further information about experts was also noted (see appendix A). The characterization as expert is based on knowledge rather than personal details (Helferrich, 2014, p. 571). Furthermore, the status of expert requires a role definition between interviewee and interviewer in order to clarify power relations. According to some authors (Bogner & Menz, 2002; Gläser & Laudel, 2009), there are some options such as authority in the same field or in another field, potential critic, or lay person. As a senior manager within industry with experience in professional practice, the researcher can be described as an authority in the same field. Thus, the interview was at eye level and it was possible to execute an interview with a high information degree because of the interviewer’s professional practice (Franz & Kopp, 2004, p. 56).
Now that research methods have been described in more detail, which data collection methods were applied within the research methods will be shown in the next chapter.

3.5 Data Collection

In qualitative research, the selection of cases and participants is carried out according to the logic of who is best informed about the research topic (Hennink et al., 2011, p. 84). As described before, the research topic is to understand good practice approaches/the process of balancing commonality and differentiation in detail in order to establish a final framework. To be more precise, it means to capture details in-depth about the process of the balancing act between commonality and differentiation. Therefore, it means to obtain knowledge about the process in various business contexts, which should also allow an in-depth understanding as to how the business context will impact the good practice approach for balancing commonality and differentiation within platform strategy. In order to obtain an in-depth insight and to generate content-related understanding, it is only possible to analyze the process of a good practice company which has experience in platform strategy and thus in the process of balancing commonality and differentiation in a real-world context. Therefore, the selection of the single case and experts was purposeful. Because of sensitivity and out of respect for the company, the selected cases and experts are anonymous.

In many research papers, the automotive industry is already identified as providing best/good practice solutions in terms of taking advantage of platform-based product families by solving the conflict of commonality and distinctiveness through appropriate balancing (Ohvanainen & Hietikko, 2012). Therefore, the selection of the single case study was within the automotive industry. The case study method allows data collection from multiple perspectives (Gummesson, 2006; Leonard-Barton, 1990). Therefore, for an in-depth understanding within the selected single case study, in-depth interviews with participants from different divisions involved in the process of balancing commonality and differentiation within platform strategy were predominantly carried out to achieve this aim. Because of the interdisciplinary process, different participants from different departments (product management, R&D, sales, production) were interviewed. The number of interviewees within the single case study depended on who was available for interview and recruiting of interviewees was terminated when...
saturation level of knowledge generation across the disciplines was reached. In addition to that, documents relevant to the process within the single case study were also analyzed in order to obtain a more complementary picture of the process of platform strategy. The business context concerning the single case study is complex in nature, since the single case is from the automotive industry with complex products, more than 3 brands and an established process across more than 2 locations around the world. Even if the selected single case is representative for a typical complex case, in any case, to analyze a single case is limited to a specific context.

A complementary understanding of the relevance of the business context, which in turn allows a more complementary good practice approach, is achieved by in-depth interviewing of consultants as experts who have been involved in the process of balancing commonality and differentiation within platform strategy over many years and in many firms. Consultants are also selected consciously, since criteria which allow an in-depth understanding require: experience in terms of duration and variety of business context to capture different processes across good practice companies. The number of interviewees is also selected according to the criteria of availability and saturation level of knowledge until no further information/knowledge comes up. As mentioned in van Aken (2004, p. 233): through data collection from expert interviews and the single case study, there was a win-win situation for both parties, since experts could reflect upon their experiences and improve them according to the results of the single case study and vice versa.

The main research instrument applied in both research methods was in-depth interviews. The research question: how to specify and balance the tradeoff between commonality and differentiation within platform strategy was operationalized by the interview guide (see appendix D and E) (Hennink et al., 2011, p. 33). The in-depth interviews in case study research with managers as participants of the decision process and with experts, allows in-depth information regarding personal experiences within the business context in which such approaches to balance commonality and differentiation within platform strategy occurred (Hennink et al., 2011, p. 53). The interview is an interaction and communication situation under certain circumstances (setting, the dynamic of interaction, personal understanding process between interview participants) which generates a context-specific construction of the world (Helferrich, 2014, p. 64).
addition to that, in-depth interviews allow an in-depth understanding of how people make decisions to balance commonality and differentiation within platform strategy and within their business context and why it is done in the way it is done. There is a meaningful partnership between interviewer and respondents which allows a knowledge-producing conversation (Hesse-Biber & Leavy, 2006, p. 128). The in-depth aspect allows gaining of detailed insight into the process of balancing commonality and differentiation from the study participants’ point of view. The in-depth interviews are based on a semi-structured interview guide with open questions to allow comparison among interviewees for each topic and to reduce bias from the interviewer, and at the same time to allow some flexibility and naturalness for the interviewee as well as to follow the recommendation for expert interviews (Liebold & Trinczek, 2009, p. 33; Patton, 2002, p. 349). The interviewees were already known to the interviewer from his own professional practice, so there was a relationship of trust between them (as cited in Hennink et al., 2011, p. 109). In-depth interviews were based on a semi-structured interview guide in the mother language of the interviewees to avoid misunderstandings. Furthermore, the interview guide was double checked by the researcher’s supervisor and reworked after feedback. In general, the interview guide is developed based on literature review and the researcher’s professional practice, and was pilot-tested with an independent person. The structure of the interview is as follows: introduction, opening questions, key questions and closing questions (see appendix D and E), as recommended by Hennink et al. (2011, pp. 112–113). In the introduction part, the researcher introduced himself and clarified ethics issues. The ethics application was based on the consent form signed by each interviewee ensuring that participation is voluntary and accepted, including as well the permission for audio recording (see appendix B and C). The opening questions are about definitions and a general understanding of platform strategy. The key questions concern the process of how participants perceive the balancing act of commonality and differentiation to gain detailed information in order to answer the research question. The closing questions are future-oriented and should capture the perceptions of participants as to whether there are any expected changes concerning balancing commonality and differentiation within platform strategy. The interview guide is based on concepts deductively gained from the design cycle by literature study. For example, there are some questions as to how customer requirements are considered within balancing commonality and
differentiation to identify differentiation boundaries. Further questions relate to the role of strategy in identifying if there is a dependency of the decisions from strategy, and if yes, how this dependency is considered within the process. In the pre-phase, through pilot testing with some interviewees, it was possible to ensure that all designed questions were clear from the participants’ perspective, and if not, then the interview guide was revised. The questions in the in-depth interviews were open, short and simple and had topical probes (derived deductively from theory to capture potentially important issues) for each question in order to ensure that necessary detailed information was collected, even if not given by the interviewee. The interviews were recorded by a high-quality tape recorder which allows for the interview to be transcribed later. Moreover, interviews were conducted at the interviewee’s home to achieve rapport with the interviewee. The duration of the interviews was 90 minutes on average. During the interview, notes were taken by the researcher focusing on strategic and important topics which allowed the interview to be steered in a purposeful manner in terms of formulating new questions, gaining early insights before the data analysis phase and facilitating it (Patton, 2002, p. 383). However, the ideal of full openness is restricted because of a specific research aim (Helferrich, 2014, p. 562). The interview was semi-structured, which allows a comparison between results derived from expert interviews (Helferrich, 2014, p. 566).

The case study allows data collection from multiple sources (DuBois & Gadde, 2002; Ghauri, 2004; Johnston, Leach, & Liu, 1999; Nieto & Pérez, 2000; Simon, Sohal, & Brown, 1996; Tellis, 1997a; Yin, 2008). Therefore, a further research instrument for collecting data within the single case study is based on a systematic search of 57 documents (see appendix F) which was valuable to gain information about balancing commonality and differentiation within platform strategy. The source of documents is multiple, so there is a data triangulation based on data sources. While there are some internal documents of the case itself, there are also specialist and professional articles from experts within the community. These documents are stable and can be reviewed repeatedly. Furthermore, the documents are unobtrusive, since they have not been created as a result of the case study. Moreover, through multiple sources it was possible to uncover many settings concerning the balancing process of commonality and differentiation (Yin, 2008, pp. 102–103).
3.6 Data Analysis

The main task within the analytic process was managing and making sense of participants’ multiple and contrasting perspectives derived from the participation and observation of the process to balance commonality and differentiation within platform strategy. The qualitative data analysis is based on principles of grounded theory (Charmaz, 2006; Corbin & Strauss, 2008; Glaser, 1978; Glaser & Strauss, 1967; Patton, 2002; Strauss & Corbin, 1997, 1998; Strauss & Corbin, 1990) which is based on an inductive approach with deductive elements. Furthermore, grounded theory depends on methods that take the researcher into and close to the real world so that the results and findings are grounded in the empirical world (Patton, 2002, p. 125). So there is interplay between induction and deduction through the analytic process (Hennink et al., 2011, p. 204). The deductive elements are deductive code development, deductive comparison and how deductive reasoning influences the inductive conceptualizing and theory building. Theory building occurs in an ongoing dialogue between pre-existing theory (see appendix G: conceptual framework) and new insights generated as a consequence of empirical data (Liamputtong & Ezzy, 2005, p. 266). The inductive reasoning begins with making inferences starting with the first interview within the case study and expert interviews, and goes deeper and deeper in the next interview until the point of information saturation is achieved, in other words, where new information is no longer coming up (Maxwell, 2005, p. 69).

3.6.1 Verbatim Transcription & Anonymizing Data

To handle the huge amount of data and in order not to be overwhelmed by these data (Vissak, 2010, p. 376), data analysis was supported by the NVivo11 software. The data analysis is a circular process whereby tasks are repeated, overlap and are conducted simultaneously to get an in-depth insight into the data (Dey, 1993; Rubin & Rubin, 2005). The first step in data analysis was preparing verbatim transcripts which enables the researcher to understand the views of study participants in their own words, to interpret their meaning and to form conclusions that are well rooted in data. The interviews were transcribed after each interview had been completed. In the event of not enough time and space between interviews, transcription was executed after the data collection had
been completed. The transcription allows for identification of issues which are further explored in subsequent interviews. The identifiers, such as names, location, places or specific information, are removed from the transcription to ensure the participant’s anonymity. Each interview lasts 2-5 hours and the production of the verbatim transcription of one interview takes 8-10 hours which results in 30 pages/12,000 words per document on average. The interviews were executed in German, in the mother language of the interviewees and the interviewer, so a translation was not needed in the data analysis stage. After data had been analyzed in German, the results were translated into English.

3.6.2 Coding Data

After the interviews were transcribed, the data was coded (see appendix H). As a logical starting point and according to the followed research methodology framework, the first deductive codes were derived from existing theory, then inductively constructed from the data. So in the end, there was a mix of deductive and inductive codes in the research.

A code refers to an issue, topic, idea, opinion etc. that is evident in the data (Hennink et al., 2011, p. 216). The codes allow the identification of the raised issues and an understanding of the meanings attached to these issues, as well as allowing for the indexing of the data, so issues can be easily located. In this research, the coding is done according to the recommendation of the logic of Glaser (1978). So, a code should be valid, robust and useful. The validity is checked by repetitiveness across different interviews. In order to prove validity of codes, inductive codes are identified by explicit coding through the first reading. Then, detailed reading is executed whilst making annotations of the data and reflecting on it, to capture different ranges of topics, in addition the discussions about the topic as well as repetitive issues as recommended in Hennink et al. (2011, p. 221). In the second step, to identify implicit codes, the data is read analytically to capture underlying issues which are not obvious in the first reading. In the third step, conceptual codes on a more abstract level are developed by identified connections between codes and comparison of codes with the conceptual framework derived deductively from theory. To capture the broad range of codes, 3 transcripts (from 10) with different contexts are selected from the expert interviews and 2 of the case study interviews (from 4) are selected from two different divisions. This allowed for
less modification of the code book in later phases. The code development was finished until the point of saturation was achieved and no more issues were identified (Glaser & Strauss, 1967). Thus, data is coded deductively through data searches driven by using the study’s conceptual framework (see appendix G) or topic, or by exploring issues that were identified inductively. The final codebook with all relevant codes for the study and the description of the code is listed in a final list (see appendix H). After the codebook is finalized, all segments of text within data is identified where a specific code is mentioned in order to focus on these segments for the analysis. Through careful reading, it was possible to identify and label the identified codes discussed in that section. It was important to identify what was being said, assessing the context of the discussion, following the argument and then deciding which codes were appropriate. If new codes and/or variation of codes not listed in the codebook were identified, these codes were added to the codebook, or codebook definitions were refined or nuances found in the data were excluded. If a new code was identified, data recorded prior was analyzed according to the new code.

3.6.3 Theory Building

After coding, the theory-building process is started. A good theory should meet the goals of the study and help to answer the research question and is based on categorizing, conceptualizing, and theorizing. Theory is usable for intended purpose (Richards, 2005, p. 130), in this case to contribute to good practice and theory of platform strategy in terms of balancing commonality and differentiation appropriately. In this research, theory development is a refinement of existing theory in literature. The refinement includes an in-depth understanding of processes applied in good practice companies and within real-world complexity. The aim of theoretical refinement is to uncover theory that is not part of an existing theory but contributes to it (Snow, Morrill, & Anderson, 2003). Therefore, the analytical task was to identify process details of balancing commonality and differentiation within platform strategy which fits into existing theory or not, as the case may be, and how to refine the pre-existing theory. The theory refinement should contribute to how good practice companies balance commonality and differentiation within platform strategy and why they handle it in this way and how this captured process differs from existing processes in theory.
The theory building process was divided according to content into 2 main topics: a) how participants define the tradeoff problem between standardization and differentiation and b) how they solve it, namely how they balance standardization and differentiation and why they solve it in the way they do. From a processual point of view, the theory building is based on building codes from the data (coding), describing and comparing through analysis of gained data, building categories consisting of codes (categorization), identifying linkages between the categories (conceptualizing) and constructing an explanatory framework for the studied phenomenon (theory development) (Denzin & Lincoln, 1998; Miles & Huberman, 1994; Rubin & Rubin, 2005; Silverman, 2005; Strauss & Corbin, 1998; Wengraf, 2001; Wolcott, 2005). In general, making inferences during the in-depth interviews have allowed the questions to be refined for the next interviews as well as inferences about the results to identify key issues in the early phase of the research, as recommended in Hennink et al. (2011, p. 111).

The data search strategies were based on searching by code, searching by topic, and analytical searching to refine propositions. The main analytical tool which was applied in Nvivo is the framework matrix (see appendix I). The framework matrices consist of columns where each interviewee is represented and rows where the topics are listed. The framework matrix allows the respondents’ answers to be summarized and allows sensible reduction to capture relevant data (see appendix I).

The phases of theory building were based on: description, comparison, categorizing, conceptualizing, and theory building. The description phase allows capturing of detailed information about the context, the breadth, and depth of the data. After the data were described and summarized, data were compared continuously to identify issues inductively and to identify similarities and contradictions. The categorization allows summarizing of the data and visualizing them. To derive a more abstract level of categorized data, data were conceptualized to derive the theory from them (Hennink et al., 2011, p. 238). The conceptualizing strategy was to generate a holistic big picture. Based on a detailed understanding of individual components of data, data were described and compared to each other in order to recognize linkages between them. After that, data were simplified to clarify core issues, identify key linkages, and explanations were given to capture the central story and the diversity in the process of balancing commonality and differentiation within platform strategy. The aim is to
summarize data, yet retain some complexity and nuance that reflects a comprehensive understanding of the process of balancing commonality and differentiation within platform strategy (Hennink et al., 2011, p. 248). Subsequently, it is described how the data were described, compared, categorized, and conceptualized to derive the theory from the research.

In the description phase, the problem of the tradeoff between commonality and differentiation is driven by the following questions: What is the concrete tradeoff by identification of which sub-dimensions of cost and differentiation are affected by platform strategy generally? Which of these dimensions are affected contradictively (and non-contradictively) by platform strategy? Why does the tradeoff occur? And which circumstances strengthen or weaken the tradeoff issue and why? The data search strategy for answering the question “What is the concrete tradeoff by identification of which sub-dimensions of cost and differentiation are affected by platform strategy generally?” was based on analyzing the code “effects”. The data collection for capturing the contradictive and non-contradictive effects was based on the sub-codes of “effects” and their relationship to each other as well as on the code “balancing cost and differentiation”. While the first was analyzed by framework matrix, the latter was based on the analysis of the code. To capture context which strengthens and weakens the tradeoff, the code “business characteristics” was analyzed by the framework matrix and search within codes of “effects” and “challenges” with indication to relevant business contexts for balancing commonality and differentiation within platform strategy. The effectiveness of the research is evidenced until theoretical saturation is reached (Eisenhardt, 1989a).

The same description phase for the solution process was lead by the following questions: how the tradeoff between cost and differentiation is handled successfully in practice, or in other words, how management of organizations defines the boundaries for standardization (=cost) and customization (=differentiation). In this context, there was an emphasis on systematic orientation on superior target competitiveness, defined by competitive strategy [P1] driven from the deductive theory. In this context, the relevant questions were: What is the superior target of platform strategy? (Is there another superior target?) [P1] Is there a systematic way (or another way)? [P1] How does the customer affect platform strategy decisions (other factors which influence decisions)?
[P2] How does the competitor affect platform strategy decisions (other factors which influence decisions)? [P2] Consider how other activities and strategies fit to platform strategy? [P3] How is the relationship between platform strategy and business characteristics to balance the tradeoff between commonality and differentiation [P4]?

The answer for systematic orientation on the superior target of competitiveness was analyzed through data search by following codes and the relationship among them: systematic compatibility between platform strategy and competitive strategy, effects, definition of competitiveness, target of the competitive strategy, contribution of platform strategy to competitiveness, success factors, decision criteria, purposed competitive strategy and execution of the platform strategy. While the code concerning systematic compatibility between platform strategy and competitive strategy was analyzed by framework matrix, other codes were analyzed by data search within each code. The question “What is the superior target of platform strategy?” [P1] was analyzed by the code “target platform strategy”. The investigation concerning “systematic” was investigated by text search (quantity and context) for “emotional”, “gut decisions”, “systematic”, “rational”, “and “experiment”. The question “How does the customer affect platform strategy decisions?” [P2] was investigated by analyzing data within the codes “customer” and “factors influencing platform decisions”. The question “How does the competitor affect platform strategy decisions?” [P2] was investigated by codes in which the competitor was part of the code. “Considering other activities and strategies and how they fit to platform strategy?” [P3] was analyzed by the code “further activities influencing competitiveness” through the framework matrix. The proposition “the platform strategy depends on business characteristics because of the intensity of the tradeoff on business characteristics [P4]” was also analyzed by the framework matrix summarizing data from the code and its sub-code of “business-characteristics” and “balancing standardization and differentiation”.

3.7 Limitations

Besides advantages of qualitative research in terms of higher flexibility, the ability to avoid pre-determined assumptions made by the researcher, and to focus on the key issues from participant’s perspectives, there are also some limitations. The main limitation of qualitative research is that it allows no statistical generalization, however,
theoretical/analytical generalization instead. Thus, making general statements about larger populations is not possible (Veal, 2005, p. 33). Qualitative research is expensive and time-consuming in terms of collection and analysis of research information (Griffin, 2004). Therefore, in this research, a systematic procedure and using of software for data analysis is applied to decrease the time-consuming activities. There are also doubts about the quality of analysis, because it depends on the researcher’s insights and conceptual capabilities (Patton, 2002, p. 541ff.).

In addition to that, there are some prejudices against the case study method such as lack of rigor because of non-systematic procedure, which should be eliminated through applying and describing systematic procedure in this research, as described in the chapters before. Like other research methods such as experiments and designing questionnaires for surveys, the case study method could be biased (Rosenthal, 1966; Sudman & Bradburn, 1982). Furthermore, generalization from the single case study is in terms of generalizing theories (analytical generalization) rather than statistical generalization (Yin, 2008, p. 15). Moreover, the case study method is difficult to carry out. The main issue lies in that the quality of research highly depends on the investigator’s ability (Yin, 2008, p. 16).

What is more, besides strength in terms of gaining in-depth information from people’s personal experiences and context under which commonality and differentiation decisions within platform strategy are made, limitations of in-depth interviews are as follows: There is no feedback because it is a one-to-one interview. Furthermore, there is a need for skills and flexibility to follow the interviewee’s story. In addition to that, qualitative research is highly time-consuming because of the necessary transcription (Hennink et al., 2011, p. 31). The interviews are based on open questions, however, bias is always inevitable (e.g. interviewee tells what interviewer wants to hear). Moreover, the selected documents and archival records are not the complete data base, so this research instrument, too, underlies a certain bias (Yin, 2008, p. 102). In particular, in studying complex processes, researchers will be unlikely to observe the same set of events. So, different interviewees may describe these events dissimilarly, so even the same interviewee may not give the same information to all interviewers, or the information to the same interviewer will vary from year to year. For example, one year later, the same event concerning balancing activities of commonality and differentiation
may be seen in a different light (Vissak, 2010, pp. 375–376). Furthermore, respondents, in particular within the single case study, may present their past decisions and actions in a very favorable light to show the good practice within the company. The risk is also present with expert interviews, however, with another direction, namely in terms of self-marketing of one’s own interests, that is to show how bad it was before consultancy work and how good the process turned out after consultancy work.

3.8 Scientific Criteria

As described in the chapters before, the research paradigm is a mix of constructivist/interpretivist and pragmatism paradigms which have different scientific criteria compared to traditional research methods. The constructivist research is based on credibility (instead of internal validity), transferability (instead of external validity), dependability in terms of systematic process systematically followed (instead of reliability), and confirmability (instead of objectivity). In summary, while traditional research strives for rigor, the constructivist research strives for trustworthiness (Patton, 2002, p. 541ff.).

Credibility/Dependability

The credibility is based on the research paradigm underlying qualitative research and applied rigorous methods. The rigorous method is characterized by high quality and systematic analysis of data. Credibility is also achieved by describing why a qualitative approach suits the research problem, how methods and analytical procedures were applied and data was interpreted to reach valid conclusions. Furthermore, to achieve scientific rigor/credibility in this qualitative research, purpose sampling, applied software to analyze data, procedural steps and methodological decisions are described in the sections before in detail (Hennink et al., 2011, p. 270). The grounded theory framework is a set of coding procedures to help provide some standardization and rigor, since this approach provides support for researchers to handle the masses of data generated by qualitative research (Patton, 2002, p. 127). The grounded theory allows a demonstration of how theory emerged from the data, how data supports the theory and whether theory fits the data (Hennink et al., 2011, p. 264). Moreover, more various strategies are applied to verify the theory (Hennink et al., 2011, p. 264): a) checking if
explanations are repeated (internal validity) (see framework matrix in appendix I), returning to data and re-reading of data after theory is developed and using a concept indicator (as cited in Hennink et al., 2011, p. 264) that includes a list of indications that concepts are well-grounded in data; b) conducting feedback from participants by presenting them the theory to validate the interpretations and explanations developed.

Considering methodological issues, to increase credibility in qualitative research is possible by searching for alternative/rival patterns/explanations inductively and logically (Patton, 2002, p. 541ff.). In this research, the search for rival explanations and triangulation of data sources (interview data, company data, and documents), methods (expert interview and case study) as well as perspective triangulation (experts and managers/participants) is applied to prove the fit of the theory by explicit searching for alternative theories by using a conditional matrix (Glaser & Strauss, 1967) and to delimit theory by identifying conditions in which the theory applies (see code “business characteristics”).

**Transferability/Confirmability**

Transferability is ensured by developing the generic and theoretical framework for balancing commonality and differentiation dependent on business context. So, results consider different business contexts allowing a systematic adaptation derived framework based on a grounded theory process to other cases.

In the chapter before, it is shown that research fits into the interpretivism paradigm by reflecting the meaning and perception of the participants within the process concerning balancing commonality and differentiation. From the interpretivism point of view, the following scientific criteria for this research are relevant: interpretive, reflexive, and appropriate. The interpretive aspect is the added value of qualitative analysis based on different rigor and scientific criteria (Hennink et al., 2011, p. 205). This is ensured by the process of grounded theory which also provides analytical rigor in interpreting qualitative data and developing empirical theory (Hennink et al., 2011, p. 206). The grounded theory process developing empirical theory from qualitative research can be built up (Liamputtong & Ezzy, 2005, p. 265). The reflection on the opinions and perception of participants was achieved by in-depth interviews to capture their perspective of the process for balancing commonality and differentiation.
Furthermore, to increase trustworthiness, it is important to increase authenticity in terms of reflexivity. Reflexive in terms of: does the researcher reflect on subjectivity, how is subjectivity managed, is there evidence of reflexivity, does the study describe both personal and interpersonal reflexivity? In other words, reflexive consciousness about one’s own perspective and appreciation for the perspectives of others is a quality criterion (Patton, 2002, p. 541ff.). As mentioned in the previous chapter, the personal and interpersonal subjectivity (e.g. consultants are known to the researcher from his professional practice), through a systematic procedure and transparency regarding how results are derived from the transcribed data were a means of ensuring the trustworthiness of the research.

Case study

In addition to negative issues of qualitative research such as high time consumption and labor intensity (Daniels & Cannice, 2004; Leonard-Barton, 1990; Nieto & Pérez, 2000; Simon et al., 1996; Stuart et al., 2002; Voss et al., 2002), the generalization from the single case study in particular is a further main point of criticism (Eisenhardt & Graebner, 2007; Voss et al., 2002; Yin, 2008, pp. 14–15). The single case study allows analytical generalization of theories rather than statistical generalization (Dyer & Wilkins, 1991; Gummesson, 2003; Stuart et al., 2002; Tellis, 1997b; Yin, 2008). The analytical generalization consists of a previously developed theory serving as a conceptual framework with which to compare the empirical results of the case study (Yin, 2008, p. 38). Therefore, the results from the single case study are complemented by a second research method of expert interviews with independent consultants who were involved in platform strategy projects in various firms and industries, as suggested by Vissak (2010, p. 382, figure 1).

Other scientific criteria especially for the case study method are listed by Yin as follows: construct validity, internal validity, external validity and reliability (Yin, 2008, pp. 24, 41). Transferred to the applied research paradigm, construct validity is credibility. Constructing validity is achieved in this research by using multiple sources of evidence: interviews with participants within the process of balancing commonality and differentiation, and documents (internal and external) which indicate how decisions concerning commonality and differentiation are made. To gain more
reliability/dependability, Patton discusses four types of triangulation: data sources triangulation, investigator triangulation, theory triangulation and methodological triangulation (as cited in Yin, 2008, p. 116). In this research, data sources triangulation (documents from multiple sources, interviews from internal and external experts), theory triangulation (propositions and rival propositions derived from theory) and methodological triangulation (the single case study and expert interviews) are applied.

The grounded theory approach allows the establishing of a chain of evidence. Furthermore, data is reviewed by key interviewees to avoid misunderstanding. These strategies lead to identifying correct operational measures for the concept being studied. The internal validity is a criterion for explanatory case studies which is not the case in this research. In this research, the aim is to explore the process for balancing commonality and differentiations within platform strategy. The domain to which single case study findings can be generalized is achieved by using the theory in order to find out if theory is confirmed or should be refined. The detailed description of the approach based on grounded theory (see chapter data collection) allows for repetition of the research whereby the same results are not guaranteed, since this research is based on interpretivism which acknowledges subjectivity and the influence of the researcher.

Therefore, the reliability concerning research procedures is achieved; however, the potential results will vary dependent on the interpretations of other researchers.

**Expert interviews**

Considering scientific criteria for expert interviews leads to the following conclusions. Both the ability of historical changes in expert knowledge and different opinions amongst experts show the need for subjective interpretations, even if there is legitimation for generalization (Helferrich, 2014, p. 570). Thus, also for the second research method: instead of objectivity, methodologically controlled and reflexive subjectivity is the main scientific criterion. Furthermore, because of context-driven qualitative research, reliability is not an appropriate scientific criterion. In other words, it is not the replication of data for new research which is relevant rather than the estimation of how data will change depending on the context in which it is captured. The validity is provided by the openness of data collection. The more openness there is, the more valid and appropriate is the research (Helferrich, 2014, p. 573).
Pragmatism paradigm: The scientific criteria for the pragmatism paradigm are as follows in table 3.

From a pragmatism point of view, the research produces a process framework as a viable artifact, since the framework is grounded in good practice companies and supports the problem specification in terms of balancing commonality and differentiation and solves it appropriately. This process framework is a solution for the relevant problem of how commonality and differentiation should be balanced appropriately taking business context and strategy into account. The well-grounded process framework in good practice companies (external validity) is an indication for utility, quality and efficacy for the framework and is a contribution to platform strategy theory and practice. The framework is constructed by qualitative methods and allows for solving of the problem of appropriate balancing of commonality and differentiation. Thus, the result of the research is for academic and management-audiences.

<table>
<thead>
<tr>
<th>Guideline</th>
<th>Description</th>
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<tr>
<td>1) Design as an artifact</td>
<td>Design-science research must produce a viable artifact in the form of a construct, model, method, and instantiation</td>
</tr>
<tr>
<td>2) Problem relevance</td>
<td>The objective of design-science research is to develop technology-based solutions to important and relevant business problems</td>
</tr>
<tr>
<td>3) Design evaluation</td>
<td>The utility, quality, and efficacy of a design artifact must be demonstrated rigorously, by means of well-executed evaluation methods</td>
</tr>
<tr>
<td>4) Research contribution</td>
<td>Effective design-science research must provide clear and verifiable contributions in the areas of the design artefact, design foundations, and/or design methodologies</td>
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<tr>
<td>5) Research rigor</td>
<td>Design-science research relies upon the application of rigorous methods in both the construction and evaluation of the design artifact</td>
</tr>
<tr>
<td>6) Design as a research process</td>
<td>The search for an effective artifact requires utilizing available means to reach desired ends, while satisfying laws in the problem environment</td>
</tr>
<tr>
<td>7) Communication of research</td>
<td>Design-science research must be presented effectively, both to technology-oriented and management-oriented audiences</td>
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Table 3: Scientific criteria for pragmatism research (Hevner et al., 2004)

3.9 Conclusions

Platform strategy is a complex phenomenon. The necessary and aimed-for complementary view of problem understanding and problem solving, plus the fact of a
complex real-world issue, leads to the conclusion that the research should be predominantly based on the interpretivism paradigm, with partly pragmatic elements and deductive reasoning. Qualitative research is appropriate, to explore people’s experiences and their views or perspectives of these experiences about the process, and how and why companies establish the boundaries for commonality and differentiation, by balancing them. Therefore, research is based on solid qualitative research methods and is appropriate for the aim of the research.

To capture in-depth insights whilst getting a broad view across different good practice approaches, the applied research methods, in terms of single case study and expert interviews, are appropriate. The systematic procedure based on grounded theory and the combination of deductive and inductive reasoning allowed a holistic, systematic and creative research which is important from different scientific criteria underlying research philosophy.

However, even if all possible measures are executed, to achieve a high-quality result, based on transparency, openness and a systematic approach, there are of course still limitations and gaps concerning generalization and further refinement of the theory, which should be closed in future research. The main limitation of qualitative research is that it allows no statistical generalization, but instead: theoretical/analytical generalization. Furthermore, generalization from the single case study is in terms of generalizing theories (analytical generalization) rather than statistical generalization. Considering the applied research methods and collected data, bias is always inevitable. In this context, the main issues are high risk of inconsistency of data because of the high complexity of the research phenomenon and self-interest of respondents.

Summarized, even if there are limitations, qualitative research methodology is an appropriate way to answer the research question and contribute to the research area of platform strategy.
4 Results

The main principle underlying data analysis is based on an analytical process searching for the same topics across research methods and data sources. The main reason for this approach is the research aim to develop a holistic framework concerning balancing commonality and differentiation including problem-specification and problem-solving practices. Therefore, it is necessary to explore how topics (e.g. how to define the tradeoff between commonality and differentiation) are discussed across research methods, interviewees and data sources. The main task was to identify similarity and differences across data from different sources. Through this approach it is possible to capture different perspectives on the same topic in order to develop a generic framework for balancing commonality and differentiation within platform strategy taking business context and strategy into account.

4.1 Definition Platform Strategy

Because different definitions of platform strategy exist in literature, the first important point which is analyzed is how this issue is discussed across research methods, interviewees, and data sources.

Even if platform strategy has been applied for many years across industries and firms, analogous with literature, the definitions vary. There are some expressions such as “platform strategy is standardization and thus reduction of part number” or expressed in other words: “re-use of parts across projects and products”. Some interviewees connect the definition of platform strategy with the nature of commonality within platform strategy in terms of: “platform strategy means standardization through over-engineering or under-engineering across products to generate common parts”. In this expression, the tradeoff between commonality and differentiation is routed in the compromise that platform strategy leads to over-engineering for some products and to under-engineering for others.

In particular, within the automobile industry, there is a differentiation between platform strategy and modular platform strategy (in German: Baukastenstrategie). The main reason for this kind of differentiation is due to flexibility. The term “platform strategy”
is linked to a rigid system of common parts which is applied across products without any modifications. Therefore, because of more individualization, the trend changed within the automobile industry. More flexible platforms are required which are enabled by modular platform strategy. The modular platform strategy means that the platform itself is not rigid and can be changed through substitution of modules with standardized interfaces as a prerequisite. One expert expresses the difference between platform strategy and modular platform strategy as: “fixed, not changing building blocks vs. flexible and changeable building blocks”. However, to some experts, platform strategy and modular platform strategy are the same. The expression in this context is: “platform strategy and modular platform strategy means common parts and common technology across products”.

Even if there are some differences in details, the core and main thought is the same. Hence, platform strategy is standardization across products whereby different kinds of standardization such as standardization of components and standardization of interfaces are realized. The standardization of interfaces means modular product architecture. Therefore, the applied definition of “Baukastenstrategie” in German industry conforms to modular platform strategy whereby pre-defined modules and interfaces are developed. Thus, in this research, the expression of “modular platform strategy” is considered as a synonym for “Baukastenstrategie”.

4.2 Objectives, Motives and Reasons for Implementing Platform Strategy

In order to understand the tradeoff between the conflicting objectives of commonality and differentiation, there is a necessity to look at the underlying reasons for it. Therefore, there is a need to understand objectives, motives and the underlying reasons for implementing platform strategies. Taking all these considerations into account, all data concerning the objectives of platform strategy were analyzed.

There are various reasons and motives for implementing platform strategies. On the one hand, companies try to generate growth through product variants to enter into as yet unoccupied market segments. The underlying thought is that product variety leads to an increase in revenue although admittedly also to an increase in cost. To compensate
for incurred costs, companies implement platform strategy and generate cost reduction by commonality. In the end, the revenue increase over-compensates for cost, driven by variants, and leads to an increase in profit. Furthermore, there are other motives mentioned to increase revenue, such as reducing time to market and increasing quality driven by commonality within platform strategy. In summary, the generic objective and motive for implementing platform strategy is also known by various interviewees as follows: “to optimize the profit, either by decreasing of costs and/or increasing revenue by over-compensating for incurred costs”.

In addition to economic factors, there are some expressions about a “chaotic situation which should be solved by platform strategy”. The “chaotic” situation is linked to the huge number of product variants resulting from historical development of product variants. Therefore, in contrast to the situation of generation of profit which is positive, a further objective will also be to avoid more chaos or to stop chaos in terms of the huge number of product variants. At this stage, companies want to “optimize the internal variety”, in other words, variants without any customer relevance or not perceived by customers should be decreased. The term “internal” is used because these variants have no impact on the customer (external from the company’s point of view). Therefore, if companies realize such commonality about internal variety, customer requirements are not affected. However, each internal variety (e.g. for fulfilling basic legal requirements not explicitly expressed by the customer) is an enabler to provide products in general.

In this context, it is very interesting that platform strategy is perceived by some interviewees as an instrument to solve the conflict objectives between costs and differentiation and does not cause this conflict. The underlying reason for this argument is that commonality can be realized without any impact on the customer through commonality regarding components realized for fulfilling internal variety. Therefore, in contrast to the view that platform strategy should balance commonality and differentiation appropriately, this often leads to the conclusion that platform strategy is a means of reducing costs by commonality without any negative effects on revenue and competitive market positioning. One of the popular examples mentioned by some interviewees is the common powertrain applied across brands. From the interviewees’ perspective, platform strategy based on the powertrain enables huge savings because components of a powertrain are irrelevant from the customer’s point of view and thus
not important for differentiating between brands. The main aim of optimization of internal variety is to optimize the current chaotic situation driven by a huge number of product variants. Therefore, the reference for the optimization is the current situation from which internal variants can be reduced by commonality within platform strategy. The key performance indicator for such a kind of optimization is the reduced number of components through commonality. In summary, in this context, there is no risk concerning differentiation driven by commonality. Considering these expressions leads to the question of why it is often also mentioned that commonality and differentiation within platform strategy should be balanced.

In conclusion from the considerations above, the conflict between objectives of commonality and thus cost reduction and differentiation, and hence the necessity of balancing between them, comes into being if the commonality degree is higher and thus exceeds components fulfilling the internal variants. Therefore, if the commonality degree should be increased above the level of internal variety based on the same requirements across products and brands, only then will the conflict between commonality and differentiation arise. If a company enters this level of commonality degree, the problem and the necessity to balance commonality and differentiation should be considered. Therefore, the conflict objectives and tradeoff between commonality and differentiation are not an issue if a company optimizes their internal variety based on equal requirements across brands and products and measures it with the current level of the number of internal variants.

Hence, subsequently, the results from the data analysis for the conflict objectives based on the 2nd level of commonality degree, which requires a balancing process between commonality and differentiation, are described in more detail in the next chapter.

4.3 Impacts and Derived Conflicting Objectives driven by Platform Strategy

Even if the generic objectives followed by implementing platform strategy are obvious, nevertheless, the intentional and unintentional effects of platform strategy should be clarified in order to recognize under which circumstances the tradeoff situation comes
into being. Therefore, data are analyzed concerning the impacts and potential tradeoffs driven by platform strategy.

### 4.3.1 Impact on Cost

Platform strategy is commonality across products and brands. Commonality leads to impacts on the cost dimension. In this context, lower complexity costs and production investment are mentioned. The complexity costs are reduced because of lower product variants and thus lower part numbers should be administered. The reduction of part numbers ranges from 20% to 60% according to the analyzed data. The reduction of part numbers means lower development and administration costs. The lower production investment is caused by common tools and processes within production. In this context, production platform strategy is often mentioned within the single case study.

Whilst cost effects concerning complexity cost and production investment are beneficial across all data sources, effects on other types of cost are ambiguous. Considering product cost, on the one hand, platform strategy leads to lower product cost driven by scale effects based on increased quantities through commonality across products and brands. On the other hand, if commonality is based on high-positioned products, it leads to over-engineering for lower positioned products, so in the end, the product cost of lower-positioned products will possibly increase. While some interviewees see this aspect as critical, others emphasize that even if for some products costs increase, there are positive effects on other types of cost, such as development costs, time to market and so on.

In general, commonality driven by platform strategy leads to a reduction of development costs and as a consequence thereof to a reduction of development-time, whereby there is a difference dependent on the development phase. While initial development costs are higher than the individual development cost, caused by different requirements, the development costs can be significantly reduced in later phases. In the end, the sum of the development costs is lower than the individual development cost. The high initial development cost is emphasized in the case study, caused by the large effort for decisions for commonality and differentiation across a huge range of products
and brands. Therefore, interviewees mention that this high initial investment is only possible with a sound financial background within the company.

### 4.3.2 Impact on Differentiation

In addition to the impacts on the cost dimension, platform strategy also leads to various differentiation dimensions, such as product performance, product variety, innovation, time to market and quality. Experts emphasize that in particular companies with a differentiation strategy with premium products perceive negative effects on innovation and product variety through platform strategy.

The commonality across products leads to more similarity among products. Therefore, commonality would in some cases possibly lead to a loss of product differentiation, thus to a decrease of product performance. The effects on differentiation concern both internal differentiation (differentiation across products and brands within the same company/organization) and external differentiation (differentiation of own products and brands from products of competitors). Considering internal differentiation, it is emphasized that cannibalization of products and brands should be avoided. Considering external differentiation, it is often emphasized that the competitor is the benchmark. Therefore, decisions about commonality and external differentiation should be oriented around the competitor.

Usually, commonality driven by platform strategy also leads to lower product variety, which is a criterion for differentiation under certain circumstances. Some interviewees see this effect positively in terms of reducing the chaos with respect to internal variety as a main target of platform strategy. Others see the main aim of platform strategy as standardizing interfaces in order to maximize or at least enable the same level of external product variety.

Furthermore, the perception about the effects of platform strategy on innovation is controversial. On the one hand, platform strategy is linked to low flexibility caused by a high commonality degree which leads to a rigid system of complicated innovations. So, innovations cannot be realized without high costs caused by necessary in-depth changes of product architecture in order to realize them. This effect leads to an increase of the period of amortization of the initial efforts. One expert even formulates the negative
effects on innovations as “destruction of creativity of the organization”. On the other hand, it is emphasized that commonality is the main key to innovation, because through scale effects it is possible to realize technology innovation which is otherwise not economically feasible across products and brands. In addition to that, commonality leads to savings of resources which can be applied for innovations, so commonality driven by platform strategy has an impact on innovation, indirectly allowing a high ability for innovation over the life time.

A further impact of commonality is on the time dimension. In this context as well, data show various ranges of perceptions. On the one hand, commonality will potentially lead to reducing time to market because components/modules/systems are developed only once. On the other hand, if the commonality degree is so high that there is low flexibility, changes take a long time, reactions to market changes are lower and disadvantages concerning time to market are generated. Moreover, in the context of time, the high initial effort caused by the great need for coordination is very often emphasized.

In addition to that, commonality driven by platform strategy also has an impact on quality. It is mentioned that commonality leads to an improvement of the learning curve and matured and already validated components/modules/systems. However, in the case of breakdowns, these breakdowns will be multiplied across products and brands caused by commonality within platform strategy. The consequence will be product recalls and loss of good image. Therefore, it is emphasized that common parts within platform strategy should be validated more in-depth than individual parts.

In summary, in line with literature, platform strategy is connected with high chances, but also high risks. Therefore, successful application of platform strategy depends on how this strategy is realized. It is important to know how the impacts vary dependent on the kind of commonality, which is shown in the next chapter.

**4.3.3 Impact dependent on Kind of Commonality**

Commonality across products and brands serving the same product and brand requirements is positive without any concerns for differentiation. Therefore, in this case, there is no conflicting objective between commonality and differentiation. The main
types of commonality mentioned in data are based on over-engineering, under-engineering and commonality of interfaces with different impacts.

The commonality based on over-engineering occurs if the common component/module/system should fulfill the highest requirement and is applied to products with lower product requirement and lower target cost. Therefore, over-engineering potentially exceeds the target cost of lower-positioned products. At the same time, based on scale effects, this kind of commonality will have potentially positive effects on product cost. The cost of higher-positioned products can be decreased since the development is based on the target cost of the higher-positioned product and, in addition to that, scale effects through volume increase are generated. Therefore, as a result, the additional scale effects will lead to a reduction of product cost of higher-positioned products. From the point of lower-positioned products: if the scale effects are higher than the over-engineering cost effects, then it would also lead to lower product costs, but if not, the target cost of the lower product will be exceeded. From a differentiation point of view, there is a high risk of cannibalization of the higher-positioned product by the lower-positioned product, since through commonality by over-engineering the product performance connected with this commonality will be more similar than before. In other words, the performance of the lower-positioned product increases, so the performance gap to the higher-positioned product is smaller than before.

Under-engineering is the exact opposite of over-engineering. In this case, common components are designed for lower-positioned products and thus at a lower product cost level. This common and reasonable component is applied to products with higher product requirements which can only partly be fulfilled or not at all. Therefore, this type of commonality will lead to potential losses of internal and external differentiation of the higher-positioned product. The underlying reason for loss of internal and external differentiation is that product performance of the higher-positioned product is more similar to the lower-positioned product than before. And at the same time the commonality by under-engineering will lead to a lower product performance level and thus to a loss of product performance, which also means a loss of external differentiation compared with competitor-products. Moreover, under-engineering for higher products will not only have an impact on customer-relevant requirements, but also on non-
customer-relevant requirements. So in the worst cases, it can also lead to a failure in basic requirements and thus prevent provision of products on the market in general.

In contrast to the cases mentioned above, commonality of interfaces has no impact on product performance, since performance itself is transferred by components/modules/systems and not by interfaces. Through commonality of interfaces, product cost will probably increase, since standardized interfaces should be designed on the boundaries of components to allow a modular connection of flanking components which are not designed in the case of an individual design optimized to target cost. However, this cost increase is less compared to commonality by over-engineering. Through standardized interfaces, positive effects on development and complexity cost as well as on product variety, time to market and quality are expected. Standardized interfaces allow a reduction of development time, since modules can be integrated easily, and as a consequence to this, development cost reduction can be generated. The required investment is also less since the same tools can be re-used.

Furthermore, commonality of interfaces allows positive effects on product variety caused by the ability for integration of various options through various modules.

4.3.4 Conflicting Objectives derived from Impacts on Cost and Differentiation

Commonality serving equal product and brand requirements is positive and has no negative impacts on differentiation. Therefore, it is often mentioned that “platform strategy allows cost reduction with no loss of differentiation”. The reason underlying this expression is caused by the fact that common components serve equal product requirements across products and brands. Hence, this product performance connected with these requirements is not differentiating. It means that companies with this type of commonality are on entry level within platform strategy. In this context, companies want to optimize their “chaotic” status, or in other words, internal variety. At this stage, there are no conflicting objectives.

If commonality serving different product and brand requirements, impacts on cost and differentiation, it is both positive and negative. These impacts vary depending on the kind of commonality. In summary, the following conflicting objectives will potentially occur.
Conflicting objectives within cost dimension are in general as follows. Commonality within platform strategy leads to cost reduction for different kinds of cost such as development cost, complexity cost, investments. There is a clear impact relationship. Not so obvious is the impact on product cost. Commonality leads to higher volumes of common components, which in turn leads to scale effects and thus to reductions in product cost. However, if the type of commonality is characterized by over-engineering and cannot be over-compensated by scale effects, the consequence is an increase in product cost. Therefore, in conclusion of this consideration, differentiation in terms of designing variants exactly at target cost level will also lead to a reduction of product cost. So in such cases, the target cost of the lower-positioned product is only achievable by designing a cost-related variant.

Impacts of commonality driven by platform strategy on differentiation also depend on the situation. The positive impact on time to market only exists if platform architecture is not rigid or if common components are not underlying dynamic market changes. Furthermore, the impact on innovation is only positive if commonality captures product sections which are not underlying changes driven by necessary innovation. Thus, resources saved through commonality in non-innovative product sections can be applied for innovation in other product sections. The improvement of quality is only positive if common parts within platform strategy are validated more in-depth, which leads to higher development costs, to avoid multiplication of breakdowns and product recalls. In addition to that, the impact of commonality on product performance and product variety is only negative if external product variety is restricted and customer-related product performance cannot be realized because of under-engineering.

The kind of commonality within platform strategy also has an impact on conflicting objectives. The commonality which leads to over-engineering potentially leads to conflicts within the cost dimension and from an internal differentiation point of view. The loss of internal differentiation occurs if commonality of components contributing to product performance of higher-positioned products is carried over to lower-positioned products with lower requirements regarding product performance and low price level. Commonality by under-engineering for customer-related product scope will lead to loss of external differentiation in comparison to the competitor caused by not being able to fulfill necessary performance requirements because of under-engineering. In addition
to that, under-engineering leads to cannibalization (loss of internal differentiation) of higher-positioned products by lower-positioned products if product performance of the lower-positioned product with a lower price is approximate to the higher-positioned product with the higher price. In the end, customers will increasingly decide for the lower-positioned product, since he/she gets a low-priced product with approximately the same product performance.

Commonality of interfaces within platform strategy leads to positive effects. However, this kind of commonality also leads to lower cost reduction compared to commonality of components driven by platform strategy. Therefore, missing targets of cost reduction expected by platform strategy is potentially not possible if only commonality of interfaces is applied.

Derived from the above considerations, there are different kinds of tradeoffs solved by commonality and differentiation decisions within platform strategy. A conflicting objective between product cost and investment exists if scale effects do not over-compensate for the increasing product cost caused by commonality of over-engineered components/systems/modules. A conflicting objective between product performance/variety and cost reduction occurs if decisions concerning commonality and differentiation about components should be made which contribute to customer requirements and innovation and at the same time underlie dynamic market requirements, because if these kinds of components are common, it will lead to a lower product performance and to a later time to market because of the required changes. And if these kinds of components are differentiated, the targeted cost reduction cannot be realized. In addition, commonality within platform strategy only leads to an improvement in quality if there is an in-depth validation on common components, even if, in turn, it leads to higher development costs which contradicts the aim of platform strategy to reduce development costs. The tradeoff between cost and differentiation in terms of missing the cost reduction target by fulfilling differentiation requirements is a potential consequence of commonality of interfaces.

After the potential tradeoffs/conflicting objectives driven by platform strategy have been described, identified factors intensifying these tradeoffs and founded in data are described in the next chapter.
4.3.5 Intensity of Conflicting Objectives

In this context, intensity is the degree of challenge to balance commonality and differentiation based on the degree of the conflict between objectives. There are various circumstances mentioned, varying the intensity of conflicting objectives. What is remarkable is that some experts do not discuss conflicting objectives, but instead talk about wasted potential for commonality. Wasted potential for commonality is the potential not used to standardize across products and brands based on the same requirements without any impact on differentiation. No impact on differentiation means no tradeoff and thus no intensity of conflicting objectives. So, the intensity of conflicting objectives increases dependent on the level of attempts for commonality across products and brands. After the wasted potential for commonality is realized and the company searches for more commonality based on unequal requirements to reduce cost further, the intensity of conflicting objectives will be exacerbated. This is particularly the case when the economic situation of the company is not good and thus there is a tendency for a high degree of commonality in order to achieve a high cost reduction. As a result, if high cost reduction effects should be realized by commonality, the risk of loss of differentiation and thus intensity of conflict between commonality and differentiation will increase.

Furthermore, product portfolio strategy aiming to serve the whole market will also increase the intensity of the tradeoff between commonality and differentiation. This is reasoned by higher heterogeneity of requirements across products and brands and in particular concerns those companies aiming for growth by way of higher product variety. Considering the high heterogeneity degree of requirements across brands, the situation is also challenging for multi-brand companies. The higher the number of brands and the higher the heterogeneity of requirements, the higher the intensity of conflicting objectives between commonality and differentiation across brands. Thus, the intensity of conflicting objectives depends on the extension of the platform across product and brand portfolio. The extension decision is often made top-down by top management, as mentioned by many experts and participants from the case study. For this decision, top management considers the similarity of products and brands characterized by product architecture features. Through this approach, the intensity of
conflicting potential is implicitly reduced, since the homogeneity of requirements, grounded in similar product architecture characteristics, increases before any considerations and decisions are made. The intensity of conflicting objectives is also different across types of modules, as shown by the case study. While some modules are a part of one platform and applied only to products and brands based on this one platform, others are applied across platforms. Hence, modules applied across platforms are underlying a higher intensity of conflicting objectives because of a higher degree of heterogeneity of requirements which should be served by these modules. In addition to the considered requirements primarily from a performance perspective, it is interesting that the extension and thus boundaries of the application of a platform is also characterized by achievable cost, which is shown by the case study. The mentioned example shows a top-down decision for a new low-cost platform, because already existing platforms were not able to achieve the required low cost-level of products based on the platform.

Moreover, the type of customer is also mentioned as a factor intensifying the conflicting objectives between commonality and differentiation. While b2b customers are more focused on cost (and thus commonality), b2c customers are more oriented towards differentiation. Therefore, in particular for b2c markets, the intensity of conflicting objectives between commonality and differentiation is higher, since both cost and differentiation are important to the same degree. Considering customer characteristics, it is also important how far customers can influence product development. If the influence of the customer on the product development process is high, then commonality will not be easily realized, which in turn leads to failing cost reduction with regard to commonality.

The potential and intensity for conflicting objectives between product cost and investments is influenced by volumes, since reduction of product cost based on scale effects depends on generated common volumes. Three main volume scenarios are mentioned by experts: a) piece production, b) favorable volumes allowing scale effects, and c) high volumes without any scale effects (more volumes will lead to higher investment because of achieved boundary capacity). In the case of a) and c), the intensity of conflicting objectives between product cost and investment will be low, since in these cases the main aim of platform strategy will be to reduce investments.
because there is no potential to reduce product cost by way of scale effects. In the case of b), the objectives of reduction of product cost and investment should be balanced, since in this case both product cost and investment play a decisive role.

In summary, the intensity of conflicting objectives within platform strategy depends on the commonality targets, economic situation of the company, degree of heterogeneity of requirements across products and brands influencing the platform, type of industry (b2b, b2c) with regard to the influencing degree of customer for product development, and volumes (see table below).

<table>
<thead>
<tr>
<th>Differentiation</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>homogeneity of requirements, high impact on differentiation</td>
<td>high intensity, low impact on cost, cost-driven business (b2b), investment-driven</td>
</tr>
<tr>
<td>homogeneity of requirements, low impact on differentiation</td>
<td>low intensity, low impact on cost, differentiation-driven business (b2c), investment-driven</td>
</tr>
<tr>
<td>no impact on differentiation</td>
<td>commonality, commonality</td>
</tr>
</tbody>
</table>

Table 4: Dependency matrix - intensity of conflicting objectives

### 4.4 Balancing Conflicting Objectives of Commonality and Differentiation within Platform Strategy

After the problem of conflicting objectives within platform strategy has been described, solutions for conflicting objectives within platform strategy derived from good practice will be shown, analyzed by data. As mentioned by experts, platform strategy itself is not risky and disadvantageous, but rather how platform strategy is managed presents a risk, especially in terms of how commonality and differentiation is balanced. This is confirmation for the relevance of the research topic from a practice point of view.

#### 4.4.1 Generic Decision Rules & Commonality-Strategy

In general, establishing boundaries for commonality and differentiation is mentioned as follows: “maximization of possible commonality in order to maximize cost reduction, and achieving sufficient differentiation at the same time in order to optimally serve the
customer and to ensure brand image”. While some interviewees mention that commonality for customer-related parts (parts perceived by the customer) should be avoided, others see no problem in commonality for customer-related parts if there is a sufficient differentiation achieved at the end. The argument for this is that if there is a sufficient differentiation achieved at the end, commonality should be used to compensate for the cost increase driven by product variety.

Sufficient differentiation is divided into internal and external differentiation. Sufficient internal differentiation is necessary in order to avoid cannibalization within one’s own product and brand portfolio and thus a reduction in revenue, which will be the case because of similar performance levels for lower prices. Therefore, it is also often mentioned that loss of internal differentiation should be avoided especially between products which are buying options from the customer’s point of view. The required external differentiation is based on ensuring competitiveness between products and brands. Ensuring competitiveness between products and brands means that performance loss towards competitor products and brands because of too high a commonality degree should be avoided. Otherwise the customer will decide on competitor products, which will lead to a reduction of revenue. In this context, experts emphasize that ensuring external differentiation is not an aim of its own, but rather ensuring competitiveness and profitability of products, since revenues and profitability can only be achieved if performance requirements for products and brands are ensured. As a result, the generic decision rule is based on an appropriate balance of commonality and differentiation (internal & external) in order to maximize profitability.

In addition to that, derived from data analysis there are two options for commonality: a) lowest commonality, and b) maximum possible commonality. The lowest commonality is based on equal requirements without any influence on differentiation and thus fulfills all equal requirements for differentiation. The establishing of lowest commonality is based on a bottom-up process and democratic. The cost reduction with this kind of commonality is realized by using common parts for equal requirements across products and brands, and common interfaces without any negative effects on individual differentiation requirements. The lowest commonality strategy is linked with a low potential for cost reduction, however, also a low risk for differentiation. In contrast to a), considering the commonality strategy form type b), the approach for defining
commonality is top-down and hierarchical. In this approach, there is a conscious compromise for differentiation of products and brands. Finding the optimal compromise across product and brand portfolio is the main target of this commonality strategy. In addition to commonality of interfaces (type a), commonality is also consciously based on over- and under-engineering which is linked to the necessary commitment to generated compromises. The reason for this compromise is to achieve more cost reduction in a comparison to commonality strategy from type a. However, the higher cost reduction is also linked to higher risks concerning differentiation. Therefore, companies following commonality strategy type b) within platform strategy are engaged to steer the differentiation risk. In summary, there are 2 main commonality strategies within platform strategy with different chance (cost-reduction) and risk (loss of differentiation) profiles and thus a different intensity of the tradeoff between commonality and differentiation. On the one hand, not as yet used cost reduction is realized based on equal requirements without any influence on and risk to differentiation. On the other hand, higher cost reduction is realized until the point of an acceptable risk of differentiation. The latter approach underlies conflicting objectives between commonality and differentiation. The decision criteria and how good practice companies handle this tradeoff is subsequently described.

4.4.2 Decision Criteria to balance Conflicting Objectives

There are various kinds of decision criteria applied in practice. These decision criteria can be clustered into cost and differentiation dimensions (with the aim of increasing the revenue). In addition to technical feasibility, analysis concerning cost drivers is executed in order to recognize focus areas. Exemplarily, if a company’s purpose is to primarily reduce development cost, the product scope with high development cost is common and low development cost intensity is differentiated. So, cost in general is a decision criterion, whereby the kind of cost considered depends on how significant it is for the company. The differentiation criterion is correlated to product and brand performance perceived by the customer and linked price positioning. In addition to performance as a differentiation criterion, product variety is a further criterion in order to optimize the differentiation dimension. Product variety is a result of variety analysis derived from
requirements whereby requirements can also be divided into legal (must have) requirements and customer requirements.

As mentioned before, conflicting objectives occur if cost-and differentiation-requirements vary across products and brands. As some interviewees mention, exemplarily fulfilling of higher requirements (because of required premium image) of some products also based on the same platform leads to conflicting objectives. On the one hand, developments fulfilling the higher requirements lead to exceedance of target project cost (if a specific variant should be developed for a premium brand) which should be funded by all brands of the platform. On the other hand, fulfilling these requirements leads to over-engineering for lower-positioned products and thus to exceedance of target cost of these products, since the performance level of the module to fulfill this requirement is too high from the perspective of the low-positioned products. So, in this case, there is a conflicting objective within the cost dimension between brands and products based on the platform. As also mentioned by many interviewees, the decision within a good practice company in such a conflict situation is always made from a company perspective and not based on a specific product and brand perspective. It means that either the premium brand has to accept the compromise that some differentiation requirements are not fulfilled, which is a loss of differentiation for the benefit on the cost side from the company perspective (e.g. ensuring of target cost for products will be more profitable from the company’s perspective compared to the fulfilling of differentiation requirements of one specific brand). Alternatively, the module variant is developed for the premium brand to the detriment of development cost. Therefore, each decision concerning commonality and differentiation has a different impact on products and brands. Whilst the decision for some products and brands is advantageous, the same decision could be disadvantageous from the perspective of other products and brands. This is the reason why the good practice approach is always based on a “holistic evaluation across products and brands”, as mentioned by the interviewees. The holistic evaluation across brands and products is based on a holistic objective system by top management. The case study in particular shows that a multi-brand company should follow the decision criteria of “holistic evaluation across products and brands”. As a result, commonality and differentiation decisions are based on the generic rule: balancing commonality and differentiation with
the consequence that there is a sufficient differentiation for each product and brand in order to ensure and increase revenue and at the same time to realize cost reduction through commonality in order to optimize the profitability. The sufficient differentiation level is not the same as fulfilling all differentiation requirements which is expressed by interviewees as an “acceptable compromise on differentiation”.

As shown in the case study, the process underlying this generic decision rule is executed by committees. There are committees at module level, platform level, product level, brand level and company level. These committees allow a multi-perspective on commonality and differentiation decisions within platform strategy. The final decision is always made at company level based on financial data, which is a clear indicator for the decision criterion: achieving the “optimum from a company perspective”. In addition to that, some interviewees from the case study also mention that budget and feasibility restrictions from a resource perspective are further criteria considered within the decision process for balancing commonality and differentiation within platform strategy.

4.5 Good Practice balancing Conflicting Objectives

4.5.1 Application of Appropriate Type of Commonality dependent on Existing Circumstances

One possible way to balance the conflicting objective between commonality and differentiation within platform strategy is to decide on a specific type and product architecture level of commonality.

The decision frame for commonality and differentiation is different in terms of the product architecture level: component level, module level, or system level. Considering the case study, commonality decisions are exemplarily made at module level. There are different possibilities for the selection of common and differentiation components for each module. As a consequence, dependent on this selection or module platform strategy, there is a different impact on module cost and module performance, as shown in chapter 4.3.
Commonality through over-engineering means that the target cost of some products with lower performance requirements and thus lower target costs could be exceeded. There are some examples mentioned by the interviewees. Exemplarily, if a product with low quantity is over-engineered by common parts, the scale effect will not be enough to compensate the exceedance of product cost. This is confirmed by data within the case study which show that expensive technology is only applied to lower-positioned products if scale effects allow a lower cost of technology in general. Therefore, commonality by over-engineering could lead to conflicting objectives between product cost and development cost. A further effect of commonality by over-engineering is that performance of the lower-positioned product will increase and as a consequence is more similar to the higher-positioned product which could lead to a loss of internal differentiation and thus cannibalization. However, considering the case study in detail, there are also opposing expressions which do not conform to the loss of internal differentiation. Often, application of common high-technology features to lower-positioned products is mentioned as a positive side effect and not as cannibalization. The main reason for this argument is that even if differentiation elements are applied to lower-positioned products, there is still enough differentiation between higher and lower-positioned products so that there is no risk of cannibalization. This is also a confirmation of the mentioned generic rule: “maximization of commonality by sufficient (not maximum) differentiation”. As a result, derived from these effects, this type of commonality by over-engineering should only be applied if the target cost of the lower-positioned product is ensured by scale effects compensating the exceedance of the target cost (and thus achieving the aimed-for profitability) and at the same time only then, if through other features, sufficient differentiation is ensured across products. In the case of commonality by over-engineering without customer relevance, there is no risk/negative influence on differentiation, as shown in chapter 4.3.2.

Commonality by under-engineering is often mentioned within the context of a loss of external differentiation. In this case, the common parts are designed for a minimum target cost of the lowest-positioned product and are applied to higher-positioned products with a higher performance level. So commonality by under-engineering means it is beneficial from a cost perspective, however, performance and thus differentiation requirements of higher-positioned products could be missed. Therefore, this kind of
commonality is only appropriate if differentiation of higher-positioned products is not negatively affected for the sake of cost reduction.

According to some interviewees, described negative effects of commonality through over-engineering and under-engineering on differentiation are handled temporarily by way of different differentiation of products and brands. Therefore, a reduction of investment can still be realized, since these differentiation features are developed one time, and at the same time a loss of differentiation is avoided by implementing these differentiation features to different points of time across products and brands. Therefore, until the feature is implemented for further products and brands, the initial implementation is a differentiation feature for the first product which already implemented this feature. However, until implementation for further products and brands has been made, scale effects and thus reduction of product cost cannot be realized, or in other words, the scale effects by commonality are not as high as compared to the case of commonality implemented at the same point of time across products and brands. Therefore, this time strategy is appropriate if the main aim of platform strategy is to reduce investments such as development cost.

Commonality of interfaces is applied and often mentioned in the context of required flexibility in future. If a certain product scope underlies a high rate of dynamic driven by changing customer/market requirements or purposed innovations, commonality of interfaces is appropriate to enable a relatively fast substitution of modules which allows changing of performance by new integrated modules. Furthermore, if product scopes underlying a high rate of dynamic changes are based on changing customer/market requirements or purposed innovations, initial efforts, usually driven by platform strategy, should be minimized, since because of a high dynamic there is no possibility to amortize the high initial efforts. In summary, dependent on the dynamic change rate for product scopes, commonality of interfaces should be applied.

In conclusion, the conscious selection of commonality type taking specific circumstances into account provides a generic solution to conflicting objectives between commonality/cost reduction and differentiation. The final decisions are made based on the generic rule of: “maximization of commonality and thus cost reduction by ensuring sufficient differentiation at the same time”. The challenge is searching for and achieving
this end result. In other words, the solution of conflicting objectives can be easily exemplarily achieved by way of commonality of interfaces, however, maybe without exhausting the full potential of commonality and cost reduction which contradicts the generic rule of “maximization of commonality and thus cost reduction”. Maximization of cost reduction can also be easily adopted by commonality through over-engineering, which in turn, however, leads to differentiation of loss and thus contradicts “sufficient differentiation”. Therefore, both conditions of the generic rule should be fulfilled by a conscious selection of commonality types dependent on existing circumstances. In the next part, good practice with regard to searching for and finding of maximum commonality and cost reduction by sufficient differentiation at the same time is described.

4.5.2 Searching for and Establishing Optimum Balance of Commonality and Differentiation

In this chapter, identified approaches for searching for and establishing the optimum balance of commonality/cost reduction and differentiation are shown. In general, identified approaches vary. The difference between approaches concerns which product architecture-level decisions are made. While some data from experts shows decisions at component level, case study data show decisions at module, product, and brand level. The case study allowed a more in-depth insight into this approach of commonality and differentiation decisions at different product architecture levels. Therefore, subsequently, these insights are explained more in-depth.

4.5.2.1 Decision area

Considering the case study, the decisions concerning commonality and differentiation are made across several brands and products. Looking at market segment strategy, within one market segment, there are several brands and products with different price and performance levels serving different customer-groups. Thus, products and brands have different competitive strategies. While some products and brands are low-cost, others are positioned in a premium segment. The aim of platform strategy is realizing maximum cost reduction and at the same time ensuring individuality of brands and products. In general, products were divided into two main categories of product scope:
The logic underlying this division is based on the criteria “important from customers’ point of view” and thus relevant for differentiation (=cab) and “not visible from customers’ point of view and at the same time cost-intensive” (=product platform). While individual product scopes are developed by each brand and product project individually without any required commitment, applied modules of product platform should be committed across products and brands (see figure 10 below).

![Decision areas for commonality and differentiation across products and brands](image)

Through this top-down division of product scope into individual part and product platform, it is pre-defined in which product scope commonality within platform strategy should be searched for, and in which product scope differentiation features should be realized. As a consequence, the complexity of the decision for balancing commonality/cost reduction and differentiation is already reduced by pre-definitions.

At first glance, it seems that there are no conflicting objectives between commonality and differentiation, since differentiation requirements for each product and brand can be realized by individual product scope. However, there is still a conflicting objective within the cost dimension. The underlying reason for this conflicting objective could be the high cost of the product platform because of commonality by over-engineering which leads to the necessity for lower target cost for individual product scope in order to achieve product profitability in the end. In other words, because target profitability depends on achieving target cost for individual product scope and target cost for product platform, decisions on product platform have an influence on the individual product scope. Therefore, within the case study there were some critical voices,
especially from departments involved in the development of individual product scope, since if product platform is fixed in the pre-phase before development of individual product scope is started, there will be some potential conflicting objectives occurring in terms of how the lower and challenging target cost for the individual product scope should be achieved to ensure product profitability. A further aspect mentioned by some critical interviewees was that through pre-definition of individual product scope and product platform, and thus definition of decision areas top-down, there is no potential for commonality within individual product scope, even if there is no potential for differentiation. Experts talking in this context refer to “wasted commonality potential”, which is also important from the competitor’s point of view, since maximum commonality and thus cost reduction will not be fully achieved in this case.

Considering the balancing process to find an appropriate level of commonality/cost reduction and differentiation, the case study shows that top management decide top-down regarding number and application of product platforms to take product and brand portfolio into account. This decision implicitly includes the assumption that products and brands based on the same platform have a high degree of homogeneity of requirements. The homogeneity of requirements is related to the similarity degree of product architecture, which means the arrangement of modules with high cost, product class (meaning products with one market segment or neighboring market segments), and product price and thus indirectly product cost. Product cost is an important criterion for the selection and alignment of products and platforms to platforms, which is clearly shown by data through development of an additional platform for low-cost products. Through this pre-definition and alignment of products and brands to platforms, it is possible to achieve a high commonality degree/cost reduction and at the same time sufficient differentiation based on similar performance levels and correlated price levels. Of course, on the boundaries of each platform, there are products which can be aligned to one or another platform. Figure 11 below schematically shows how such decisions concerning number and alignment of platforms to products and brands which are made by top management could be.

The determined platforms are headed by a lead brand. The lead brand is selected by its relevance. Relevance is determined by the importance of the impact of platform to the brand. For example, if a brand has the most volumes, and thus the most impact on scale
effects, or if a brand is the most important from a profitability point of view, this brand is defined as lead brand for the modular platform strategy. However, the target of the lead brand is to consider all interests of brands equally and objectively and to manage platform strategy decisions driven by targets defined for platform strategy. Exemplarily, even if products of the lead brand are launched later than other brands based on the platform, the lead brand has the responsibility to initiate all necessary activities in order to implement platform strategy for other brands on time.

Figure 11: Example for top-down decisions of management for number of platforms and alignment of products and brands to platforms

4.5.2.2 Process

After platforms have been determined and the lead brand defined top-down, scenarios consisting of different selections of commonality and differentiation are developed bottom-up. All decisions concerning commonality and differentiation within platform strategy are prepared by interdisciplinary teams and SE (Simultaneous Engineering) teams and presented in decision committees with a favored scenario for decision. The decision committees consist of a vertical and horizontal organization structure (matrix). The vertical line includes all product lines based on the platform with an interdisciplinary composition and the horizontal line includes the steering organization of certain
platforms also with an interdisciplinary composition headed by lead brand. So, the linkage of module organization and product organization is realized by the platform organization. Under this organizational constellation, scenarios for platform decisions at module level and resulting impacts on product and brand differentiation are developed bottom-up. The impacts on product and brand differentiation are considered from an internal and external differentiation point of view including all economic consequences for the company. So, each type of committee looks to different consequences from different perspectives.

The final decisions and financial release for platform strategy issues are only made by the product steering committee, the company’s most important and powerful committee, since platform strategy is not a brand issue, rather it is a company issue. Before decisions are made at this level, each brand also has a brand steering committee whereby impacts of platform decisions are discussed from a brand differentiation perspective. The first brand steering committee where platform decisions are discussed is the brand steering committee of the lead brand, followed by discussions in further brand committees which are affected by the platform strategy decision. If a platform strategy decision across brands and products in one of the committees is not achieved, then issues are escalated to the next level of committee. Then, decisions made at the next level are communicated to committees at lower levels through to the module committee. After platform strategy decisions are made, the exit of a brand is possible until a certain milestone is met during the product development process without any financial consequences. However, if a brand exits after this milestone, the financial plan should be adhered to in any case. Therefore, brands and all parties within the decision phase are focused on making the right decision in order to avoid paying for modules without any benefit, since each brand is responsible for the profitability of its own products at the bottom line.

4.5.2.3 Modules

Considering modules in more detail, the selection of modules for the platform is decided by a separate steering committee at company level. The modules are released by the operational working group at module level. The modules consist of a common scope across all applications. Furthermore, modules have a variation scope varying within
some parameters across all applications, and a differentiation scope distinctive across all applications. In order to integrate brand and product interests, participants from the brand and product line organization are involved in the module development process to determine the common, variation, and differentiation scope. So, modular platform strategy consisting of modules and its determination concerning commonality, variation and differentiation is based on the requirements of products and brands. There are two types of modules called: “platform modules” and “independent modules”. While platform modules are applied exclusively for one determined platform, independent modules are applied across platforms. Through top-down determination of which products are based on which platforms, the decision frame for platform modules and thus which product and brand requirements should be considered during module development, are also determined. In contrast, the decision frame for independent modules is across all products and brands. To illustrate the considerations concerning modules, see figure 12 below.

The underlying logic, or in other words, determination criteria of the independent module is based on the relatively high cost relevance of modules and thus relatively high potential of cost reduction by platform strategy. The challenge for development of independent modules and decision-making concerning common, variation, and differentiation scope is significantly higher than for platform modules, since not only the higher heterogeneity of requirements of products and brands is challenging, but also requirements of each platform should be considered in order to integrate these modules into platforms. Both platform modules and independent modules are scalable. The main generic decision rule for both kinds of modules is to maximize cost reduction by maximum possible commonality and at the same time to achieve sufficient differentiation based on target differentiation requirements and also to achieve target cost of the module, whereby target cost of modules is derived top-down from the target cost of the product.
The target cost for the module is determined by the lowest target cost derived from lowest product target cost based on the platform or, in the case of the independent module, derived from the lowest product target cost within the product portfolio. The target differentiation is determined by the product-applying module with the highest performance level. The range between these extremes is realized by scalable modules consisting of common (see figure 13 below: green) and differentiated scopes whereby the latter is divided into scaled variation (yellow) and fully unique scope (red). The scaled variation scope leads to a lower cost than fully unique parts. The reason is that the variation scope is conceptually equal across applications and requires exemplarily lower development costs. The common scope could be common parts or common interfaces (see above type of commonality). As mentioned above, common interfaces allow a lower risk of differentiation, however, also a lower chance for cost reduction than other commonality strategies within platform strategy.
Figure 13: Platform-strategy decisions across brands and products based on module level

Depending on the type of module, either the platform module or the independent module, the funding cost is divided into user products/brands. In the case of the platform module, the cost for development is divided by user products and user brands of each aligned platform. In the case of the independent module, the funding is divided by user products/brands across platforms. Thus from a product profitability perspective, modules with development costs and investments can be implemented across products and brands for a significantly lower cost, since the high cost is divided by user. Therefore, the application of modules within platform strategy has a significant positive impact on product profitability.
From the perspective of each brand, using delete modules across products, brands, and platforms is economically beneficial. The underlying reason for this is that necessary investments are divided and are reduced significantly in comparison to the case of individual development. Furthermore, through the scale effect of common parts of modules, product cost will be reduced. As a result, the economically positive effects of platform strategy are also confirmed in the case study.

Considering the fact that cost reduction is realized by the common scope of modules and differentiation is realized by the variation and differentiation scope, there is purportedly no tradeoff between commonality/cost reduction and differentiation. However, the first glance is deceptive. According to the interviewees, a target conflict of course exists for the following circumstances. Through the top-down target for modules in terms of target performance, target cost and target investments, the consequence is reached that the common scope should be increased to achieve economic targets, which in turn leads to a potential loss of differentiation of higher-positioned products and brands by a limited differentiation scope. Or, vice versa, target differentiation leads to an increase of the differentiation scope, which in turn leads to exceedance of target cost and target investment. As a result, the exceedance of economic targets leads to highly challenging targets in the cab scope in order to achieve the targets at product level. A further critical aspect is that through the approach of the top-down decision area for platforms, the commonality potential in the cab scope remains unexhausted. So, in some situations even if there is commonality potential in the cab scope, a decision in the platform scope leads to target conflict which can not be solved satisfactorily from a cost and differentiation perspective. In addition to that, the decision process within this committee structure needs time, which in turn leads to a loss of time to reach market differentiation which is the aim of platform strategy.

In summary, the target conflict is not automatically solved by scalable modular platform strategy, although the approach is most appropriate for balancing commonality and differentiation within platform strategy. The target conflict is simply translocated from the product level to the module since the decisions concerning commonality and differentiation are made at module level. As a further result of the data analysis, how commonality and differentiation are balanced in good practice within platform strategy is subsequently shown in more detail.
4.5.2.4 Balancing Commonality and External Differentiation

As mentioned by most of the interviewees, the role of the competitor within platform strategy is described as “serves as benchmark”. This expression is used for all kinds of decisions regarding platform strategy, and also for decisions across product portfolio. Therefore, decisions balancing commonality and differentiation within platform strategy are always made to take the competitors’ performance, product cost and product price into account. The performance is expressed through differentiation towards the competitor while there are three types which are influenced by platform strategy decisions: product variety, product performance (also called product characteristics), and time to market and quality, as already mentioned in the chapter “impacts in differentiation”. Considering the economic parameters, for external differentiation product price is decisive, since between competitive products customers also decide because of product price. The realization of product price is linked to product cost and target profitability of the product. Therefore, to realize product price through external differentiation depends on product cost and thus on commonality decisions influencing it. This is the result of both the expert interviews and the case study, while the importance of parameters varies across data. The underlying reason therefore is the experiences of different participants within different business contexts. In other words, dependent on business context parameters are discussed with a different level of importance. Exemplarily, while time to market and product variety are relevant differentiation characteristics in one specific business context, in other business contexts product characteristics and quality are more important. Therefore, the expression “benchmark” means that one’s own products should be compared according to defined decision criteria while the definition and importance of decision criteria varies across business context. Hence, each consequence of commonality and differentiation decision for the pre-defined criteria, dependent on business context, is compared to the competitors’ products.

How this comparison is executed depends on the competitive strategy followed by the company. The competitive strategy is described as “west/European strategy vs. east/Asian strategy “or “low-cost provider vs. premium provider”. Also, as shown in the theory of competitive strategy, these expressions can be summarized under “cost
leadership”, “differentiation leadership” and a combination of both known as “hybrid strategy”. The competitive strategy defines through which way the company proposes to achieve over-proportional profitability. The strategy is transferred by products of the company which are compared to competitor products for pre-defined criteria dependent on the business context in order to have transparency of consequences of commonality and differentiation decisions within platform strategy. A company following cost leadership proposes high cost reduction through platform strategy in order to achieve higher profitability and/or lower prices and thus higher quantities compared to the competitor. In this context, it is often talked about “achieving competitive prices” based on realized high cost reduction though commonality within platform strategy. So, through this cost reduction by commonality within platform strategy, the company is placed in a position to be able to provide the lowest prices on the market. In contrast to cost leadership, differentiation leadership provides over-proportional performance to over-proportional/high prices to achieve over-proportional profitability. In this context, it is often talked about “revenue growths through portfolio growth (product variety)” which leads to higher costs. These higher costs are compensated for by commonality within platform strategy which enables over-proportional profitability by over-proportional revenue growth. Otherwise, revenue growth by way of portfolio growth with higher costs will lead to higher revenues, but not to higher profitability. The hybrid strategy proposes over-proportional profit through both strategies: over-proportional cost reduction (cost leadership) and over-proportional revenues (differentiation leadership). The underlying logic is to generate cost and revenue effects following a combination of cost leadership and differentiation leadership at the same time.

In summary, each commonality and differentiation decision within platform strategy is evaluated concerning price-performance ratio compared to the competitor. Thus, each decision concerning commonality and differentiation and its consequences is compared to the competitor concerning price and performance whereby the performance dimension according to external differentiation is pre-defined. From the point of view of differentiation leadership, decisions within platform strategy are made with the consequence that the external differentiation criteria (product performance, product variety, time to market, and quality) are better than the competitor. This rule is
emphasized by many interviewees with this expression: “even if economic benefits are significant sometimes, commonality should be avoided to ensure differentiation leadership compared to the competitor”.

The benchmark compared with the competitor is important to generate competitiveness from the customer’s point of view. The advantages from the customer’s point of view will be either price or performance. Even within one market segment the price-performance ratio varies. On the one hand, there are more performance-oriented customers, on the other hand there are price-focused customers. In any case, the customer decides on alternatives and therefore the role for the competitor is described as “benchmark” to provide the better alternative to the customer in terms of performance and price compared to the competitor. The determination of which customer group, performance-oriented and/or price-oriented, should be addressed by products, is described by the proposed competitive strategy.

While cost leadership aims for lower prices than the competitor to satisfy the price-oriented customer better than competitor can, differentiation leadership proposes providing better performance compared to the competitor. And in the case of hybrid strategy, the aim is to provide products with better performance and lower prices compared to the competitor in order to address the price and performance-oriented customer. Even if this hybrid strategy is a generic target of companies, at the same time experts mention that this kind of strategy is not realizable in most cases without “compromises”. This is also confirmed by Porter’s theory that companies can only realize hybrid strategy under specific and exceptional conditions. From this theoretical point of view and from the experts’ point of view, companies aiming for hybrid strategy and not realizing it are threatened by being “stuck in the middle” and neither satisfy price-oriented customers nor performance-oriented customers. In summary, customers have different preferences which can be clustered into price and performance. The different groups are served by different competitive strategies which in turn leads to the situation that commonality and differentiation within platform strategy are weighted differently dependent on competitive strategy. As a consequence, competitive strategy has an influence on commonality and differentiation decisions within platform strategy. So, good practice concerning the balancing of commonality and differentiation within
platform strategy requires a systematic compatibility of competitive strategy and platform strategy (see figure 14 below).

Figure 14: Balancing commonality and differentiation variants across competitive strategies

Derived from the data, dependent on competitive strategy, the main difference concerning the decision policy for commonality and differentiation is based on a distinct risk awareness of potential loss of differentiation. While cost leader incrementalism aims for maximal possible commonality with a relatively high risk of loss of differentiation, in case of doubt, the differentiation leader always decides for differentiation. The underlying reason for the policy of the differentiation leader is that over-proportional profitability is realized through product performance and thus differentiation which allows no compromises. In contrast, the cost leader provides less product performance and variety for a lower price. Associated with risk awareness of potential loss of differentiation, differences concerning the kind of commonality appear based on different core targets of each competitive strategy. The core target of the differentiation leader is to provide more product variety and to aim for high prices justified by high performance. In contrast, the cost leaders’ core target is to provide high volumes at lower prices by realizing high cost reduction based on commonality which leads to scale effects. Considering the risk awareness, potential quality problems from scaling failures of commonality across the product and brand-portfolio are more critical from the differentiation leader’s point of view compared to the cost leader, because the
consequences of potential quality problems are more critical for the differentiation leader (known as “luxury car brand”). Because of the mentioned differences concerning targets followed by competitive strategy, the selection of the kind of commonality and linked consequences is different. The differentiation leader selects commonality of interfaces primarily in order to react flexibly and quickly to potential changes on the market with the consequence of more or further variety, and only realizes commonality of components/modules/systems if there is no risk to product performance and thus loss of differentiation, called unused commonality based on equal requirements. In contrast, the cost leader selects commonality of parts/modules/systems with rigid product platform architecture in order to achieve maximum possible cost reduction. The cost leader implements platform strategy if there is a further cost reduction possible driven by lower variety and higher quantities which leads to scale effects based on commonality of components/modules/systems. In addition to that, and concluded from data, the cost leader selects commonality by under-engineering preferably, to realize higher cost reduction compared to commonality by over-engineering, although this approach is accompanied by a higher risk of loss of quality because of designing the common components based on lower performance levels, which in turn could lead to failures for application to higher requirements. In contrast, commonality by over-engineering is mostly applied by the differentiation leader, because of the aim of avoiding quality risk and thus ensuring the differentiation image. The ensuring of the differentiation image is necessary, since customers paying high prices for differentiated products have higher expectations regarding product performance and thus quality. In summary, the approach of balancing commonality and differentiation differs across competitive strategies justified by a distinct risk awareness concerning loss of differentiation and the kind of commonality applied within platform strategy. Therefore, there is a strategic fit between platform strategy decisions and proposed competitive strategy.

As shown in the case study, multi-brand companies follow different competitive strategies through products and brands. Therefore, product competitive strategies vary in multi-brand companies. As a result, it is interesting how good practice companies decide on their approach under such circumstances to bring different product and brand competitive strategies and platform strategy together, in particular to balance various
commonality and differentiation requirements considering the fact that different products and brands from different market segments are based on the same product platform. In this context, it is often mentioned that “decisions are made by weighing up between profitability and differentiation for a brand compared to the competitor whereby these aspects can influence the decision either way”. So, there are two options: a) “brand has to live with the compromise” - loss of differentiation, or b) “brand develops the required variant if it is profitable and funded by the brand itself” - lower cost reduction in favor of brand differentiation. In contrast to this, some interviewees mention that brand differentiation within the competition is ensured in any case, even if it is not profitable from a platform perspective. So, some interviewees emphasize that differentiation leadership should be ensured in any case even if cost reduction by commonality within platform strategy is not realized, since the main reason for profitability is driven by high price only available through differentiation leadership. Therefore, it is not a contradiction between these perspectives, but instead opinions about how the profitability is ensured. While some interviewees see it as being by way of realizing platform strategy, others mention that the profitability is better ensured by way of competitive strategy. Therefore, there are two different perspectives concerning how competitive strategy and platform strategy are prioritized with each other.

The listed options a) and b) answer the question of how boundaries for commonality and differentiation within platform strategy are defined. The mentioned options within commonality and differentiation decisions within platform strategy concern isolated case questions and are not from a holistic point of view which considers all consequences in sum at the end from the product and brand perspective. Therefore, the generic rule of: “maximization of commonality and at the same time achieving sufficient differentiation” complements this view of the isolated case decision appropriately. In summary, good practice for balancing commonality and differentiation within platform strategy takes the different product and brand competitive strategy into account. Either loss of differentiation for the brand is accepted if sufficient differentiation and thus product competitive strategy is ensured, or differentiation is realized to the detriment of cost reduction from the platform perspective, however with equal or more profitability driven by high prices of the individual product based on this differentiation. Considering the commonality and differentiation decisions as being isolated, there are
two options. However, which of these options is selected is answered through a holistic consideration evaluation which is described in chapter 4.5.3. So, also within multi-brand companies, striving for a strategic fit between platform strategy decisions and competitive strategy can be observed whereby the order of prioritization is not always obvious.

4.5.2.5 Balancing Commonality and Internal Differentiation

On the one hand, balancing of commonality and differentiation within platform strategy is based on external differentiation and thus impact on competitiveness. On the other hand, it is based on internal differentiation and thus one’s own product positioning. Ensuring internal differentiation within balancing activities between commonality and differentiation is known as: “cannibalization between products and should be avoided in any case”.

Both commonalities by over-engineering and under-engineering lead to more similarity of products concerning cost and performance. Commonality of over-engineering is designing common parts/modules/systems to fulfill the highest performance level. Therefore, in the case of commonality, lower-positioned products also have the feature realized by this common part/module/system, even if there is not a market requirement. The cannibalization occurs if this equal performance through commonality is relevant from the customer’s perspective. As a consequence, customers will decide for the low-priced product which provides the similar or even equal level of performance, mentioned in the data as “low-price product will cannibalize higher-positioned products”. If, in this cannibalization case the price of the low-priced product does not fit with the higher performance level, through higher product cost and higher volumes to the detriment of the high-priced products, the company’s profitability will decrease since the price remains stable while product cost increases. In the case of an increase in the price of the lower-positioned product because of higher performance level, price similarity and thus the same product positioning will make no sense from the market’s perspective, because there will be no two authentic alternatives rather than two products reflecting one alternative with the same price and performance level. In the case of commonality by under-engineering, common parts/modules/systems are designed for low performance level which will lead to a loss of differentiation of the
higher-positioned products. If there is no correlation between price and performance level, the lower-positioned product is the better option from the customer’s perspective, since the same or a similar performance level is provided at a lower price. Where the price matches the performance level, a lower price for a higher-positioned product, the higher positioned product is the better option from the customer’s perspective, since the higher performance level is at similar prices compared with the lower-positioned product. In this case, the higher-positioned product will cannibalize the lower-positioned product. As a result, potentially, the kind of commonality influences product positioning and leads to cannibalization, since either cost (and thus price - under the assumption that the aimed-for profitability should be realized) or performance is so similar that customers will decide either for the lower-priced product with similar performance or for a higher performance at a similar price. This phenomenon is also noted by various examples in literature. In conclusion, internal differentiation driven by product positioning should also be ensured by balancing commonality and differentiation within platform strategy. The expression of “sufficient differentiation” in the generic decision rule is equal to performance, and the price difference represented by product positioning.

The more similarity there is between the price-performance positioning of products and thus alternatives from the customer’s point of view, the higher the risk of cannibalization. Derived from the case study, a typical and schematic product and brand portfolio within the price-performance coordination system is shown below in figure 15. The price-performance relationship should be ensured to avoid cannibalization. While brand positioning is determined by the corporation, price and performance difference is derived from the requirement to serve different market segments. Therefore, in particular between neighboring products (e. g. P1 and P4, P3 and P6), the risk of cannibalization is high. In contrast, the more the distance of price-performance positioning (e. g. P1 and P6 minimum potential risk of cannibalization), the lower the risk of cannibalization, since even if there is some commonality across these products, there is always “sufficient” difference in performance and thus provision of real alternatives from the customer’s point of view.

Therefore, good practice always clearly shows the impact of commonality driven by platform strategy to product positioning in order to decrease the risk of cannibalization.
However, the case study in particular shows that this process should be steadily controlled; otherwise the existence of cannibalization will be recognized too late or not at all. As a result, commonality decisions are made individually, so that the sum of all individual decisions leads to a higher similarity of performance at the same time at different prices. The cannibalization is a slow process which occurs subconsciously. As shown in the case study, the corporation initially recognized the cannibalization effect within platform strategy, after volumes of lower-positioned products increase to the detriment of the higher-positioned product. Concluded from the case study, it is shown that even if commonality decisions within platform strategy are made individually for each decision, the impact should always be tracked at the product-positioning level.

![Internal differentiation and cannibalization across product portfolio](image)

**Figure 15: Internal differentiation and cannibalization across product portfolio**

### 4.5.3 Holistic Balance of Commonality and Differentiation

Both expert interviews and the case study show that platform strategy is one means to an end to steer cost and differentiation. There are further possibilities to influence differentiation. One example is to improve brand image and thus improve differentiation by advertising. On the cost side, for example localization of components
to countries with a low labor cost is a means of reducing the cost. Alternatively, design
to cost is also a well-known possibility for reducing product cost.

These insights are valuable, since they show that platform strategy decisions influence
cost and the differentiation dimension cannot be made independently from other
decisions and also affect cost and the differentiation dimension. In other words,
balancing commonality and differentiation within platform strategy should possibly be
executed by way of further activities in order to avoid negative effects at platform level.
Exemplarily, if commonality leads to a potential loss of differentiation, there are further
possibilities outside of platform strategy to compensate for this effect. Or, vice versa, if
differentiation is realized by advertising, there is more room for commonality within
platform strategy. Another consideration is that if there is a significant loss of
differentiation by commonality within platform strategy, other cost reduction methods
(such as measures without any effects on product performance) should be realized in
order to remain competitive on the cost dimension.

So, in addition to platform strategy, there are further actions possible which impact cost
and differentiation. Therefore, platform strategy decisions concerning commonality and
differentiation are considered holistically with other possible measures to balance
cost/commonality and differentiation.

4.6 Summary of Results

Balancing conflicting objectives of commonality and differentiation within platform
strategy is dependent on the commonality targets within the company. The first step
will be to realize the unused (wasted) potential of commonality based on the equal
requirements across product and brand portfolio. If this potential is fully realized, then
good practice companies striving for commonality targets based on unequal
requirements are linked with potential loss of differentiation. Therefore, the intensity of
the conflicting objectives of commonality and differentiation and the necessity for a
balancing act depends on the commonality target based on the already realized and
desired commonality degree, measured by equality of requirements of products and
brands.
Commonality within platform strategy impacts cost and differentiation and its sub-dimensions. Impacts clearly show that different conflict situations in terms of involved parameters will occur. There are conflicting objectives within the cost dimension between product cost and investment. Furthermore, there are conflicting objectives across different sub-dimensions of cost and differentiation, such as between product performance and cost reduction which are treated in-depth in literature. In addition to that, there are potential conflicting objectives between quality improvement and development cost and between time to market and cost reduction.

Dependent on the kind of commonality (over-engineering, under-engineering, interfaces), there are different kinds of conflicting objectives. The kind of commonality also influences the intensity of conflicting objectives within platform strategy. Moreover, the intensity will be strengthened and disarmed by the business context.

In summary, the conflicting objective situation in detail is not so obvious and should be clarified in the first step. Based on this identification of the concrete conflicting objective situation, solutions should be developed to balance commonality and differentiation appropriately.

The generic solution rule to balance commonality and differentiation is as follows: “maximize cost reduction by commonality by realizing sufficient differentiation at the same time”. Furthermore, there are different commonality strategies within platform strategy: a) lowest possible commonality degree with low risk for differentiation or b) highest possible commonality degree with some tradeoffs and c) between a) and b). The tradeoff relates to sufficient differentiation whereby external (towards competitor) and internal (own product and brand portfolio) differentiation is considered. The main objective of the solution is to optimize the profitability of the company, even if some decisions seem disadvantageous from the product and brand perspective. The kind of solutions for balancing commonality and differentiation are: a) selecting an appropriate kind of commonality dependent on business context and b) steering of commonality across products and brands at a different time in order to ensure product differentiation. Furthermore, balancing commonality and differentiation is always realized by ensuring competitive strategy, in other words to ensure sufficient external differentiation in comparison with the competitor measured by the dimensions of price and performance.
Considering the case study it is clearly shown that even good practice concerning balancing commonality and differentiation can be improved. The first improvement can be realized by unused (wasted) potential of commonality because of the top-down determination of the product scope where commonality and differentiation should be realized. Through pre-determination of differentiated product scope, there are no investigations at operative level about potential commonality. A further aspect is that time–to-market effects are compensated for by a long and complicated decision process involving many participants from the product line and brands.

A further main result is that good practice companies consider platform strategy as one means of impacting cost and differentiation. The decision-making process is executed holistically by integrating further actions and strategies also influencing cost and differentiation dimensions.

However, as mentioned in Chapter 3, the main limitation of qualitative research is that it allows no statistical generalization. Thus, making general statements about larger populations is not possible. Therefore, there is a need for longitudinal studies to capture/prove good practices of balancing commonality and differentiation within platform strategy.

Derived from the data analysis, results concerning the occurrence of conflicting objectives within platform strategy and current solutions to balance commonality and differentiation, as well as some conclusions and recommendations especially concerning process are made in the next chapter in order to support companies applying platform strategy. While tools and methods within the process are mentioned, underlying evaluations within these tools are not described in detail to keep the focus on the process itself.
5 Conclusions

5.1 Balancing Commonality and Differentiation within Product Platform Strategy emerging from Research

5.1.1 Definition of Commonality Targets within Platform Strategy to identify Potential Conflicting Objectives

The occurrence of conflicting objectives depends on commonality targets. This means that in order to identify conflicting objectives, it is necessary to clarify which commonality targets will be followed. In this context, the impact for the customer is an important issue to identify the effects of commonality on differentiation. Therefore, there are 4 main commonality targets in combination with the impact for the customer requirements:

a) Commonality without impact on explicit customer requirements. Commonality serves equal requirements (not explicitly mentioned by the customer) across products and brands.

b) Commonality without impact on explicit customer requirements, however, serving unequal requirements across products and brands.

c) Commonality with impact on explicit customer requirements which are equal across products and brands.

d) Commonality with impact on explicit customer requirements which are unequal across products and brands.

The conscious consideration of the kind of commonality target enables transparency about conflicting objectives and how this should be balanced. While a) is without any conflict, means d) has maximum conflict because of loss of differentiation based on commonality for customer-related unequal requirements. If b) is selected, there is a conflict within the cost dimension between product cost and investment, since different requirements connected with different product cost targets should be served with commonality. While investment can be decreased because of commonality, product target cost could be exceeded because of commonality. The option c) means there is no conflict expected because of commonality, since customer-related requirements are equal, however if option d) is selected already, commonality by c) will strengthen the loss of differentiation caused by d).
At this point, the sequence of commonality targets is also important. To realize commonality targets under a) and c) in the initial step is rational, since through this approach it is possible to gain from platform strategy without any negative impact on differentiation. After commonality potential is fully exhausted through a) and c), considerations about further commonality and cost reduction should be made first of all under b) and then d). Under d), maximum cost reduction is possible, however, with the highest risk for differentiation. Therefore, the main challenge arises if the company wants to realize commonality step d). Thus, in particular recommendations for balancing commonality and differentiation for step d) will be shown. Under step d), there are different conflicting objectives which should be handled. Conflicting objectives between product cost and investment occur if scale effects driven by commonality cannot compensate for the higher product cost through commonality by over-engineering. Conflicting objectives between product performance/product variety and cost reduction exist if components/modules/systems, related to customer requirements or affected by dynamic market requirements and innovation, are common. Furthermore, positive effects in terms of quality improvement by commonality can only be realized if common components/modules/systems are validated more in-depth to avoid multiplication of breakdowns across products and brands. Conversely, to the detriment of cost reduction (if not fully realized), commonality based on interfaces avoids loss of differentiation.

In summary, there is a need to define the commonality target in the pre-phase. In order to do this, there are many steps required. First of all, there is a need to capture the current situation on which level commonality is already realized. Second, if there is a need for more profitability by decreasing cost by commonality within platform strategy, realizing the next level of commonality is the aim with clear transparency about potential conflicts arising. Exemplarily, if commonality in terms of step a) and c) is not realized, it is not rational to begin the commonality considerations on step d). The reason is that cost reduction within platform strategy can be realized without any loss of differentiation, which is more rational before taking risks with regard to differentiation. So, there is a need to execute each step successively. These steps can be aligned to the well-known plan-do-check-act framework to satisfy the iterative logic. The main reason is that this tool is well-known and easy to apply. The step-by-step process execution by way of a plan-do-check-act logic is as following. After step a) (plan) and
linked cost reduction potential is determined (do), target cost reduction to realize more profitability should be checked and if enough, the process is ended (act). If not enough, and only then, the same process should be repeated for step c), and then for b) and finally for d).

This approach will assume that increase in product profitability is affected only by product platform strategy. However, the data analysis clearly shows that there are further strategies to influence cost and differentiation, such as advertising for premium brand image (differentiation) to achieve higher prices on the market, vertical integration to decrease cost and so on. Furthermore, realizing production platform strategy is also a potential measure to decrease cost without any impact on differentiation. However, a prerequisite for production platform strategy is product platform strategy. Therefore, the main success driver and challenge is an appropriate product platform strategy based on a balance of commonality and differentiation. Considering the effect of that there are many measures to steer cost and differentiation and thus profitability. The target profitability should be divided into planned strategies in order to know which parts should be contributed by product platform strategy. To know the target contribution of platform strategy and to analyze the current situation regarding in which step the company already realizes commonality (see above a, b, c, d) allows transparency about the gap which should be closed by platform strategy. Otherwise, commonality could be exaggerated with unnecessary negative impacts (e. g. realizing commonality level of d) with a high risk to differentiation even if step a) and c) are sufficient), and even if there are other possible strategies in order to achieve the cost decrease and fulfill the aimed-for target. Or, vice versa, commonality realized within platform strategy is not sufficient to achieve profitability targets. To identify the gap which should be closed by commonality within platform strategy also allows to see the risk for differentiation, and thus at the end the balancing task for the appropriate commonality and differentiation to take the current realized level of commonality into account. In other words, if there is a high degree of contribution of product platform strategy to profitability, the task of balancing is more challenging as is with the case of a low necessary contribution degree of platform strategy. This transparency will also allow knowing how much risk for loss of differentiation within platform strategy is appropriate. For example, if differentiation is realized primarily by other strategies (excluding platform strategy), there is more room
for loss of differentiation in terms of product functionality to the advantage of commonality. Or, if there are further strategies planned to decrease cost without any relevance to product performance and thus differentiation, the platform strategy can be balanced so that the risk of loss of differentiation is minimized or eliminated completely.

Of course, the target of profitability and its division amongst the planned strategies is dynamic and will change over time. Therefore, the described process should be continually controlled in order to find the right balance of commonality and differentiation within platform strategy. Furthermore, also during the realization of strategies, if results show that the target cannot be achieved, the division of contribution degree to profitability should be reworked. As a result, there is a need for a feedback loop. The described process is shown below (see figure 16 red-framed part). As shown in this chapter, the most challenging balances of commonality and differentiation are in the cases of step b) and d), which will be described in more detail in the next chapter.

Figure 16: Commonality process
5.1.2 Balancing Commonality and Differentiation for different Product Requirements without an Impact on Explicit Customer-Requirements to solve the Conflict between Product Cost Objective and Investment Objective

If commonality potential based on equal product requirements is already realized (step a and c) and there is still a gap for cost reduction, then commonality based on unequal product requirements will be realized to close the gap and decrease cost. At this point, the first step is to establish product requirements without explicit customer relevance. These requirements are characterized by two main aspects: a) fulfilling these requirements is necessary, otherwise the product is without basic function for customer and b) not mentioned explicitly by the customer because of the assumption that these requirements are fulfilled in any case (e.g. legal requirements). According to the KANO framework, these functions are embedded within the basic requirements which are a prerequisite of the customer and are not buying (differentiation) criteria. An example for these kind of requirements are legal requirements, which are a prerequisite of the customer, however, if the requirements are not fulfilled, then the product can be launched on the market and there is loss of brand image.

To standardize components affected by unequal product requirements without any customer-relevance allows for realizing further cost reduction without loss of differentiation, since from the customer’s point of view there is no change in relevant and perceived product requirements. Because of commonality based on unequal requirements, common components are realized at a specific product performance level, either at one specific product-performance level or between them. This means the specification of common components either allows to fulfill the minimum product performance, maximum product performance or a performance between these boundaries. The specification level of common components is over-engineered from the product’s perspective with a lower product requirement, and under-engineered from product perspectives with higher product requirements. Both cases are a compromise, as also mentioned many times within collected data. The under-engineering means to fulfill the product requirements only partly or not at all. Because of no customer relevance, the under-engineering has no negative effects on the market and thus revenue side. However, if it leads to a lack of functions, these will also be perceived by the customer and, as a consequence, will lead to loss of image and revenue, since the
customer will recognize that expected basic requirements are not fulfilled. So, either product requirement is unnecessarily high and should be corrected or under-engineering will lead to lack of functions. In other words, under-engineering cannot be applied because the fulfillment of basic requirements is a prerequisite or the high level of requirement is “unnecessary” and can be decreased, because of no customer relevance. Through modifying the requirement to a lower level, the level will be potentially equal to other requirements and could be served by common components without any negative effects (see the chapter before commonality under a and c - equal requirements). So, a different level of requirements should be checked and modified. A different level of requirements should be justified only for the customer or for necessary functional reasons. Furthermore, if there is a justified different level of requirements, commonality through under-engineering is not appropriate for the reasons mentioned above. So, as a result, in this case only, commonality of components through over-engineering and/or commonality of interfaces is appropriate to serve different levels of requirements.

To serve different levels of requirements without any customer relevance by over-engineering commonality means the specification of common components is oriented towards a maximum performance level and applied also to products with a lower requirement level. The specification at maximum requirement level also means to meet the target cost of the highest product cost level and to exceed the target cost of the lower-positioned products with a lower performance level. At the same time, the price level of the lower-positioned product cannot be increased, because the requirements and linked product functionality are not a relevant buying criterion from the customer’s point of view. Therefore, the customer will not pay more for fulfilling requirements which are not relevant from his/her point of view. As a result, exceeding the target product cost whilst retaining the price ends in lower profitability for lower positioned products. So, on the one hand, commonality should be realized for cost reduction reasons, at the same time for some products, the profitability decreases due to the described effects which leads to missing target product profitability. However, there are also other effects which should be considered in this context. Considering the higher quantities of the common components will lead to scale effects, which in turn lead to reduction of product cost. So, if higher product cost effects can be over-compensated
for by scale effects, then the decision from the product cost point of view is for commonality. If not, further decision criteria should be considered in order to decide from the cost perspective. As described before, commonality also allows decreasing investment such as development cost, production investment and complexity cost. This effect is independent from the level of requirements and thus positive in any case. So, if there is no positive effect on product cost, reduction of investment is a further decision criterion and should be considered. If investment overbalances negative product cost effects, then commonality should be applied. However, if not, commonality makes no sense from a rational point of view.

Considering these effects, the decision will also depend on the significance of the kind of cost, in other words on the cost structure within the business context. To analyze the significance of the kind of cost, quantities should also be considered, since product cost increase is multiplied by quantities. Furthermore, product complexity is also a decisive business context criterion, since the higher the complexity, the higher the significance of investment and complexity cost. In conclusion, the higher the quantities and the lower the product complexity, the more the business is driven by product cost and the more probable it will be that product cost increase effects overbalance investment by commonality through over-engineering within platform strategy. In addition, the higher the product complexity and the lower the quantities, the more significant the investment will be, much more than product cost, which will lead to more commonality by over-engineering within platform strategy. Therefore, the cost structure within the business context should be analyzed in the pre-phase, in order to be prepared for solving the conflicting objective within the cost dimension between product cost and investment, even if differentiation is not concerned at this stage. Of course, there will be cases in practice whereby no clear significance is obvious. Or the target of the company will be a reduction of a specific kind of cost, even if the significance of this cost dimension is low. For such situations, the decision-making process is executed individually or more clearly to decide on more commonality to reduce the targeted kind of cost. At this point, the main recommendation is that analyzing the significance of the kind of cost within the business context is necessary to be able to decide on commonality of components to serve different requirements which are not relevant for
the customer. The considerations are summarized in figure 17 below. The QFD matrix is a means to identify the components affected by the requirements.

![Diagram](image)

**Figure 17: Balancing commonality and differentiation within cost dimension**

As described in the data analysis chapter, the case study shows the method of scalable commonality. This approach means that there are clusters of unequal requirements, served by different common components across the identified cluster. The cluster of requirements means that the requirement level within the same cluster is different, however, the degree of difference is as minimal as possible. So, the described effects of commonality within the cluster, both positive and negative, are not as intense as in the case of a high difference in requirements. So, exceeding product cost is not so much for the lowest-positioned product within the same cluster as in the case of application of the commonality across the whole product portfolio, since the cluster itself is a harmonization of requirements. However, the reduction of investment is also lower, since exemplarily there is still a necessity for development of different solutions for each cluster as compared to the case of one development without any cluster. Therefore, the main difference to the approach of application of commonality across the whole product portfolio is the decision scope of commonality. While the approach for the whole product portfolio includes a broad decision scope, the cluster approach allows the decision scope to the requirements within one cluster to be reduced. The building of the cluster is nothing more than the transformation of the described top-down alignment
The process of products to the platforms with the difference that this approach is at system/module/component level with a lower impact on the business level. The extreme form of cluster is clustering only one element, thus creating each variant.

The lowest possible kind of commonality within scalable modules is the commonality of interfaces. The main aim for common interfaces is the fast adaptability of new solutions to react to market requirements. The commonality of interfaces is also the minimum kind of commonality by over-engineering, since if each product is designed to a minimum possible cost level, there will be no common interfaces. So, the kind of commonality of interfaces also means a possible minimum product cost increase because of the interface itself. The necessary product functions/requirements are fulfilled by the components themselves and not by interfaces, therefore common interfaces are independent from requirements. However, in the case of commonality of interfaces, positive effects on investment are also minimal compared to commonality of components. The main effect on the investment side is the faster integration of modules developed for changing requirements compared to the case in which the complete product should be redesigned and validated. In conclusion, considering the consequences of common interfaces within the cost dimension means a lower risk of exceeding product cost and lower chances for reducing investment.

Considering the effects of clustering and commonality of interfaces as the minimum kind of commonality by over-engineering, the question is how to deal with decisions for commonality for non-customer-relevant requirements. Commonality by over-engineering should be realized if scale effects over-compensate for the increase of product cost. If not, there is a detailed analysis about the significance of the kind of cost between product cost and necessary investment. If investment over-compensates for the product cost increase, commonality should be realized. Also in cases whereby companies define investment reduction as their main target of platform strategy, this will lead to realizing commonality by over-engineering for non-customer-relevant requirements. So, if there is no possibility of over-compensation, or if the target of product cost is of higher priority to the company and thus there is no economic legitimation for commonality, the next step should be to create a cluster in order to consider possible commonalities with a lower product cost increase which could be over-compensated for by scale effects and/or reduction of investment. The point of
creating a cluster should be such that maximum possible scale effects and maximum reduction of investment can be achieved. Therefore, the first step is to create 2 clusters, whereby one common solution specified for the highest requirement level of each cluster is developed. So, the product cost increase will be lower compared to the case of one cluster, since there are 2 solutions more similar to the requirement of the lowest level of requirement. The delta of product cost between the highest-level requirement and lowest level of requirements should be similar. Thus, it is ensured that there are two sense-making clusters from the product cost, scale effect, and investment point of view.

The same approach for each cluster should be executed as described above for one cluster/whole product portfolio: if product cost increase can be over-compensated for by scale effects, then commonality should be realized; if not, it should be clarified if the investment reduction over-compensates for the product cost increase, if yes, then commonality should be realized. If not, the cluster should be divided into two clusters following the same logic as described and so forth. The process should be executed until the cluster consists of one product. At this stage, if there is no cost reduction by commonality of components possible, in order to realize reduction of investment at least, the next step will be the exploration of commonality of interfaces. The commonality of interfaces is the minimum possible investment reduction possibility with the minimum product cost increase. If there is also no positive cost benefit at this stage, there is no rational reason for commonality, even if the requirements are not relevant to the customer and thus without any effect on differentiation.

In summary, the approach is exemplarily shown below in figure 18. This approach is stopped in the case of over-compensating for the increase of product cost and/or the product cost increase being accepted by the company. The building of clusters will lead to a lower increase of product cost. Independent from this effect, it is possible that companies accept a low product cost increase because of further positive qualitative effects which cannot be quantified. As mentioned in the data analysis of the case study, the cluster will be created top-down if a company has long-term experience and knows which requirements cluster makes sense because of similarity. At this point, the process is described in detail to also support inexperienced companies with finding their cluster.

Until now, recommendations for commonality decisions for components which serve requirements not relevant to the customer, and thus not relevant from a differentiation
point of view, have been made. The next chapter deals with recommendations for balancing commonality and differentiation and thus commonality decisions for components serving customer-relevant requirements.

Figure 18: Narrowing decision scope for balance of commonality and differentiation
5.1.3 Balancing Commonality and Differentiation for Components serving different Product Requirements relevant to the Customer to solve the Conflicting Objective between Cost Reduction and Differentiation

The starting point for this step is the current and desired product positioning. The desired product positioning is important for two reasons: a) profitability increase through cost reduction (internal view) and b) price positioning in the case of cost leadership based on achieved cost reduction or performance positioning based on product performance to achieve high prices (external view). The generic target of platform strategy is to increase profitability through cost reduction driven by commonality. Cost reduction is realized by cost reduction of product cost and reduction of investment. The reduction of investment can be transferred into product cost by dividing the investment through volumes. The target cost reduction is exemplarily and schematically shown in figure 19 below.

Figure 19: Current and target product positioning

This target for cost reduction should be initially realized by commonality step a and secondly by commonality step c, so for components serving equal requirements across the product and brand portfolio. If this is not enough and there is still a gap between the target and potential cost reduction, commonality step b should be realized in order to avoid any effects on the customer, thus loss of differentiation. Last but not least, if this step is also not sufficient for achieving the target for cost reduction, then commonality
step d, which includes maximum conflict potential because of unequal and customer-relevant requirements, should be considered (see figure 20 below).

![Diagram](image)

**Figure 20: Identification of gap to target through the potential of commonality steps a, b, c**

In order to close the gap, commonality should be realized for components serving unequal customer-relevant requirements. As shown in the chapter “Kind of Commonality”, there are different possible kinds of commonality, such as commonality by over-engineering, commonality by under-engineering, and commonality of interfaces. Commonality by over-engineering and connected conflicting objectives within the cost dimension (product cost increase vs. investment reduction) was already described in detail in the chapters before. This means that the decision for commonality by over-engineering to solve the conflicting objective between product cost increase vs. investment decrease should be executed exactly as already described above. However, if the decision is for commonality, the second decision cycle should be executed in order to reach a final decision. The reason for the second decision cycle is that the consequence of commonality affects product performance relevant to the customer, so influences the differentiation-dimension. Concretizing the impact of commonality by over-engineering, the performance of the lower-positioned products is increased by the attributes of the higher-positioned products. If there is no price increase of the lower-
positioned products because of higher performance level, it will lead to cannibalization of higher-positioned products by lower-positioned products, since the customer will decide on low-priced products with a similar performance. As a result, there will be a loss of internal differentiation. This effect is shown exemplarily and schematically (see figure 21 below).

**Figure 21: Loss of internal differentiation by commonality step d through over-engineering**

If commonality by over-engineering is at the level of product P2, the product cost will decrease driven by scale effects (see green arrow). The product cost of product P1 will increase and is over-compensated for potentially by scale effects (which should be approved for the individual case; see vertical orange arrow). In addition, the product performance of product P1 will increase (see horizontal orange arrow). Therefore, in the end, the internal differentiation between product P2 and P1 will decrease (see internal differentiation old and new). Through commonality the product positioning is changed (estimated product position), differing from the target product positioning. Therefore, commonality by over-engineering should be treated as follows. Firstly, the decision cycle within the cost dimension should be executed and then the decision cycle for internal differentiation follows. The more decisions are made by commonality by over-
engineering serving unequal and customer-relevant requirements, the more the loss of internal differentiation and so the more the risk for cannibalization of the higher-positioned product by the lower-positioned product will be. As shown in the data analysis for the case study, the tradeoff is found in good practice by the criteria of “sufficient differentiation”. Therefore, critical boundaries for acceptable loss of internal differentiation should be determined in the pre-phase, in order to ensure that the sum of decisions for commonality by over-engineering do not exceed these boundaries and thus ensuring sufficient internal differentiation between products. It requires that any change of product positioning by commonality by over-engineering should be controlled in order to ensure that commonality decisions allow a sufficient internal differentiation which justifies the price on market. If the sum of commonality decisions leads to the achievement of critical boundaries for sufficient internal differentiation, there is no possibility for commonality by over-engineering, except for a decision made before reversal. In other words, commonality by over-engineering serving unequal and customer-relevant requirements should be executed until pre-determined critical boundaries are reached for internal differentiation in order to achieve maximum possible cost reduction and sufficient internal differentiation in order to justify performance-price relations on the market. The picture below schematically shows a critical boundary for internal differentiation in the case of realizing commonality by over-engineering.
Achieving cost reduction targets and profitability, the second type of commonality which can be applied in the case of commonality of components serving unequal and customer-relevant requirements is commonality by under-engineering. As described before, commonality by under-engineering means that the specification of common elements is at the lower performance level and below the required performance level of the higher-positioned products. Commonality by under-engineering leads to cost reduction driven by scale effects. The cost reduction effects of higher-positioned products are based on two reasons: a) scale effects and b) design for the lower performance level. Therefore, because of effect b) commonality by under-engineering leads to loss of performance (horizontal orange arrow). This leads to estimated product positioning (see figure below). This effect also leads, as with commonality by over-engineering, to loss of internal differentiation, driven by loss of performance of the higher-positioned product. So the effect is the same, however, the reason for the loss of differentiation is different. Therefore, for this kind of commonality too, there is a need for pre-determined critical boundaries in order to ensure sufficient internal differentiation, as described in detail for commonality by over-engineering.
Figure 23: Critical boundaries for ensuring sufficient internal differentiation driven by commonality through under-engineering

Furthermore, in the case of commonality by under-engineering, there is also a potential loss of external differentiation compared to the competitor. If performance requirements of higher-positioned products are not realized, then customers will decide more and more for competitor’s products. As a consequence, even if sufficient internal differentiation is ensured, aiming for competitiveness can define further critical boundaries for commonality (see figure below). The data analysis shows that the competitor serves as a benchmark within platform strategy decisions. Therefore, ensuring competitiveness is a necessary circumstance for decisions within platform strategy. So, critical boundaries for commonality by under-engineering are determined by competitiveness. The competitiveness is expressed in various ways: differentiation leadership, cost leadership, hybrid (combination of both) (see Porter’s theory). Therefore, dependent on product competitive strategy and thus the definition of product competitiveness, boundaries for commonality by under-engineering will vary. The differentiation leader’s competitiveness is to provide maximum possible performance at higher prices. The cost leader tries to achieve the lowest prices. The hybrid strategy involves more performance than the differentiation leader and lower
costs than the cost leader, which is a highly challenging task compared to other strategies. Because of these competitive targets, the critical boundaries vary across product competitive strategies. In the case of differentiation leadership strategy, both critical boundaries for internal and external differentiation should be determined in the pre-phase. Considering both boundaries, the most critical of them is which of both boundaries is exceeded first. Exemplarily, even if decisions are not critical from the internal differentiation’s point of view, the critical boundary for external differentiation is the crucial case. Therefore, decisions in this case should be oriented on the critical boundary of external differentiation. So, the sum of commonality decisions for product P2 must not lead to exceeding the critical boundary for external differentiation, otherwise the performance will be equal or less than the competitor (Cd) (see figure below).

Figure 24: Pre-determined critical boundaries for internal and external differentiation from differentiation leader’s point of view

From a cost leadership perspective, the decisive parameter for benchmarking with the competitor is the price and cost. Therefore, commonality by over-engineering must not lead to higher costs and thus higher prices than the competitor’s. As a consequence, in
addition to the critical internal differentiation boundary to avoid cannibalization, there is a need for a critical horizontal boundary for cost to ensure achieving cost, and thus price leadership over the competitor (see figure 25 below, shown exemplarily for cost leader product P1 and the main competitor Ck). So, the decision cycle within the cost dimension and impacts on internal differentiation are necessary in order to consider the impact of decisions from a cost leadership perspective.

Figure 25: Pre-determined critical boundaries for internal and external differentiation from a cost leader’s point of view

In the case of the hybrid as a product competitive strategy, there is a need for a combination of both considerations, as mentioned above for differentiation leadership and cost leadership in order to ensure competitiveness towards the differentiation leader (better performance), cost leader (lower cost) and internal differentiation.

The recommendations made assume that the commonality by over- or under-engineering is developed exactly at the specification level of the high- or low-positioned product. However, it is of course possible to specify the performance and cost level in between products which will lead to the same effect in principle, but with a lower
intensity. Nevertheless, the decision framework will be the same in order to achieve maximum cost reduction by sufficient internal and external differentiation”.

5.1.4 Balancing Time to Market for Future Innovations and Cost Reduction by Commonality

The data analysis shows that one of the main criticisms for commonality within platform strategy is that this approach leads to inflexibility in terms of reaction to market changes. Therefore, on the one hand, experts recommend that commonality should be avoided for a highly dynamic market environment. Contrary to this criticism, commonality also leads to a reduction in time to market, since a common product scope (platform) already exists and should not be developed. As a result, the selection of the appropriate product scope for commonality within platform strategy is a key success factor. To select the appropriate product scope for commonality within platform strategy allows gaining from a reduction in time to market because this scope already exists and inflexibility should be avoided for market changes.

To achieve this status of gaining from commonality and at the same time being flexible for market changes, there is a need for identification of market requirements and probability for changes in the future in order to identify which components are affected or not. The result from this transparency is that there is a clear picture of the evaluation of the dynamics of the product scope. A highly dynamic product scope indicates a high necessity for innovation and a low dynamic indicates that this product scope should be common and gaining from better time to market based on commonality. Of course, there is also a grey zone which can be aligned to one or the other group. Therefore, it is also necessary to establish in the pre-phase how important time to market is. This is expressed by product competitive strategy. If time to market is a differentiation factor in the market and if the product competitive strategy is differentiation leadership, then decisions within the grey zone will be more to the advantage of differentiation and thus commonality only decided upon if there is no dynamic expected in the future. In the case of cost leadership, the decisions should be more directed towards commonality gaining from cost reduction, rather than to react to market dynamics.

In summary, after time to market has been weighed in general from a business context-perspective and product competitive strategy’s perspective, product scope should be
evaluated according to contribution to time to market. If time to market is a criterion, beginning with components with no contribution to time to market, these should be decided as common. At this stage, if target cost is achieved, there is no conflicting objective, since the rest of the product scope can be differentiated to ensure flexibility. However, if target cost has not yet been achieved, the next step will be to decide on commonality beginning with the most uncrirical product scope until the target cost is achieved. The same process should be executed for investment. Therefore, target investment should be checked. If target investment is also achieved, commonality can be stopped, if not, then commonality should be realized for further components until it is achieved.

It is noticeable that target cost and target investment is lower in the case of cost leadership compared to differentiation strategy. Therefore, the tradeoff between cost and time to market should be solved in order to take product competitive strategy into account. If the conflicting objective cannot be solved, because of different product competitive strategies, the overall target for platform strategy concerning time to market and/or cost should be modified in alignment to further strategies aimed at a cost decrease and revenue increase as mentioned at the beginning of the process.

5.1.5 Balancing Quality Improvement and Investment in terms of R&D Cost, especially Validation Cost

As mentioned before, commonality leads to quality improvement because of learning effects within the process. On the other hand, there is a high risk if there are breakdowns within the product platform, since the breakdowns will also be multiplied. Therefore, quality improvement is only possible if the risk of breakdown for platform components is minimal. In order to achieve this, there is a need for more in-depth validation for platform components which in turn means lower investment decrease effects compared to the main idea of validation of common components one time.

In particular, in the case of differentiation strategy, quality is one of the main pillars of this strategy. Therefore, firms with differentiation product competitive strategy should ensure achieving quality improvement by commonality through product platform strategy. Considering cost leadership, achieving significant cost reduction and thus investment reduction is important. Because of the effect on investment within the cost
dimension, it is necessary to establish in the pre-phase how important investment is compared to product cost generally within the specific business context. If the business is driven by investment, then there is a need for clarification of how much the part of validation costs is, in order to know how relevant this dimension is. In the case of cost leadership, the in-depth validation will not be as extensive as in the case of differentiation strategy. This means higher risk regarding quality to the advantage of significant investment reduction. In the case of differentiation leadership, the company will focus more on quality improvement driven by common product platform components to the disadvantage of the fact that investment cannot be reduced so significantly at the maximum level. And in the case of hybrid strategy, it means a combination of both considerations.

As a result, if validation cost is a significant part of cost dimension and at the same time differentiation leadership through high quality is aimed for, the common parts should be validated in-depth to ensure product competitive strategy. In the case of cost leadership, the validation cost will be lower with the consequence of higher risk on the quality side. The risk to quality depends on the degree of commonality, in other words how many components are common and from the extension of common parts across brands and products. The best circumstance is when validation cost has a less significant ratio on investment, then platform strategy will lead to a reduction of investment and will contribute to quality improvement at the same time.

In summary, balancing quality improvement and validation cost also requires the weighing of the sub-dimensions of cost and differentiation in the pre-phase. Furthermore, decisions can only be made by taking product competitive strategy into account.

**5.2 Final Process Framework for Effective Balance of Commonality and Differentiation**

In this chapter, derived from results and conclusions, a final process framework emerges. After assumptions underlying the research are mentioned, process stages (consisting of necessary preparation and the execution of the process, according to the plan-do-check-act logic) are described in detail.
In this research, it was assumed that organizations have an excellence in engineering so would know how a component should be designed ideally from a technical and economical point of view. Furthermore, it was assumed that excellence in engineering allows finding efficient solutions on the Pareto curve. The focus of this research was how to balance commonality and differentiation effectively from a strategical point of view, in other words, how to find which of the efficient scenarios on the Pareto curve is best taking business context and business strategy into account.

A further assumption is that there is a requirements management established which considers and is aware of relevant requirements, which allows standardized requirement genres with different variants of the same genre and with the characterization of requirements concerning their dynamic, in other words, concerning the probability of change during the platform life cycle. Furthermore, the requirements management should also allow transparency about the relevance across products and brands. From a methodological point of view, it is also important that the company knows how to deal with the QFD matrix which allows matching of requirements to the components and modules. Subsequently, for the sake of convenience, components as a term is used, however, if a requirement is served by a module or system consisting of components, of course the term of component can be replaced by module/system.

Based on these assumptions and research results, the following final framework to balance commonality and differentiation within platform strategy can be summarized.

5.2.1 Stage 1: Preparation

5.2.1.1 Stage 1.1: Specification of Cost and Differentiation Dimensions taking Business Context into account

Conflicting objectives driven by commonality within platform strategy can occur between the different sub-dimensions of cost and differentiation with a different intensity. Therefore, there is a need in the pre-phase to identify relevant dimensions of cost and differentiation from the specific business point of view. To achieve this transparency, there is a need for comparison of different kinds of cost: product cost vs. investment to identify the relevant key cost indicator for the business context. Moreover, there is a need for transparency about the ratio of R&D within investment
and how the ratio of validation cost within R&D is. Furthermore, there is a need for transparency about differentiation. What exactly is understood by differentiation? Is it performance, and/or time, and/or quality? This step should allow identifying key dimensions regarding why customers pay over-proportionally high prices for products. As a result of this stage, the relevance of cost and differentiation dimensions from a specific business perspective is evaluated. As a further result, irrelevant dimensions of cost and differentiation should be eliminated in order to allow a focus on relevant issues important for the business.

![Diagram of business context analysis to identify cost and differentiation dimensions](image)

**Figure 26: Business context analysis to identify cost and differentiation dimensions**

### 5.2.1.2 Stage 1.2: Clarification of desired Targets by Platform Strategy through Visualization of the Gap between current and desired Product Positioning

The second main step is the identification of targets based on already identified cost and differentiation dimensions. In order to do that, there is a need for transparency of the profitability target across the product portfolio and, as a consequence, for each product. The target profitability consists of the difference between target price and target cost. The current situation of price and cost compared to target price and target cost shows the delta which should be closed by different strategies. As shown before, there are different strategies within the company which influence price and cost of products. To get a holistic view, there is a need for transparency regarding which ratio each of the strategies should contribute to in order to close the gap between price and cost. The result of this stage is to obtain a transparency of target contribution of product platform strategy to close the gap between target price and target cost. There is also a need for
target investment to obtain a complete view of the cost dimension. On this basis, the products should be shown in a price/cost-performance matrix whereby the current situation and the desired product positioning is shown. As a result, there is a delta between the current and desired product positioning (see figure 27 below).

5.2.1.3 Stage 1.3: Definition of Sufficient Differentiation by Determination of Critical Boundaries for Internal and External Differentiation

After the differentiation criteria are defined, there is a need for a definition of the critical boundaries for internal and external differentiation within the product positioning matrix. The critical boundaries for internal differentiation are necessary to avoid cannibalization, and the external critical boundaries are required to ensure competitiveness. Depending on competitive strategy, the critical external boundary will either be on the differentiation side, or the cost side, or both. Following a cost leadership strategy means that the critical external boundary is based on cost rather than on differentiation whilst an internal critical boundary is based on differentiation. Following a differentiation leadership strategy means the critical external and internal boundary is based on performance. Following a hybrid strategy means the internal critical boundary is based on performance and cost compared to the cost leader and at the same time also compared to the differentiation leader within the customer segment. The figure below shows the process complemented by the mentioned activities.
5.2.1.4 Stage 1.4: Component Characteristics according to Cost and Differentiation

To determine which components should be considered for commonality, there is a need for transparency about its characteristic which should be prepared in the pre-phase. Because of the criteria cost and differentiation there is a need for assignment of each component according to these criteria already specified in stage 1.1. Therefore, there is a necessity of information about its cost relevance which can be gained through a cost break-down according to the relevant cost parameters. Furthermore, there is a need for information about the relative contribution of each component/module/system to differentiation. To obtain this information, the QFD matrix, which is extensively shown in platform strategy literature, should be applied in order to determine which components contribute to which requirements. Therefore, the final result will be a cost-
differentiation matrix whereby each component should be assigned within this (see figure below).

Figure 29: Exemplary assignment of components to the cost-differentiation matrix

While some components are a dot or a line, others are squares. And while some components are on the axes, others are within the square. The dots show that there is no difference concerning cost and differentiation across products and brands. If there is a line, it shows the component is characterized only by one dimension, either cost or differentiation, which varies across products and brands. And if components are squares, then it means components are characterized by cost and differentiation, which varies across products and brands. Components on the cost axis only have a cost impact without any differentiation impact. Components on the differentiation axis only have a differentiation impact without any cost impact. Therefore, components on the differentiation axis are not relevant for commonality. The dot components on the cost axis are called “a” according to pre-descriptions of the commonality step which is that commonality of components contributes equally and is non-relevant to the customer/differentiation. The dot components within the cost-differentiation matrix are called “c” according to “commonality step c” which is commonality of components serving equal differentiation requirements across products and brands. The line components on the cost axis are known as “b” according to “commonality step b” which
is commonality across products and brands serving unequal requirements and thus with different costs, not relevant to the customer and thus with no impact on differentiation. The square components within the cost-differentiation matrix are known as “d” according to “commonality step d”, showing components with a range of cost and differentiation dimensions. The figure below shows the complemented process describing the preparation stage with the desired results of preparation.

Figure 30: Preparation stage complemented with component characteristics according to cost & differentiation

5.2.2 Stage 2: Plan, Do and Check

In general, it is possible that the kinds of requirements vary by their probability to change during the platform life cycle. In addition, serving these kinds of requirements also possibly varies dependent on the competitive strategy. So, a differentiation leader
would try to serve these requirements as quickly as possible in order to use the window of opportunity to realize over-proportional prices on the market. A differentiation leader also proposes realization of innovations, which are nothing other than planned changing requirements not known by the customer himself, but they will satisfy the customer over-proportionally if these exciting requirements are fulfilled. So, components serving requirements with no probability to change during the platform life cycle should be common, as already described. Components serving requirements with a high probability to change (driven by the customer or planned innovations) should be designed with common interfaces which allow a quick alteration of the component/module at the time as a new design for the changed requirement is finished. This approach of dealing with changeable requirements should be noted for all kinds of requirements, as subsequently described. So, commonality of interfaces (modularization) depends on the fact regarding how requirements served by components/modules are characterized in terms of probability for change within the platform life cycle. The standardization of interfaces leads to increased product cost which should be included into the cost consideration.

5.2.2.1 Stage 2.1: Commonality Step a)-Realization of unused Potential of Commonality for Components only serving Equal Requirements not relevant to the Customer

After the preparation stage is executed and results are generated, the first step within the action stage is commonality of components serving only equal requirements which are not relevant to the customer (a-components), called commonality step a. In general, if there are no a-components, this stage can be skipped, which also applies to the subsequent steps. After planning and simulation of the first commonality step, there is a need to check whether the gap in the cost dimension can be closed between the desired product positioning and the current product positioning (see stage 1.2). If yes, the process is finished without any conflicting objective, since the desired cost reduction is achieved (see figure below).
If not, or if there is more need for cost reduction, there is a need for more commonality which leads to the next step.

5.2.2.2 Stage 2.2: Commonality Step c) - Realization of unused Potential of Commonality for Components only serving Equal Requirements relevant to the Customer

The second step should be commonality of c-components only serving equal requirements with customer relevance. In addition, after this step, there is a need to check whether the gap between the desired and current product positioning concerning cost is closed. If yes, the process is finished (see fig. 32 below).
Figure 32: Process complemented with commonality step c

If not or if there is more need for cost reduction, there is a need for more commonality which leads to commonality step b.

5.2.2.3 Stage 2.3: Commonality Step b) - Commonality of Components serving unequal Requirements not relevant to the Customer

The level of inequality of requirements varies across products and brands. The higher the inequality of requirements and thus the impact on the component design, the higher the difference of cost. Therefore, making components common with a high inequality of requirements will lead to an exceeding of target costs of products with a low performance level. Therefore, in this case, there is a need for a sub-decision within the cost dimension to decide on commonality within platform strategy.

The case study shows the method of scalable commonality. This approach means that there are clusters of unequal requirements, served by different common components. The cluster of requirements means that the requirement level within the same cluster
is different, however, the difference degree is not as high as described above. Therefore, the described effects of commonality within the cluster, both positive and negative, are not as intense as described above without any cluster. So, exceeding product costs are not as high for the lowest-positioned product within the same cluster as in the case described before, since the cluster itself is a harmonization of requirements. However, the reduction of investment is also lower, since exemplarily there is still a necessity for development of different solutions for each cluster as compared to the case of one development without any cluster. So, the main difference to the approach before is the decision scope of commonality. Whilst the approach before includes a broad decision scope, the cluster approach allows a reduction of the decision scope to the requirements within one cluster. The building of a cluster is nothing other than the transformation of the described top-down alignment-process of products to the platforms with the difference that this approach is at system/module/component level with a lower impact at the business level. The extreme form of cluster is clustering one element, thus creating each variant (see fig. 18: narrowing decision scope for balance of commonality and differentiation).

Considering decision scope, there are two possible ways to reach these clusters. The first one is to start by trying the maximum potential of commonality, in other words, to over-engineer the component at the highest performance level and apply it to all products, thus also for products with a low performance level. After this step, beginning with the lowest level and thus lowest target cost, it should be checked whether scale effects because of commonality can over-compensate for the exceedance of target cost. If not, the extension of the application of the common component can be reduced down to the level of performance and thus to an appropriate level of target cost that scale effects because of commonality can over-compensate for the exceedance of the target cost, so that in the end, cost reduction is achieved. So, after this step, the first cluster is built. The next step is to design the component at the next performance level directly under the lowest performance level of the cluster already built, and to apply it again to all performance levels below them and look to see whether cost reduction driven by scale effects over-compensate for the exceedance of target cost and to build again a new cluster and so forth. The building of clusters is based on a bottom-up process.
In contrast, building a cluster for commonality decisions can also be done by a top-down process based on experience to narrow the decision scope from the beginning. As shown in the case study, in particular companies with complex products where the bottom-up process will take a long time, follow the top-down process in order to focus on decision scope for commonality decisions. However, in practice, there is no critical consideration of this cluster after the top-down decision is made. Therefore, participants of the balancing process of commonality and differentiation within platform strategy from the case study mention that there are potentially more commonality decisions possible. Therefore, complementary to this top-down approach, the boundaries of each cluster should be considered in detail in order to verify in which cluster more cost reduction can be gained.

Similar to the above process steps, after this process, once again, current and desired product positioning should be checked. If the desired product positioning is not achieved, the next step is to decide on commonality of components serving unequal requirements relevant to the customer and thus loss of differentiation (see figure below).

Figure 33: Process complemented with commonality step b
5.2.2.4 Stage 2.4: Commonality-Step d) - Commonality of Components serving Unequal Requirements relevant to the Customer

Beginning with components with the lowest contribution to differentiation, commonality decisions are made. If two components have the same contribution level to differentiation, the component with the higher cost should be common first (see figure below).

![Figure 34: Sequence of commonality for d-components- exemplarily](image)

After each commonality decision, current and desired product positioning and the distance to the pre-defined critical boundaries should be checked. There are three critical boundaries: internal differentiation (cannibalization), external differentiation (performance), and cost (in the case of cost leadership).

The first kind of commonality that should be applied is commonality by over-engineering which leads to no loss of external differentiation, rather than potentially to loss of internal differentiation of higher-positioned products and exceedance of target cost of low-positioned products. Therefore, this kind of commonality should be executed until the critical boundaries of internal differentiation. The commonality of under-
engineering leads to a loss of differentiation, which in turn leads to a loss of external differentiation and also a loss of internal differentiation of higher-positioned products. Therefore, commonality by under-engineering should also be executed up to the internal and external boundaries in order to ensure competitive positioning and to avoid cannibalization.

In conclusion, the aim of this process is always making decisions concerning commonality to close the gap between current and desired product positioning. The art of decision-making regarding commonality and differentiation within platform strategy is to move from the current product position in the direction of the desired product positioning selecting the right kind of commonality and ensuring to stay within the critical boundaries of internal differentiation and external differentiation and maximum cost level. The selection of commonality by over-engineering means movement to higher cost, except when this can be compensated for by scale effects and other cost reduction effects (see decision-making within the cost dimension), and to higher performance. Therefore, to visualize it within a cost-differentiation coordination system, it means movement in the right-upper direction of the lower-positioned product and vertical down direction of the higher-positioned product. In the case of scaling, it means commonality by over-engineering on an in-between level meaning the same movement for the lower-positioned product, however, not as intensive as in the case of the higher over-engineering level. Also at the same time, the case of commonality by over-engineering on an in-between level means that the higher-positioned product moves not only vertically down, rather than in a left-down direction (lower differentiation and lower cost).

In the end, the commonality and differentiation decisions within platform strategy should be balanced so that each product is within the critical boundaries. If this is not possible, at least either the defined target and thus desired product positioning should be removed or further measures outside of platform strategy should be found to move each current product position into the critical boundaries, ideally to achieve the desired product positioning. This approach contributes to following the generic rule for balancing of commonality and differentiation within platform strategy: “to achieve maximum possible cost reduction and at the same time sufficient differentiation”.

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The final framework addresses how commonality and differentiation within platform strategy should be balanced from a processual perspective. In comparison to existing solutions in platform strategy theory, the generic process allows reduction of the decision scope, to an important degree, to identify main conflicting areas. Moreover, the step-by-step approach allows a context-specific approach, to find the right balance among possible efficient solutions. Good practice approaches from empirical data are synthesized into a process framework, which considers issues from practice and different business contexts. However, even if there is a sound basis for this final process framework, it allows no statistical generalization, based on a single case study and expert interviews. Thus, making general statements about larger populations is not possible. Therefore, there is a need for longitudinal studies to capture/prove good practices of balancing commonality and differentiation within platform strategy.
6 Research Contributions and Implications

The contribution of research is twofold. On the one hand, there is a contribution to theory of platform strategy literature to complement it by not only finding an efficient balance of commonality and differentiation within platform strategy, but also finding the right balance of commonality and differentiation among these efficient solutions. The research shows an emergent framework for the strategic process derived from good practice of platform strategy which allows an appropriate approach for the balance of commonality and differentiation taking the specific business context and competitive strategy into account. Furthermore, the research shows how real-world complexities managed to find the right balance of commonality and differentiation for platform strategy through analysis of good practice by experienced experts and companies. So, these insights are valuable for research in trying to find the optimum balance of commonality and differentiation within platform strategy. Furthermore, considering the theory of strategy, research shows that platform strategy is a sub-strategy of competitive strategy influencing the same parameters. Platform strategy can be interpreted as a competitive advantage from a resource-based view (RBV) in terms of a) finding the best possible platform strategy alternatives in terms of efficient solutions to balance commonality and differentiation (which is assumed and not addressed in this research), and b) to be able to select the right alternative among these platform strategy alternatives. While a) addresses a more engineering perspective to find smart alternatives, b) is a strategic selection. The competitive advantage from the RBV perspective under b) requires taking business context and competitive strategy into account, in other words, taking the market-based view (MBV) into account. As mentioned in many strategy papers, this research also shows that RBV and MBV are two sides of the same coin. The MBV activities allow building a competitive advantage on RBV.

On the other hand, the research also contributes to practice. The emerged process framework can be applied for experienced companies to try to improve their platform strategy approach as well as for inexperienced companies wanting to implement platform strategy in their organization. Furthermore, the strategic process of balancing commonality and differentiation within platform strategy is flexible and allows tailoring
to specific cost and differentiation-parameters which should be optimized. In addition to that, the strategic framework allows holistic decision-making taking further strategies and company targets into account. In particular, the step-by-step approach and taking the company’s targets into account avoids commonality with unnecessary risks on the differentiation side. This framework leads companies to consider targets expected by platform strategy in detail and conscious risk-taking in terms of loss of differentiation. So, if companies apply this process to balance commonality and differentiation, platform strategy is not an isolated strategy with problems of acceptance within the organization, but is integrated into the company context, which allows a cohesive strategy for the company. The main aim of the research was to reveal a process framework and not a ready solution. Therefore, the process framework is highly dependent on business context and should be tailored accordingly. The application will be critical because of the complexity of tailoring and abstract level of the process framework. Therefore, companies, especially non-experienced ones, should be consulted for the first time of application.

7 Limitations and Further Research

In addition to the limitations listed in-depth within previous chapters, in this chapter, further limitations from methodological and applicational points of view will be mentioned in order to identify potential further research areas.

The main prerequisite for executing such a good practice framework in balancing commonality and differentiation within platform strategy is to have a successful requirements management within the company. This competence is decisive in order to establish the impact on components and on decisions for commonality and differentiation. Therefore, in some cases, companies should be implementing a successful requirements management first before implementing platform strategy.

Furthermore, the emerged framework requires high transparency and preparation of data concerning product positioning strategy, competitive strategy/data about competitors and business characteristics. Therefore, the prerequisite for a successful approach within platform strategy is time-consuming and not self-evident. One of the
main challenges will be to prepare these data to decide on commonality and differentiation within platform strategy.

A further challenging topic is the quantification of data. For example, the differentiation requirements between one’s own products compared to competitor products should be quantified in order to evaluate the impacts of commonality and differentiation decisions. Furthermore, cost information should also exist. Therefore, in some cases, it will be a challenge in itself to quantify the prepared data at all.

In addition to that, in a dynamic and complex business environment, the decisions for commonality and differentiation should be reviewed continuously. In particular, for complex products with a high changing rate, the process complexity could be enormous.

As mentioned in Chapter 3, from a methodological point of view, the research is based on a single case study and qualitative interviews. Therefore, further in-depth studies are needed to validate the identified framework within another context and to complement this good practice approach. For example, a study to apply the good practice approach within a longitudinal study will be interesting to identify further potentials for improvement.

The approach requires various competencies and prerequisites. To validate the applicability of the suggested good practice approach, it will be interesting to identify how many firms who implemented platform strategy have the mentioned competencies. Therefore, it will also be interesting to quantify how each of these competencies contributes to the success of platform strategy, or expressed in other words, to identify the impact of company competency and platform strategy success.
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## Appendices

### Appendix A: Profiles of Interviewees and Experts

#### CASE STUDY

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#### EXPERT INTERVIEWS

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Appendix B: Information Sheet

Investigator: Mr. Erdem Yilmaz (Student)
Supervisor: Mr. Prof. Dr. Rolf Rascher, University of Applied Sciences/Labor Optical Engineering, Edlmairstrasse 6 + 8, 94469 Deggendorf; Germany,
Tel.: +49 (0)991/3615 323, Fax: +49 (0)991/3615 399,
E-Mail: rolf.rascher@hdu-deggendorf.de

05.03.2015

Research project: An investigation concerning to contribution of platform strategy decisions to competitiveness

Research purpose:
The research aim is to investigate follow research questions:

• How management of competitive strong organizations handle the tradeoff between cost and differentiation driven by platform strategy? What are the underlying reasons therefore?

The research purpose is to identify good practices concerning platform strategy decision making, especially to solve contradicting objectives of cost and differentiation, to support decision makers/management who want to implement platform strategy in their organizations. Furthermore, theoretically the research will contribute to platform strategy theory to take decision theory and competitive theory into account.

Research methodology:
The first step is to review literature to get more insight into the topic and formulate more insightful questions/propositions and develop a conceptual framework. Then, propositions will be verified qualitatively by case study research and expert interviews (deductive approach). Furthermore, case study research and qualitative interviews with experts will allow also capturing exceeding good practices grounded in data (inductive approach). The research is based on interplay between deductive and inductive approach. The qualitative research is divided into following activities: data preparation, data collection and data analysis.

Expectations from research participants:
While data collection process research participants will be interviewed anonymously concerning purposed research area. The main expectation is that research participants answer the questions within qualitative interviews based on their working experience and enable an in-depth insight to relevant research issues. The duration of the interview is approximately 2 hours. The interviews will be recorded by tape.
Confidentiality and their treatment within the research project:
A potential risk of the research is the lack of confidentiality. In order to ensure confidentiality consent form, as an agreement in written form between researcher and interviewee, have to be signed by interviewee. This document will ensure that personal details will be treated confidentially respectively will be deleted after the study. Only universal information about the interviewed departments will be used without any chance to draw a conclusion to the personal details. The data base of the case study and expert interviews will be stored only by the researcher. The researcher will use a password-protected personal computer so that any misusing of the data can be excluded.

Data collection and publication:
The data collection is based on documents, archival records and interviews. The data will be published anonymously. Only universal information about the interviewed departments will be published in thesis in order to show that the results are based on interviews from different perspectives of the organization.
You are free to withdraw your participation in the research at any time, and if you do it you will not be subjected to any penalty or discriminatory treatment.
Charles Sturt University’s Human Research Ethics Committee has approved this project. If you have any complaints or reservations about the ethical conduct of this project, you may contact the Committee through the Executive Officer:

The Executive Officer
Human Research Ethics Committee
Office of Academic Governance
Charles Sturt University
Panorama Avenue
Bathurst NSW 2795

Tel.: +61 2 6338 4628
Fax: 61 2 6338 4194

Do you agree to participate in the research? I will contact you to clarify your participation.
Sincerely

Erdem Yilmaz
(Investigator)
Appendix C: Consent Form

Investigator: Mr. Erdem Yilmaz (Student)
Supervisor: Mr. Prof. Dr. Rolf Rascher, University of Applied Sciences/Labor Optical Engineering, Edlmairstrasse 6 + 8, 94469 Deggendorf; Germany, Tel.: +49 (0)991/3615 323, Fax: +49 (0)991/3615 399, E-Mail: rolf.rascher@hdu-deggendorf.de

DD.MM.YYYY

Research project: An investigation concerning to contribution of platform strategy decisions to competitiveness

I understand that I am free to withdraw my participation in the research at any time, and that if I do I will not be subjected to any penalty or discriminatory treatment.
The purpose of the research has been explained to me and I have read and understand the information sheet given to me.
The purpose of the research has been explained to me, including the risks/discomforts associated with the research. I have read and understood the written explanation given to me.
I understand that any information or personal details gathered in the course of this research about me are confidential and that neither my name nor any other identifying information will be used or published without my written permission.

This study has been approved by Charles Sturt University Faculty of Business’s Ethics in Human Research Committee.

I understand that if I have any complaints or concerns about this research I can contact:

School of Business
Faculty of Business
Charles Sturt University
Bathurst NSW 2795
Australia

School Secretary Phone: +61 2 63384232

Sincerely
Signed
Appendix D: Interview Guide Case Study

Entscheidungsverhalten innerhalb des Baukastenmanagements insbesondere bei Zielkonflikten über Marken/Produkte

Einleitung

Persönliche Informationen:

1) Könnten Sie sich bitte kurz vorstellen?

2) Welche Tätigkeit üben Sie aus?

3) Wie lange arbeiten Sie in dieser Branche/Industrie?

4) Könnten Sie bitte Ihre bisherigen Haupttätigkeiten erklären?

5) Welche Erfahrungen haben Sie im Bereich Plattform- und Baukastenstrategie?

Eröffnungsfragen

Plattformstrategie:

6) Was verstehen Sie unter Plattform-/Baukastenstrategie?

7) Welche Ziele verfolgen Sie mit Plattform-/Baukastenstrategien?

8) Was sind die Nachteile/ Risiken von Plattform-/Baukastenstrategien?

Wettbewerbsvorteil:

9) Was verstehen Sie unter Wettbewerbsvorteil?

Schlüsselfragen

Erfassung der Strategien und den Anteil von Plattformstrategie:

10) Was sind die wesentlichen Strategien für ihren Erfolg im Wettbewerb?
11) Welche Rolle spielt hierbei die Baukasten- und Plattformstrategie für ihren Erfolg im Wettbewerb?

Erfassung Entscheidungsverhalten/Entscheidungsprozess innerhalb des Baukastenmanagements:

12) Wie würden Sie ihren Entscheidungsprozess innerhalb des Plattform- und Baukastenmanagements im Detail beschreiben?

12.1) Welche wesentlichen Entscheidungen treffen Sie im Rahmen von Plattform- und Baukastenstrategie?

12.2) Wer sind die Entscheidungsträger im Rahmen von Plattform- und Baukastenstrategie?

12.3) Was sind die wesentlichen Herausforderungen im Rahmen von Entscheidungen innerhalb der Plattform- und Baukastenstrategien mit denen Sie konfrontiert sind?

12.4) Welche internen Einflussfaktoren haben einen Einfluss auf Ihre Entscheidungen innerhalb der Plattform- und Baukastenstrategie?

12.5) Welche externen Einflussfaktoren haben einen Einfluss auf Ihre Entscheidungen innerhalb der Plattform- und Baukastenstrategie?

12.6) Welche Rolle spielt dabei der Kunde?

12.7) Welche Rolle spielt dabei ihr Hauptwettbewerber?

12.8) Welche Rolle spielt dabei die eigene Unternehmens- und Wettbewerbsstrategie?

12.9.1) Denken Sie bitte mal an den Entscheidungsfindungsprozess in Ihrem Unternehmen. Wie ist der Entscheidungsprozess in Ihrem Unternehmen, wenn im Sinne der Kostenreduzierung Teile von günstigen Produkten/Marken in teure Produkte/Marken eingesetzt werden sollen?

12.9.2) Was sind die wesentlichen Gründe für das beschriebene Entscheidungsverhalten?

12.10.1) Denken Sie bitte mal an den Entscheidungsfindungsprozess. Wie ist der Entscheidungsprozess in Ihrem Unternehmen wenn von teuren Produkten/Marken Teile in günstige Produkte/Marken eingesetzt werden sollen?

12.10.2) Was sind die wesentlichen Gründe für das beschriebene Entscheidungsverhalten?

12.11) Welche Zusammenhänge gibt es zwischen Plattform- und Baukastenstrategieentscheidungen und anderen Strategien/Maßnahmen im Unternehmen?
12.12.1) Wenn Sie an die Produkte der verschiedenen Marken denken, die auf dem Baukasten basieren, welche Zielkonflikte entstehen im Rahmen Entscheidungen innerhalb des Baukastenmanagements?

12.12.2) Wie lösen Sie Zielkonflikte, die im Rahmen der Entscheidungen innerhalb des Baukastenmanagements entstehen insbesondere dann wenn mit Standardisierungs- und Differenzierungsentscheidungen sowohl hohe Kostenreduktionspotentiale als auch zu hohe Leistungsverluste verbunden sind?

12.12.3) Und wie ist die Entscheidungsfindung innerhalb einer Marke wenn damit sowohl hohe Kostenreduktionspotentiale als auch zu hohe Leistungsverluste verbunden ist?

12.12.4) Wie definieren/finden Sie die Grenzen für den Standardisierungs- und Differenzierungsgrad über das Produkt- und Markenportfolio die sich aus dem Baukasten bedienen?

12.12.5) Wie definieren/finden Sie die Grenzen für den Standardisierungs- und Differenzierungsgrad über innerhalb einer Marke?

Schluss

Erfassung Zukunftsentwicklung und Verbesserungspotentiale/Auslauf:

13) Welche Bedeutung werden Plattform-/Baukastenstrategien in Ihrem Unternehmen in Zukunft einnehmen?

14) Was sind aus Ihrer Sicht die größten Hebel/Verbesserungspotentiale im Rahmen von Entscheidungen zu Baukasten- und Plattformstrategien?

-Haben Sie noch abschließende Anmerkungen?

Vielen Dank für die Teilnahme.
Appendix E: Interview Guide Expert Interviews

Einleitung

Hintergrundinformationen:
1) Könnten Sie sich bitte kurz vorstellen?
2) Welche Tätigkeit üben Sie aus?
3) Wie lange arbeiten Sie in dieser Branche/Industrie?
4) Könnten Sie bitte ihre Haupttätigkeiten erklären?
   4.1) Könnten Sie mir bitte mehr darüber erläutern aus welchen Industrien/Branchen Ihre Kunden stammen, welche Größe Sie haben?
   4.2) Über welche Erfahrungen verfügen Sie speziell bei Kunden (Unternehmen), die Plattform- und Baukastenstrategien nutzen?

Eröffnungsfragen

Kundenbezogene Fragen

Plattformstrategie:
5) Was verstehen Ihre Kunden unter Plattform-/Baukastenstrategie?
6) Welche Vorteile erwarten Ihre Kunden beim Einsatz von Plattform-/Baukastenstrategien?
7) Welche Nachteile erwarten Ihre Kunden beim Einsatz von Plattform-/Baukastenstrategien?
8) Welche Risiken erwarten Ihre Kunden beim Einsatz von Plattform-/Baukastenstrategien?
9) Basierend auf ihren Erfahrungen welche Ziele verfolgen Ihre Kunden mit dem Einsatz von Plattform-/Baukastenstrategien?
10) Was sind die Ergebnisse, die Ihre Kunden mit dem Einsatz von Plattform-/Baukastenstrategien erzielen?

11) Wie erfolgreich sind diese Unternehmen die Plattform- und Baukastenstrategien einsetzen im Vergleich zu den Unternehmen die andere Strategien verwenden?

Kundenbezogene Fragen
Wettbewerbsstrategie/Wettbewerbsvorteil:

12) Basierend auf ihren Erfahrungen was verstehen Unternehmen unter Wettbewerbsvorteil?
13) Basierend auf ihren Erfahrungen was verstehen Unternehmen unter Wettbewerbsstrategie?

Schlüsselfragen

Kundenbezogene Fragen

Erfassung der Strategien und den Anteil von Plattformstrategie:

14) Was sind die wesentlichen Strategien von ihren Kunden um ihre Wettbewerbsfähigkeit zu erhöhen?
15) Welche Rolle spielt die Plattformstrategie in Zusammenhang mit Wettbewerbsfähigkeit bei ihren Kunden?

Kundenbezogene Fragen

Fokussierung auf Entscheidungsverhalten/Entscheidungsprozess innerhalb der Plattformstrategie:

16) Denken Sie bitte an Ihre Kunden, wie würden Sie den Entscheidungsprozess innerhalb der Plattform- und Baukastenstrategien beschreiben?

16.1.1) Wer entscheidet im Rahmen von Plattformentscheidungen?
16.1.2) Was sind die wesentlichen Entscheidungen, die im Rahmen von Plattformentscheidungen bei ihren Kunden entschieden werden?
16.1.3) Welche wesentlichen Herausforderungen für Entscheidungsträger konnten Sie dabei beobachten?
16.1.4) Was waren die wesentlichen Gründe für dieses Entscheidungsverhalten ihres Kunden?

16.2.1) Welche internen Einflussfaktoren haben ihrer Beobachtung nach einen Einfluss auf die Entscheidungen innerhalb der Plattformstrategie?
16.2.2) Welche externen Einflussfaktoren haben ihrer Beobachtung nach einen Einfluss auf die Entscheidungen innerhalb der Plattformstrategie?
16.2.3) Welche Rolle spielt dabei der Kunde ihres Kunden?
16.2.4) Welche Rolle spielt dabei der Hauptwettbewerber ihres Kunden?

16.2.5) Welche Rolle spielt dabei die Unternehmensstrategie ihres Kunden?

16.3.0) Welche Zusammenhänge konnten Sie zwischen Plattform- und Baukostenstrategieentscheidungen und anderen Strategien/Maßnahmen im Unternehmen beobachten?

16.4.0) Wie lösen Unternehmen den Zielkonflikt zwischen Kosten und Differenzierung innerhalb der Entscheidungsprozesse?

17) Denken Sie bitte an jeweils ein Unternehmen/Kunden, der seinen Wettbewerbsvorteil gegenüber seinen Hauptkonkurrenten durch

    a) niedrigste Kosten realisiert
    b) durch seine Differenzierung und den damit generierten Kundenvorteilen höhere Preise erzielen kann
    c) sowohl durch niedrigste Kosten als auch durch seine Differenzierung und den damit generierten Kundenvorteilen höhere Preise erzielen kann

17.1) ..... worin unterscheidet sich das Entscheidungsverhalten innerhalb der Plattform- und Baukostenstrategien?

    17.1.1) Was waren die Ergebnisse dieses Entscheidungsprozesses?
    17.1.2) Was waren die wesentlichen Gründe für dieses Entscheidungsverhalten?

17.2) ... worin unterscheidet sich der Entscheidungsprozess wenn im Sinne der Kostenreduzierung Teile von günstigen Produkten/Marken in teure Produkte/Marken eingesetzt werden sollen?

    17.2.1) Was waren die Ergebnisse dieses Entscheidungsprozesses?
    17.2.2) Was waren die wesentlichen Gründe für dieses Entscheidungsverhalten?

17.3) ..... worin unterscheidet sich der Entscheidungsprozess wenn von teuren Produkten/Marken Teile in günstige Produkte/Marken eingesetzt werden sollen?

    17.3.1) Was waren die Ergebnisse dieses Entscheidungsprozesses?
    17.3.2) Was waren die wesentlichen Gründe für dieses Entscheidungsverhalten?

17.4) ..... worin unterscheidet sich die Vorgehensweise wie Unternehmen den Zielkonflikt zwischen Kosten und Differenzierung lösen?

    17.4.1) Was waren die Ergebnisse dieses Entscheidungsprozesses?
    17.4.2) Was waren die wesentlichen Gründe für dieses Entscheidungsverhalten?
17.5)...worin unterscheidet sich die Vorgehensweise wie Unternehmen die Grenzen für den Standardisierungsgrad über das Produktportfolio definieren?

17.5.1) Welche Ergebnisse resultieren aus diesem Vorgehen?

17.5.2) Was waren die wesentlichen Gründe für die Bestimmung der Grenzen für den Standardisierungsgrad?

_Eigene Meinung_

18) Was sind Ihrer Meinung nach die wesentlichen Unterschiede zwischen wettbewerbsstarken und wettbewerbsschwachen Unternehmen in puncto Entscheidungsverhalten innerhalb der Plattformstrategie?

_Schluss_

_Eigene Meinung_

_Erfassung Zukunftsentwicklung und Verbesserungspotentiale:_

19) Basierend auf Ihre Erfahrungen welche Bedeutung werden Plattform-/Baukastenstrategien ihrer Ansicht nach in Zukunft einnehmen?

20) Was sind aus Ihrer Sicht die größten Hebel/Verbesserungspotentiale im Rahmen von Entscheidungen zu Plattformstrategien um zukünftig Wettbewerbsfähigkeit und Erfolg in Zukunft zu haben?

-Haben Sie noch abschließende Anmerkungen?
Appendix F: Documents Case Study

___führt modularen Produktionsbauskasten ein - Automobil- und Motorentechnik Produktion Artikel.pdf
___pdf
___New global growth driver.pdf
___autogramm" - Die Zeitung für die Mitarbeiterinnen und Mitarbeiter der Marke ____pdf
___7 Fragen zum ____ - Das Auto. Magazine.pdf
___2010 ____ China Product Strategy____pdf
___2012_Fressworkshop____ und neue Motoren.pdf
___2012_RB_COO_Insights__.pdf
___Die Forschungs- und Förderungslandschaft sollte paritätischer sein.pdf
___Erfolg durch Modularisierung.pdf
___Faszination Karosseriebau.pdf
___Kosten und Preisdruck spielen eine wichtige Rolle.pdf
___masch18-factory_01-2012_de_e-mail.pdf
___Modulare Baukastenstrategie____pdf
___Modularisierung von Karosseriestrukturen.pdf
___MTZ-Konferenz Modular____ Automobil- und Motorentechnik Aus der Branche Nachrichten.pdf
___Stellhebel bei den Kosten die Baukastenstrategie - Automobil- und Motorentechnik Motorentechnik Artikel.pdf
___Unterwegs in die Zukunft____pdf
___learnsto_use_Modular_Function_Deployment.pdf
___Vortrag____.pdf

___Baukasten Motoren____pdf
___Teil_1.1_Unterlagen TH Nürnberg.pdf
___Teil_1.2_Unterlagen TH Nürnberg.pdf
___VDI-n 2014-06-20 ___-Motorenfertigung' (2).pdf
Appendix G: Conceptual Framework
### Appendix H: Code Book

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<td>Auswirkungen der Standardisierungsentscheidungen innerhalb der Plattformstrategie auf die Produktleistung im Sinne von Innovationen</td>
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<tr>
<td>Produktvielfalt</td>
<td>Auswirkungen der Standardisierungsentscheidungen innerhalb der Plattformstrategie auf die Produktleistung im Sinne von Produktvielfalt</td>
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<td>Zeitvorteile</td>
<td>Auswirkungen der Standardisierungsentcheidungen innerhalb der Plattformstrategie auf das Zeitvorteil im Sinne als Differenzierungsmerkmal aus Sicht des Kunden</td>
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<tr>
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<td>Kosten</td>
<td>Auswirkungen der Standardisierungsentcheidungen innerhalb der Plattformstrategie auf die Kosten</td>
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<tr>
<td>Einmalkosten</td>
<td>Auswirkungen der Standardisierungsentcheidungen innerhalb der Plattformstrategie auf die Einmalkosten</td>
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<td>R&amp;D Kosten</td>
<td>Auswirkungen der Standardisierungsentcheidungen innerhalb der Plattformstrategie auf R&amp;D Kosten</td>
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<td>Sonstige Investitionen</td>
<td>Auswirkungen der Standardisierungsentcheidungen innerhalb der Plattformstrategie auf die sonstigen Investitionen wie z. B. Betriebsmittel</td>
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<td>Herstellkosten</td>
<td>Auswirkungen der Standardisierungsentcheidungen innerhalb der Plattformstrategie auf die Herstellkosten</td>
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<tr>
<td>Materialkosten</td>
<td>Auswirkungen der Standardisierungsentcheidungen innerhalb der Plattformstrategie auf die Materialkosten z. B. durch Skaleneffekte</td>
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<td>Produktionskosten</td>
<td>Auswirkungen der Standardisierungsentcheidungen innerhalb der Plattformstrategie auf die Produktionskosten</td>
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<tr>
<td>Komplexitätskosten</td>
<td>Durch Gleichteile/Standardisierung kommt es zu Kostenreduzierungen in den Komplexitätskosten de durch Varianz erzeugt wird</td>
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<td>Reduzierung der Teileanzahl</td>
<td>Auswirkungen der Standardisierungsentcheidungen</td>
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<tr>
<td>Plattformstrategieentscheidungen</td>
<td>Was sind die Entscheidungen innerhalb der Plattformstrategie und wie wird in der Praxis entschieden</td>
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<td>--------------------------------------------------------------------------------------------------</td>
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<td>Entscheidungen &amp; Entscheidungsträger</td>
<td>Unterschiedliche Entscheidungsphasen mit unterschiedlichen Themen und entsprechenden Entscheidungsträgern</td>
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<td>Entscheidungsträger</td>
<td>Wer entscheidet in welchen Fragestellungen innerhalb der Plattformstrategie</td>
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<td>Organisatorische Entscheidungen in der Roll-out Phase</td>
<td>Was sind die Entscheidungen in der Roll-outphase der Plattform</td>
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<td>Projekt und operative Ebene in der Mitte</td>
<td>welche Entscheidungen werden vom Projekt und von der operativen Ebene getroffen</td>
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<td>mach jetzt 1 oder 2 Varianten</td>
<td>Entscheidungen hinsichtlich Variantenanzahl</td>
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<td>Top-Management und strategisch am Anfang</td>
<td>Strategische Entscheidungen innerhalb der Plattformstrategie die vom Top-Management entschieden werden</td>
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<tr>
<td>was setzen wir für Ziele</td>
<td>Ziele die das Top-Management setzt</td>
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<tr>
<td>welche Ausprägungen was möchte ich für eine Vielfalt, auf einer ganz hohen Ebene</td>
<td>Vielfaltseentscheidungen auf höhere Ebene die vom Top-Management getroffen wird</td>
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<td>welche Baureihen wollen wir reinnehmen in den Baukasten</td>
<td>Entscheidungen hinsichtlich welche Produkte sollen auf welche Plattform</td>
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<tr>
<td>welche Marktsegmente</td>
<td>Entscheidungen vom Top-Management hinsichtlich welche Marktsegmente bedient werden sollen</td>
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<td>Was sind die Entscheidungskriterien innerhalb der Plattformstrategischen Entscheidungen</td>
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<td>Erfolgsfaktoren</td>
<td>Was sind die Erfolgsfaktoren in der Praxis im Rahmen von Plattformentscheidungen</td>
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<td>Faktoren die die Entscheidungen beeinflussen</td>
<td>Einflussfaktoren die Plattformentscheidungen beeinflussen</td>
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<td>Gesetzgebung</td>
<td>Gesetzgebung als Einflussfaktor für Plattformentscheidungen</td>
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<tr>
<td>Interne Organisation</td>
<td>Organisatorische Gegebenheiten als Einflussfaktor für Plattformentscheidungen</td>
</tr>
<tr>
<td>Kunden</td>
<td>Kunde als Einflussfaktor für Plattformentscheidungen - definiert das Differenzierungsniveau resultierend aus den Leistungsanforderungen</td>
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<tr>
<td>Lieferant</td>
<td>Lieferant als Einflussfaktor für Plattformentscheidungen</td>
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<tr>
<td>Positive Beispiele, best practices</td>
<td>Positive Beispiele als Einflussfaktor für Plattformentscheidungen im Sinne von dass die Plattformstrategie Potentiale hat und eingeführt werden sollte (auf OB-Entscheidungen) und im Sinne von wie macht das der Wettbewerber (auf WIE-Entscheidungen)</td>
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<tr>
<td>Wettbewerber</td>
<td>Wettbewerber als Einflussfaktor für Plattformentscheidungen - definieren Kosten und Differenzierungsgrenzen, d. h. für den Kostenführer die Kostengrenze die unterschritten werden muss bei minimaler Differenzierungsniveau, für den Differenzierer das Differenzierungsniveau was überschritten werden muss bei gleichzeitig einem zu erreichenden Kostenniveau, für den Hybrid die Kosten- und Differenzierungsniveau</td>
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<tr>
<td>Ob Plattformstrategie eingeführt werden soll</td>
<td>Entscheidungen ob die Plattformstrategie eingeführt werden soll</td>
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<td>Thema</td>
<td>Beschreibung</td>
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<td>---------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
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<tr>
<td>Ob ich die Plattform überhaupt einführe</td>
<td>Entscheidungen ob die Plattformstrategie eingeführt werden soll</td>
</tr>
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<td>WANN Plattforme eingeführt werden sollen</td>
<td>Plattformentscheidungen im Sinne von Wann Plattform eingeführt werden sollen</td>
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<td>Wie -Ausführung der Plattform</td>
<td>Wie werden die Standardisierungs- und Differenzierungsumfänge der Plattform entschieden</td>
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<td>Inhaltliche Ausführung der Plattformstrategie</td>
<td>welche Umfänge werden standardisiert und differenziert</td>
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<td>Alternativen</td>
<td>welche Alternativen gibt es innerhalb der Plattformstrategie</td>
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<td>Anzahl Varianten</td>
<td>welche Varianten sollen abgebildet werden</td>
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<td>Wie ist die inhaltliche Ausführung der Plattformstrategie</td>
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<td>Differenzierung</td>
<td>Wie werden Differenzierungseentscheidungen getroffen</td>
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<td>Differenzierung nach Kundenwahrnehmung</td>
<td>Differenzierungseentscheidungen auf Basis von Kundenwahrnehmung</td>
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<tr>
<td>Verbindung zu Markenstrategie - Markendifferenzierung bei Mehrmarkenangebot</td>
<td>Differenzierungseentscheidungen auf Basis Markendifferenzierung</td>
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<td>Verbindung zu Produktportfoliostrategie – Produktdifferenzierung</td>
<td>Plattformentscheidungen die im Rahmen von Produktportfoliostrategien in Zusammenhang stehen- Einfluss der Produktdifferenzierung auf Plattformentscheidungen</td>
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<td>Lösungen zum Zielkonflikt Kosten und Differenzierung</td>
<td>Wie werden die Zielkonflikte zwischen Kosten und Differenzierung innerhalb der Plattformstrategie gelöst</td>
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<td>Lösungsfundung</td>
<td>Wie ist der Lösungsfindungsprozess um die Balance zwischen Kosten und Differenzierung festzulegen</td>
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<tr>
<td>Näherungsprozess</td>
<td>von wo nähert man sich den Standardisierungs- und Differenzierungsgrenzen heran</td>
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<tr>
<td>------------------------</td>
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<td>wo man sich aneinander reibt</td>
<td>wie werden Standardisierungs- und Differenzierungsumfänge innerhalb der Organisation bestimmt</td>
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<td>Definition der Standardisierungsumfänge angelehnt an vorhandene Entwicklungskapazitäten</td>
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<td>Modularisierung</td>
<td>Modularisierung als Mittel um Standardisierungs- und Differenzierungsumfänge mit feiner Granularität festlegen zu können</td>
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<td>Overengineering</td>
<td>Overengineering als Mittel zur Standardisierung</td>
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<tr>
<td>Standardisierungs- und Differenzierungsplan</td>
<td>Standardisierungs- und Differenzierungsplan als ein Werkzeug zur Festlegung von diesen Umfängen im Voraus</td>
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<td>Variantenplanung</td>
<td>Variantenplanung als Werkzeug zur Festlegung von Standardisierungs- und Differenzierungsumfängen</td>
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<td>Versuch und Irrtum Logik</td>
<td>Versuch und Irrtum Logik als Mittel bei der Plattformstrategieplanung</td>
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<td>Referenz</td>
<td>Was ist die Referenz zur Festlegung von Standardisierungs- und Differenzierungsgrenzen</td>
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<td>besser als Ist-Stand</td>
<td>Optimierung im Vergleich zum Ist-Stand</td>
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<td>besser als Wettbewerber</td>
<td>Festlegung im Sinne von Erzielung von Wettbewerbsvorteil</td>
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<td>maximale Kostensenkung</td>
<td>Festlegung der Standardisierungs- und Differenzierungsgrenzen um maximal mögliche Kosten zu senken</td>
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<tr>
<td>maximale Kundenzufriedenheit</td>
<td>Festlegung der Standardisierungsfang und Differenzierungsgrenzen um den Kunden maximal zu befriedigen</td>
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<td>--------------------------------------------------------------------------------------------------</td>
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<tr>
<td>Standardisierung</td>
<td>Wie bestimmt man die Standardisierungsgrenzen</td>
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<td>Standardisierung angelehnt an die Entwicklungskapazität</td>
<td>Standardisierung angelehnt an die Entwicklungskapazität</td>
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<td>Standardisierung durch Overengineering</td>
<td>Standardisierung durch Overengineering</td>
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<tr>
<td>Standardisierung nach Unternehmenszielen</td>
<td>Standardisierung nach Unternehmenszielen - hier: Kosteneinsparung</td>
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<td>Standardisierungsart - Starre und Flexibilität der Plattform</td>
<td>Starre und flexible Umfänge in Abhängigkeit von den Zukunftsszenarien</td>
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<td>Verbindung zu Unternehmensstrategie</td>
<td>Welche Verbindung gibt es zwischen der Unternehmens- und Plattformstrategie</td>
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<td>Prozessuale Bestimmung der Plattformstrategie</td>
<td>Wie wird prozessual die Plattform festgelegt</td>
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<td>Systematische Kompatibilität von Plattform- und Wettbewerbsstrategie</td>
<td>Verbindung der Plattform- und Wettbewerbsstrategie - eine systematische und rationale aufeinander Abstimmung von Plattformstrategie und Wettbewerbsstrategie um die Dimensionen Kosten und Differenzierung bewusst zu steuern</td>
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<td>Standardisierungsart angelehnt an die Wettbewerbsstrategie</td>
<td>Festlegung der Standardisierungsart nach Wettbewerbsstrategie - hier: Differenzierer eher Schnittstellen, Kostenführer eher starrer damit mehr Gleichenteile und gleiche Architekturen</td>
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<td>Systematische Kompatibilität von Plattform- und Wettbewerbsstrategie</td>
<td>Beziehung zwischen Plattformstrategie und Wettbewerbsstrategie - eine systematische und rationale aufeinander Abstimmung von Plattformstrategie und Wettbewerbsstrategie um die Dimensionen Kosten und</td>
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<td>Übersicht</td>
<td>Beschreibung</td>
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<td>Übergeordnete Unternehmensziele</td>
<td>Übergeordnete Ziele im Rahmen der Plattformstrategie - bei Zielkonflikt von Kosten und Differenzierung --&gt; Orientierung an übergeordnetes Ziel</td>
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<td>Beabsichtigte Wettbewerbsposition</td>
<td>ist die gewünschte Wettbewerbsposition des Unternehmens charakterisiert in der Ausprägung der Dimensionen Kosten und Differenzierung</td>
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<td>Differenzierungsführerschaft als gewünschte Wettbewerbspositionierung</td>
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<td>Gesamtmarkt</td>
<td>vertreten im Gesamtmarkt</td>
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<td>Sowohl Kosten- als auch Differenzierungsführerschaft als gewünschte Wettbewerbspositionierung</td>
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<td>Nischenanbieter</td>
<td>vertreten in Nischensegmenten</td>
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<td>welchen Beitrag leistet die Plattformstrategie zu Wettbewerbsstrategie</td>
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<td>Profitabelste Anbieter</td>
<td>Profitabilität als Oberziel des Unternehmens</td>
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<td>Zeithorizont für Unternehmensziele</td>
<td>Zeithorizont für Unternehmensziele- je kurzfristiger desto schlechter aus Sicht der Plattformstrategie</td>
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<td>Weitere Aktivitäten und Strategien mit Einfluss auf Kosten und Differenzierung</td>
<td>Sonstige Aktivitäten/Strategien die Kosten und Differenzierung beeinflussen und die mit in die Plattformstrategieentscheidungen mit einbezogen werden</td>
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<td>Ziele Plattformstrategie</td>
<td>Was sind die Ziele der Plattformstrategie</td>
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<tr>
<td>Zieldefinition (prozessual)</td>
<td>Wie werden Plattformziele definiert</td>
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<td>Wozu führen Plattformentscheidungen</td>
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<td>Differenzierung</td>
<td>Durch Gleichteile innerhalb der Plattformstrategie kann es zu Differenzierungsnachteilen kommen</td>
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<td>Produktleistung</td>
<td>Produktleistung ist ein Differenzierungsmerkmal aus Sicht des Kunden</td>
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<td>Qualität ist ein Differenzierungsmerkmal aus Sicht des Kunden</td>
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<td>Kosten</td>
<td>Durch Gleichteile/Standardisierung innerhalb der Plattformstrategie kommt es zu Kostenreduzierungen</td>
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<tr>
<td>Einmalkosten</td>
<td>Durch Gleichteile/Standardisierung kommt es zu Kostenreduzierungen in den Einmalkosten</td>
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<td>R&amp;D Kosten</td>
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<td>Durch Gleichteile/Standardisierung kommt es zu Kostenreduzierungen in den Einmalkosten hinsichtlich sonstigen Investitionen wie z. B. Betriebsmittel</td>
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<td>Komplexitätsgesamtkosten</td>
<td>Durch Gleichteile/Standardisierung kommt es zu Kostenreduzierungen in den Komplextitätsgesamtkosten de durch Varianz erzeugt wird</td>
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<tr>
<td>Materialekosten</td>
<td>Durch Gleichteile/Standardisierung kommt es zu Kostenreduzierungen in den Materialekosten aufgrund Skaleneffekte</td>
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<tr>
<td>Produktionskosten</td>
<td>Durch Gleichteile/Standardisierung kommt es zu Kostenreduzierungen in den Produktionskosten aufgrund Lerneffekte</td>
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<td>Reduzierung der Teileanzahl</td>
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<td>Geschäftsfeleigenschaften</td>
<td>bestimmt welche Kosten- und Differenzierungsdimensionen zur beabsichtigten Wettbewerbsstrategie betrachtet werden</td>
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<td>b2b oder b2c</td>
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<td>Kundeneigenschaften</td>
<td>Kundencharakteristik des jeweiligen Geschäftsfeldes</td>
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<td>Die Art und Weise wie das Produkt gekauft wird</td>
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<td>Kaufkriterien</td>
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<td>Kundeneinfluss auf Produktgestaltung</td>
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<td>Preissensitivität</td>
<td>Kunden sind bereit für mehr Leistung mehr zu bezahlen</td>
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<td>Produktleistung als Kaufkriterium</td>
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<td>Zeit als Kaufkriterium</td>
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<td>Produktkomplexität als Geschäftsfeldcharakteristik ist entscheidend welche Kostenarten bei den Plattformentscheidungen berücksichtigt werden wie z. B. R&amp;D-Kosten</td>
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<td>Relationen der Einzelkosten zueinander</td>
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<td>Produktmodularität</td>
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<td>Stückzahl</td>
<td>Stückzahl ist entscheidend ob Skaleneffekte generiert werden</td>
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<td>Description</td>
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<td>Transparenz und Erkenntnis über Auswirkungen der Plattformstrategie</td>
<td>können bzw. wie sich die Kosten pro Stück verteilen</td>
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<tr>
<td>Ziele Plattformstrategie (inhaltlich)</td>
<td>was sind die inhaltlichen Ziel der Plattformstrategie</td>
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<td>Komplexitätsbeherrschung</td>
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<td>Kostenoptimierung</td>
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<td>möglichst wenig interner Variantenvielfalt möglichst viel externe Variantenvielfalt zu erzeugen</td>
<td>Minimale interne Varianz bei maximal externer Varianz als Plattformziel</td>
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<td>besser als Ist-Stand im Sinne einer Optimierung als Zielreferenz für Plattformstrategie</td>
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<td>besser als Wettbewerber im Sinne einer Optimierung als Zielreferenz für Plattformstrategie</td>
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<td>Wachstumsziel</td>
<td>Plattformstrategie soll das Wachstumsziel ermöglichen</td>
</tr>
<tr>
<td>Ziele Plattformstrategie</td>
<td></td>
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<tr>
<td>Ziele Wettbewerbsstrategie Wettbewerbsvorteil</td>
<td>Was sind die Ziele der Wettbewerbsstrategie</td>
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</table>
### Appendix I: Example – Excerpt from Framework Matrix

<table>
<thead>
<tr>
<th>A: Interview Dr. B 20150325</th>
<th>B: Interview Dr. Z 20150305</th>
<th>C: Interview Pf 20150319</th>
<th>D: Interview Dr. Sch 20150423</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entscheidungen werden oft aus dem Bauch heraus getroffen (Widerspruch zu systematischen Vorgehensweise)</td>
<td>die Notwendigkeit der Differenzierung ist verknüpft mit der Notwendigkeit der Plattform- und Baukastenstrategie</td>
<td>Differenzierer achten bei der Umsetzung der Plattformstrategie darauf, dass die externe Varianz nach wie vor gegeben ist</td>
<td>Entscheidung wie viel Vielfalt braucht man</td>
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<td>-Kostenführer (hier Preisführer genannt) sind eher bereit die Kompromisse einzugehen, die aus der Standardisierung heraus resultieren</td>
<td>-Differenzierer wollen sich anhand ihrer Markenpositionierung in bestimmten Merkmalen differenzieren um ihrer Preis- und Wettbewerbspositionierung am Markt gerecht zu werden und stellen sich die Frage wie sie die beabsichtigte Profitabilität mit einer Plattform- Baukastenstrategie erreichen können</td>
<td>-Erfolgsfaktor ist es die Baukastenstrategie aus der Unternehmensstrategie abzuleiten</td>
<td>-Der Standardisierungsgrad korreliert nicht mit der Wettbewerbsstrategie da Variantenbildung (nicht standardisieren) aus Sicht Kostenführerschaft und Differenzierer sinnvoll sein kann, aus Sicht Kostenführer weil die Produktkosten aufgrund des Overengineerings nicht überschritten werden und aus Sicht des Differenzierers weil damit beispielsweise Innovationen umgesetzt werden können die nicht aus dem Standard vorgehen</td>
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<td>-bei Differenzierern basieren die Entscheidungen auch auf Basis von Wirtschaftlichkeitsbetrachtungen jedoch mit mehr Fokus hinsichtlich Kundenrelevanz</td>
<td>-Plattformstrategie unterstützt Wachstums- und Kostenreduzierungsziele</td>
<td>-Der Standardisierungsgrad anhand der externen Variabilität und der markenorientierten Strategie abgestuft von Kostenführer (Preisführer), Hybrid und anschließend Differenzierer wobei der Standardisierungsgrad abnimmt</td>
<td>-Der Unterschied in der Baukastenstellung bei den unterschiedlichen</td>
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<td>-hinsichtlich Gleichheit/Kompatibilität von Plattform- und Wettbewerbsstrategie unterscheidet sich das Ganne abgestuft vom Kostenführer (hier Preisführer), Hybrid und anschließend Differenzierer wobei der Standardisierungsgrad abnimmt</td>
<td>-Differenzierer müssen schauen dass ihre Differenzierung durch den Baukasten nicht verloren durch entsprechende Baukastenvariation entweder in</td>
<td>-Der Differenzierer konsultiert die externe Variabilität für die Differenzierung bei den Baukastenvariationen</td>
<td>-Der Unterschied in der Baukastenstellung bei den unterschiedlichen</td>
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