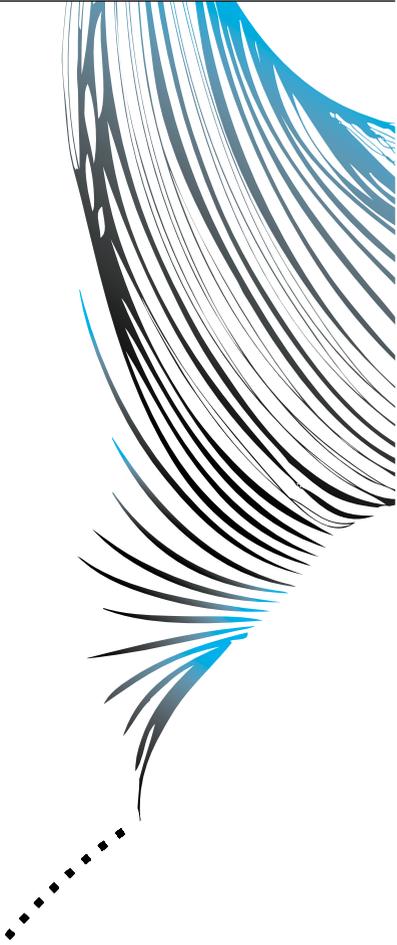


INAUGURAL LECTURE

30 APRIL 2015



IS THE WHOLE  
MORE THAN THE  
SUM OF ITS PARTS?

ON THE INTERPLAY OF MARKETING  
AND DESIGN RESEARCH

**PROF. DR. JÖRG HENSELER**

**UNIVERSITY OF TWENTE.**



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# IS THE WHOLE MORE THAN THE SUM OF ITS PARTS?

ON THE INTERPLAY OF MARKETING  
AND DESIGN RESEARCH

Inaugural lecture given to mark the start of the  
position as professor of **Product-Market  
Relations** at the Faculty of Engineering  
Technology of the University of Twente on  
Thursday 30 April 2015 by

**PROF. DR. JÖRG HENSELER**



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# 1. INTRODUCTION

Dear Rector Magnificus, dear Colleagues, dear Ladies and Gentlemen. With this talk, I formally inaugurate the Chair of Product-Market Relations. The positioning of this chair is unique in the world: It is placed at the interface of design engineering and marketing. It contributes to both disciplines in interdisciplinary ways, and develops research methodology for marketing and design research.

## 2. DESIGN AND MARKETING

### 2.1 DESIGN AND MARKETING IN PRACTICE

One of the most important building blocks of well-functioning economic systems is competition. According to the so-called law of competition, as formulated by Adam Smith, commercial organizations compete for the share of customers' wallets, and customers open their wallet for the offering they consider best for them. If things go well, consumers get the right goods and services at the right time, at the right price, at the right place, with the right communication. Figuratively, this is all done by an 'invisible hand'.

To reach this desired situation, several fields of knowledge have been developed. Here, I focus on two particular disciplines that play major roles in facilitating that customers get the products, services, and solutions they want; let's call design and marketing the thumb and the indicator finger of this invisible hand.

As consumers, we are exposed to these two disciplines almost continuously. Design is all around us. For instance, we face architecture in the building we are in, fashion design in the usual – or maybe today not-so-usual – garments we wear, industrial design in the furniture and technical equipment we use, sound design in the acoustics we hear, and service design in the toast we will have after this talk.

Marketing is all around us too, sometimes visible and sometimes not. Marketing research monitors our social communication, purchasing, and consumption patterns to better understand our needs and wants. Many people have their favorite brands close to them, for instance, an accessory or a technical device. Sometimes we note marketing communications like the various forms of advertisement; sometimes it catches us off guard, such as in the case of sponsoring. And I would certainly not be unhappy if, after this talk, you had the impression that this was good marketing for the University of Twente and for myself.

For businesses, design and marketing also play important roles. Design is widely recognized as a success factor in business because it has the potential to boost a firm's competitiveness (Hertenstein et al., 2013). Many companies have developed design capabilities, to differentiate themselves from competitors. Overall, the importance of design – particularly industrial design – is widely acknowledged (e.g. Gemser and Leenders, 2001;

Sarasvathy et al., 2008; Ulrich and Eppinger, 2000).

Marketing is a key determinant of a firm's success. If firms act as marketing suggests, they can expect more satisfied and more loyal customers (Zeithaml et al., 1996) and – ultimately – increased business profitability (Narver and Slater, 1990). And, with a wink: *Isn't it true that marketing is the only department that generates value, whereas other departments create costs?*

Owing to the important roles of design and marketing, I will focus on each in some in detail. Specifically, I will focus on design research and marketing as scientific disciplines. All scientific research seeks to advance knowledge (Bunge, 1967a). Marketing and design research differ in both *what* they research and in *how* they conduct research. I will show that the strengths of the one discipline are the weaknesses of the other, and vice versa, and that together they can achieve more than either can achieve alone.

## 2.2 DESIGN RESEARCH

Design has been a companion of mankind for thousands of years. Design had its birth when people began to purposefully create tools, cloths, shelters, and other artifacts. According to the Accreditation Board for Engineering and Technology, design can be defined as “the process of devising a system, component, or process to meet desired needs. It is a decision-making process (often iterative), in which the basic science and mathematics and engineering sciences are applied to convert resources optimally to meet a stated objective.” As the U.S. design professor Shimon Shmueli says so succinctly: “Design is art optimized to meet objectives.”

In light of the long tradition of design, it seems surprising that design research is actually quite a young scientific discipline – it only emerged in the 1960s. Its mission is “to produce knowledge for the design and realization of artifacts, i.e. to solve construction problems, or to be used in the improvement of the performance of existing entities, i.e. to solve improvement problems” (Aken, 2004, p. 224). An important contribution to its self-understanding was the seminal work of Herbert Simon (1969), who introduced design research as the “science of the artificial”.

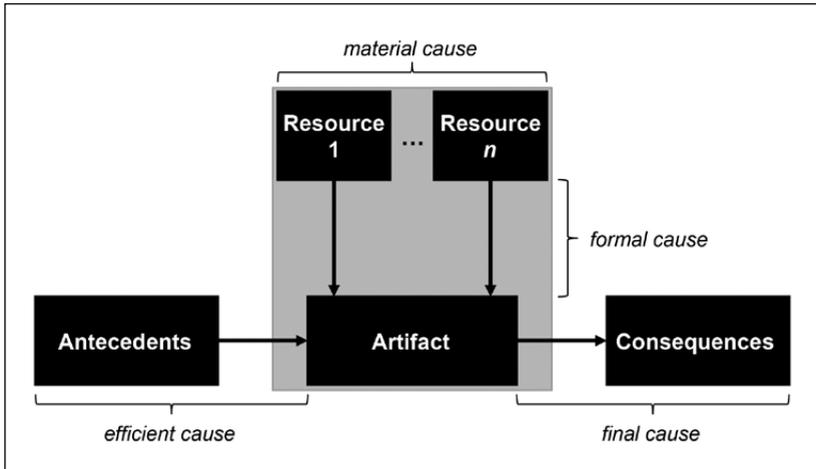


Figure 2.1: A Framework for Design Research

Design research differs fundamentally from behavioral sciences or natural sciences (Kornwachs, 1998). While behavioral sciences or natural sciences seek to describe and explain the existing world, design research is about shaping it (Hevner and Chatterjee, 2010). Design research focuses on what the Argentinian philosopher Bunge calls “technological rules” (1967b). Technological rules are of the nature, *If you wish to achieve objective A, then come up with the solution B*. Consequently, a typical research question in design research is *Does it work?*, while behavioral research would ask *Is it true?*. While the quest for truth and the faith in a true model are characteristic of the positivist paradigm, design research instead follows a pragmatic paradigm (Goldkuhl, 2012; Hevner, 2007). Figure 2.1 presents a framework of how design research can be viewed in light of the pragmatic paradigm. An artifact can be understood as some transformation of resources, and it is embedded in a nomological net of antecedents and consequences. A key aspect of this framework is that design per definition must consider an artifact’s purpose. For instance, product design and how the product appears fulfils several roles for consumers (Creusen and Schoormans, 2005): it communicates aesthetics; it provides symbolic, functional, and ergonomic information; it draws attention; and it helps one to categorize.

Although it may not be immediately noticeable, the design research framework shown in Figure 2.1 differs from conventional causal models of behavioral science. The primary difference is that not all arrow connections

represent causal relationships, as understood in behavioral science. Rather, a more nuanced understanding of causality is helpful, as Aristotle already proposed. "Aristotle distinguished four causes... material, formal, efficient, and final. Respectively they indicate that from which something was made (material cause), the pattern by which something was made (formal cause), that from which comes the immediate origin of movement or rest (efficient cause), and the end for which it is made (final cause)..." (Poole, 2000, p. 42). While, in natural science, only the material and the efficient cause are considered (Bacon, 1828), all four causes have roles in design research (Heidegger, 1954). The value of Aristotle's four causes is ubiquitous: for a more effective design of artifacts or systems of any kind, for a better understanding of reality, and for structuring our knowledge (Müller-Merbach, 2005).

The different foci of design research vs. behavioral research also translate into different teaching practices in academic education. Unlike the behavioral sciences, design research is not an empirico-deductive system that can be taught as concepts and their interrelationships. Thus, while in behavioral sciences, it is common to learn by following lectures or seminars, design learning happens in the form of a reflective practicum, and practical design knowledge is developed in a master-apprentice relationship.

Sometimes one could get the impression that design research has a disadvantage compared to behavioral research. This is definitely the case if, in a scientific discipline, a design-oriented research stream competes with a research stream rooted in natural or behavioral sciences. A clear example can be found in information systems (IS) research, where 121 researchers signed a memorandum in which they conjure up the "danger of shifting from a design-oriented discipline into a descriptive one" (Österle et al., 2011, p. 8). They trace this danger back to criteria formulated by academic gatekeepers, such as journal editors, noting "that publications providing statistical evidence of empirically identified characteristics of existing IS are favored over publications presenting innovative solutions that are considered highly beneficial for business" (Österle et al., 2011, p. 8). In short, behavioral research is easier to get published than design research, because design research lacks adequate methods of empirical research.

The availability of adequate research methods and researchers' familiarity with them has a pivotal influence on a scientific discipline's progress. We must not forget that "[s]cience is a group activity that relies heavily on mutual criticism to maximize the validity of conclusions. Much of what characterizes good research is the ability to anticipate, and neutralize with data, potential criticisms of conclusions" (Cliff, 1983, p. 118). Because

market research has always been an integral part of marketing, marketing research methodology is fairly well developed. In contrast, almost from the founding of the design research discipline onwards, “there had been a lack of success in the application of ‘scientific’ methods to design” (Cross, 2007, p. 2). Blessing and Chakrabarti (2009) decry the lack of a shared terminology, benchmarked research methods, and a common research methodology in design research. Design research does regard the development of new research methods as a key issue (Blessing et al., 1998, p. 54), besides the adaptation of existing research methods from other disciplines such as computer science, sociology, psychology, or management. However, an own methodological research stream in design research comparable to psychometrics, econometrics, or chemometrics, for instance, is not in sight. Given the different nature of design research, it is also unsurprising that methods from other disciplines do not prove too useful. Instead of relying on other disciplines’ methodologies, design research – and all its subdisciplines – would benefit from an own methodological framework. I will provide a first glimpse on a possible methodological framework for design research shortly.

## 2.3 MARKETING

Many of marketing’s focal phenomena such as selling, word-of-mouth, or pricing have been around for several thousand years. Nonetheless, just like design research, marketing as a scientific discipline is also relatively young. It was only in the first half of the previous century that marketing constituted itself as a scientific discipline. In 1948, a Definitions Committee appointed by the American Marketing Association defined marketing as “[t]he performance of business activities that direct the flow of goods and services from producer to consumer or user” (Definitions Committee, 1948, p. 209). Soon thereafter, the marketing concept emerged; it holds that the key to achieving organizational goals is being more effective than competitors in creating, delivering, and communicating superior customer value to the selected target customers (Kotler and Keller, 2009).

In the following years, marketing developed into a multidisciplinary science, incorporating knowledge from many different fields, notably microeconomics and behavioral sciences. In the 1960s, the marketing discipline seemed to have reached puberty as it entered an identity crisis. Scholars reiterated the questions of marketing as the science of what? What should be its core focus? The question was answered by Bagozzi (1975), who

coined the view of marketing as the science of exchange.

In the following decades, marketing continued to seek inspiration from neighboring disciplines. Behavioral science, particularly psychometrics, also built the methodological foundation for large parts of the discipline. Concretely, the latent variable model has become one of the dominant models for marketing research. According to the latent variable model, there is an unobservable (latent) variable that is the underlying cause of one or more phenomena. Since this variable is not observable, its existence can only be inferred through the occurrence of immediate consequences.

I will illustrate the latent variable model by means of a construct that has received ample attention in the marketing literature, customer satisfaction, which can be defined as “the outcome of the subjective evaluation that the chosen alternative (the brand) meets or exceeds the expectations” (Bloemer and Kasper, 1994, p. 153). Customer satisfaction is a desired result of an exchange process, not least because it has been identified as a direct and indirect antecedent of customers’ re-purchase intentions (cf. Oliver, 1980; Bloemer and Kasper, 1995; Coelho and Henseler, 2012). Since it facilitates future exchange, customer satisfaction has received ample attention among marketing scholars. Particularly for service firms, customer satisfaction is of high practical relevance. It serves as performance indicator with multiple implications for management. Who among you has not been approached by a firm asking you how satisfied you were with a certain product or service? Firms struggle with the fact that customer satisfaction is not directly observable, and the best one can do is to infer customer satisfaction from their answers to satisfaction-related questions.

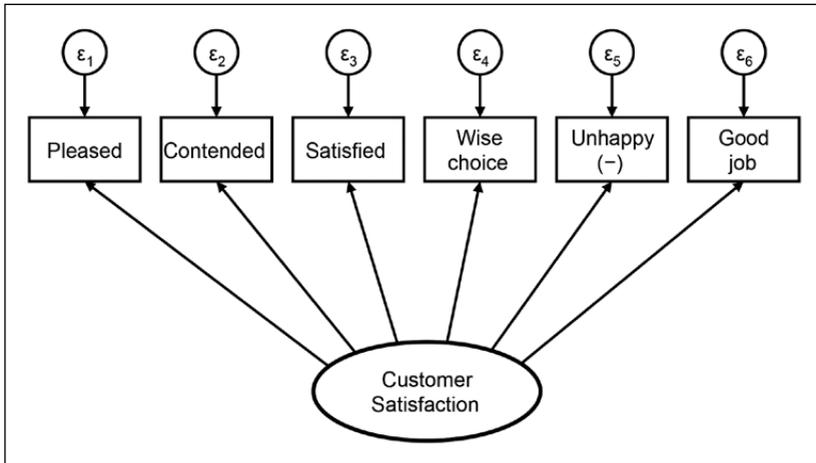


Figure 2.2: Example of a Latent Variable Model: Customer Satisfaction (as modeled for instance by Oliver and Swan (1989))

Figure 2.2 depicts a model of customer satisfaction as proposed by Oliver and Swan (1989). Each rectangle represents customers' answers to a questionnaire item. For instance, the item on the far left captures the answer to a semantic differential scale ranging from *poor job* to *good job*. Every item can be considered as a measurement error-prone manifestation of the latent variable *customer satisfaction*. Values for the latent variable are typically obtained using factor-analytical or other scoring techniques. Over the years, thousands of marketing papers have investigated comparable latent variable models, and the number of proposed latent variables in the marketing discipline has steadily increased.

However, along with the recommendation that marketing should consider paradigms other than positivism (Peter and Olson, 1983), other types of marketing models have also emerged. One of the major contributions of the marketing discipline is the construct of market orientation, which can be considered as a pragmatic, action-oriented implementation of the marketing concept. Kohli and Jaworski (1990, p. 6) conceptualized market orientation as "the organization-wide generation of market intelligence, dissemination of the intelligence across departments, and organization-wide responsiveness to it." Notably, this is a set of activities; Figure 2.3 depicts their conceptualization. Clearly, the arrow direction speaks against a latent variable model. This conceptualization of market orientation calls for

an artifact. Apparently, marketing scholars did not feel too at ease with this model, and only six months later, a competing conceptualization of market orientation as a corporate culture was introduced (Narver and Slater, 1990); this came closer to the latent variable model.

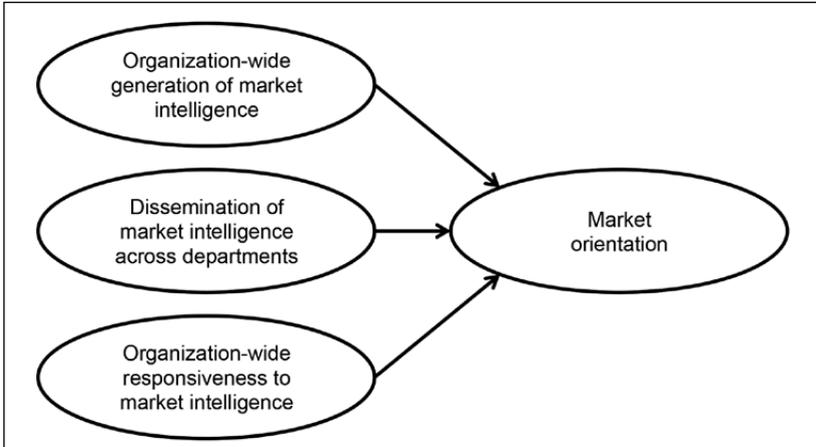


Figure 2.3: Key Marketing Concept: Market Orientation (as conceptualized by Kohli and Jaworski, 1990)

The more one thinks about it, the more marketing concepts do not adhere to the latent variable model, but turn out to be designed. When a set of activities, a portfolio, or a mix is introduced, we always face a piece of design research within marketing. Classical examples include the marketing plan, the brand portfolio, and the media mix.

While the marketing discipline sometimes seems to battle to incorporate design research, this does not hold for marketing practice. Already in 1948, the task of a marketing executive was described as "... a 'mixer of ingredients,' who sometimes follows a recipe prepared by others, sometimes prepares his own recipe as he goes along, sometimes adapts a recipe to the ingredients immediately available, and sometimes experiments with or invents ingredients no one else has tried" (Banting and Ross, 1973, p. 1). The fact that marketing management is actually a design task was already noted by Simon (1969, p. 129), who wrote that "The intellectual activity that produces material artifacts is no different fundamentally from the one... that devises a new sales plan for a company..."

# 3. THEORY TESTING AND DESIGN RESEARCH

## 3.1 EMERGENCE AS THE CENTRAL THEORY OF DESIGN RESEARCH

The idea that design science should be rooted in theories was pioneered by Walls et al. (1992). However, Stolterman and Wiberg (2010, p. 98) observe “a lack of research approaches that focus on theoretical advancement *and* are design and concept oriented at the same time.”

Current developments in design research theories mainly focus on generalizations from single design instances. Examples of such generalizations are patterns (cf. Ishikawa and Silverstein, 1977), annotated portfolios (cf. Gaver, 2012), and strong concepts (cf. Höök and Löwgren, 2012). These generalizations form a body of intermediate-level knowledge, which – in terms of abstraction level – is situated between single design instances and actual design theories. Figure 3.1 visualizes this idea. Among the three mentioned types of intermediate-level knowledge, strong concepts possess the highest abstraction level. They are “design elements abstracted beyond particular instances which have the potential to be appropriated by designers and researchers to extend their repertoires and enable new particulars instantiations” (Höök and Löwgren, 2012, p. 5).

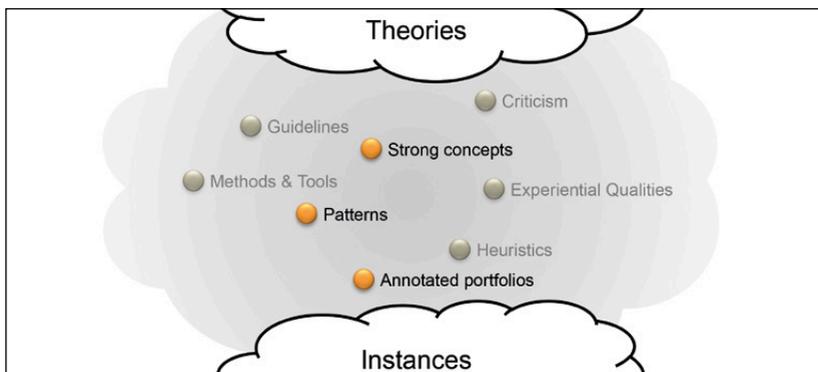


Figure 3.1: Intermediate-level Knowledge of Design research (derived from Höök and Löwgren (2012))

Gaver (2012) argues that design research theories are not falsifiable,

and provides two arguments for this assertion: First, design theories are too vague or not sufficiently specified to permit falsification. Second, refuting theories would run counter to the nature of design, which is fairly generative, creative, and conforming rather than seeking to refute. Although this view might describe the status quo, I consider it too limited a view to allow design research to progress. As this assertion demonstrates, design research may benefit from more concrete theories that are specific enough to be falsifiable. An important condition for their usefulness is that they should capture design's creative nature.

Two aspects make me confident that falsifiable design research theories are well within reach: the rise of concept-driven research and the use of emergence as a criterion for the adequacy of design.

The process of designing concepts is becoming a crucial element of theorizing in any design discipline (Stolterman and Wiberg, 2010). Nelson and Stolterman (2003) remind us that, in design, the observable world does not necessarily exist yet; it is emerging as a result of design efforts. Theories about new forms of artifacts must therefore not only deal with the existing but also with the not-yet-existing (Nelson and Stolterman, 2003). One way to achieve this is to study strong concepts, which become the key elements of concept-driven research (Stolterman and Wiberg, 2010). The character of a concept design is the overall organizing principle that makes up the composition of the design as a whole (Nelson and Stolterman, 2003).

Regarding a design as a whole leads us to the main title of this inaugural lecture: *Is the whole more than the sum of its parts?* This question again refers to Aristotle, who in his *Metaphysics* argues that the whole is separate from the parts. Nowadays, this notion is discussed under the term *emergence* – a process through which larger entities, patterns, or concepts with certain properties arise that are comprised of smaller or simpler entities that themselves do not exhibit such properties (O'Connor and Wong, 2012). One can discuss whether it must be *more than*, *greater than*, or just *different to*. The core idea of emergence is that the whole gets a surplus meaning that is not captured by its parts alone. Figure 3.2 visualizes this notion by means of an example in two parts, a parallelogram and a right triangle. These two parts can be studied separately, they can be arranged to form a composite, and they can be used to create a composite with a surplus meaning. In the latter case, we would speak of emergence.

When we look at this example, we find it fairly easy to determine whether the artifact has a surplus meaning. In this case, we can answer the question, *Is this artifact a new meaningful entity?* by comparing it to known concepts – in this case, a fish. Properties like ability to swim or edibility are meaningful concerning the new entity, but not its constituents. More sophisticated means are needed to determine whether a not-yet-existing concept has the attribute of emergence.

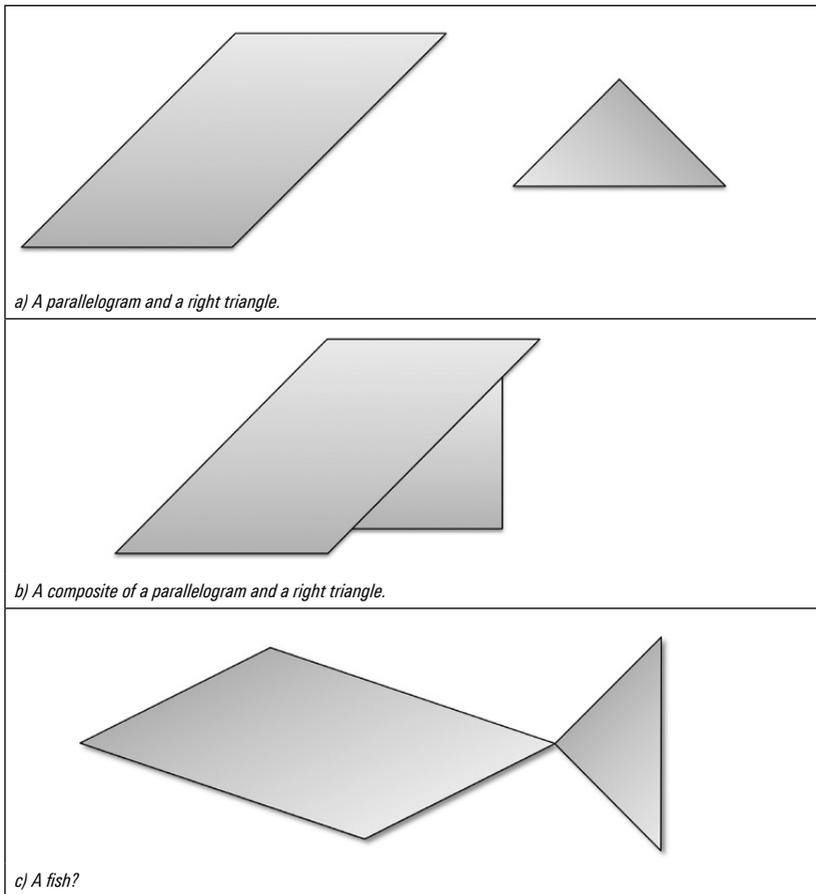


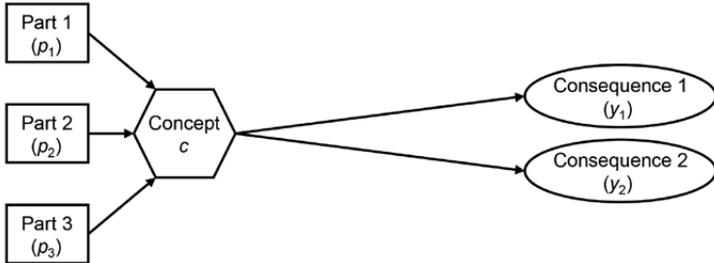
Figure 3.2: An Example of Emergence

The idea of design as a form of emergence is particularly prevalent in systems design (Ottino, 2004), but has also occasionally been recognized in other design research fields, such as landscape design (Motloch, 2000). Apparently, while emergence is considered to be an exciting phenomenon in behavioral and natural sciences, design research seems to take it for granted so much that it is seldom discussed. However, awareness of emergence as a crucial theme of design research paves the way for an empirical assessment of design research theories.

While the degree to which a single design instance is experienced as a whole is determined solely by the designer's judgment (Nelson and Stolterman, 2003), strong concepts ask for a more objective assessment of whether or not they form a whole. Instead of a mere judgment by the design researcher who introduces a strong concept, a more thorough and objective approach seems needed. Thus, I postulate that strong concepts should be empirically tested for emergence, i.e. whether they form a whole. "Artifacts are not exempt from natural laws or behavioral theories" (Hevner et al., 2004); on the contrary, artifacts and strong concepts can stand up to empirical assessment.

Testing whether a concept possesses the attribute of emergence requires a nomological net, i.e. a set of other concepts or variables in which the focal strong concept play a role as a whole. Neither a strong concept nor its parts are informative about the attribute of emergence alone. The study of concepts within a nomological net makes it possible to identify those concepts for which the attribute of emergence holds; moreover, it facilitates analyzing both the technical and the social system, and how these interact (Adriaanse et al., 2010).

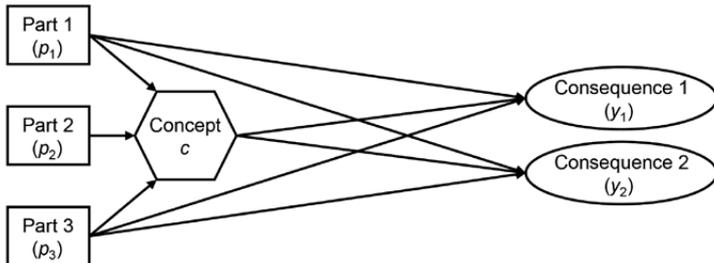
a) A model containing a strong concept for which emergence holds



Variable	implied correlations	
	$y_1$	$y_2$
$p_1$	$\text{cor}(p_1, c) \cdot \text{cor}(c, y_1)$	$\text{cor}(p_1, c) \cdot \text{cor}(c, y_2)$
$p_2$	$\text{cor}(p_2, c) \cdot \text{cor}(c, y_1)$	$\text{cor}(p_2, c) \cdot \text{cor}(c, y_2)$
$p_3$	$\text{cor}(p_3, c) \cdot \text{cor}(c, y_1)$	$\text{cor}(p_3, c) \cdot \text{cor}(c, y_2)$

Parameters:  $\text{cor}(p_1, c)$ ,  $\text{cor}(p_2, c)$ ,  $\text{cor}(p_3, c)$ ,  $\text{cor}(c, y_1)$ ,  $\text{cor}(c, y_2)$

b) A model without emergence



Variable	implied correlations	
	$y_1$	$y_2$
$p_1$	$\text{cor}(p_1, y_1)$	$\text{cor}(p_1, y_2)$
$p_2$	$\text{cor}(p_2, y_1)$	$\text{cor}(p_2, y_2)$
$p_3$	$\text{cor}(p_3, y_1)$	$\text{cor}(p_3, y_2)$

Parameters:  $\text{cor}(p_1, y_1)$ ,  $\text{cor}(p_2, y_1)$ ,  $\text{cor}(p_3, y_1)$ ,  $\text{cor}(p_1, y_2)$ ,  $\text{cor}(p_2, y_2)$ ,  $\text{cor}(p_3, y_2)$

Figure 3.3: Contrasting a Model with Emergence and a Model without Emergence

Figure 3.3 shows two competing models: The first model contains a strong concept for which the attribute of emergence holds. If the parts form a whole that has additional or at least different characteristics to the parts, the nomological net that includes the parts and the strong concept should demonstrate a certain correlational pattern: If emergence takes place, we can expect that the effects of the parts on the consequences (if any) are fully mediated by the strong concept. The second model captures a situation in which there is no case of emergence; in this case, the effects between parts and consequences are not necessarily mediated by the concept, so that the correlations between parts and consequences are unrestricted.

As soon as a strong concept consists of more than two parts and is embedded in a nomological net of two or more other variables, the number of required parameters in a model of emergence will be smaller than the number of effects in the competing model without emergence. This difference in the number of parameters provides the basis for an empirical test of the model with emergence. If the model with emergence does not behave significantly worse in explaining the interrelationships of the variables than the model without emergence, it can be said that we have empirical support for the model with emergence. More precisely, we would rely on Occam's razor, which means that in the light of two equally plausible models we should favor the simpler one, i.e. the one with fewer parameters. We now only need a statistical technique that is capable of testing and comparing this class of models.

## 3.2 CONFIRMATORY COMPOSITE ANALYSIS

Many scientists would agree that experiments are the gold standard of empirical research. While this may be true for natural and behavioral sciences, this is not necessarily so for design research, because "the synthetic nature of design is incompatible with the controlled experiments useful for theory testing" (Gaver, 2012, p. 940).

In marketing and organizational research, the so-called *holistic construal* (Bagozzi and Phillips, 1982) has found widespread dissemination. It relies on generalized methods for testing hypotheses concerning underlying structures in covariance matrices, which "is perhaps the most important and influential statistical revolution to have occurred in the social sciences" (Cliff, 1983, p. 115). The holistic construal includes representation and testing of entire theories, and combines two forms of logical reasoning:

deduction and induction. However, design research typically uses a different form of logical reasoning, namely abduction (Harnesk and Thapa, 2013), which can be equated with pragmatism (Burks, 1946). In its original form, the holistic construal lacks an abductive step, which limits its direct use for design research.

Informed and inspired by the holistic construal, I propose an empirical method that includes deduction, induction, and abduction (as depicted in Figure 3.4). This method seeks to empirically test or compare theories of concept-driven design research. Because strong concepts, the building blocks of concept-driven design research, are typically emergent, we cannot use the common factor model, because – in the words of Cliff (1983, p. 121) – “factors never ‘emerge.’ They stay hidden. Correlations and factors derived from them do not specify what they are.” Instead, there are good reasons to prefer the composite model (Rigdon, 2012). Nelson and Stolterman (2003, p. 119) remind us that “[a]lthough it’s true that ‘the whole is greater than the sum its parts,’ we must also acknowledge that the whole *is of* these parts.” I therefore propose modeling strong concepts as composites. Correlation, which is an integral characteristic of emergence (Goldstein, 1999), opens the possibility for empirical and statistical assessment (Alexiou, 2010; Jost et al., 2010).

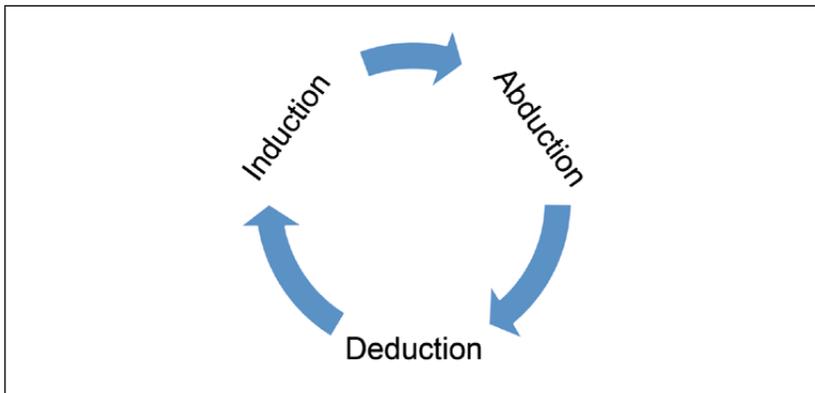


Figure 3.4: Combining three forms of logical reasoning for design research

I suggest confirmatory composite analysis as the statistical workhorse to validate theories of concept-driven design research. The term *confirmatory composite analysis* was coined by Henseler and Dijkstra (Henseler et al., 2014), who also reported the first instance of its use. Confirmatory composite analysis consists of three building blocks:

1. A prescription, which specifies how the elements of the composite should be weighted to form the composite,
2. A structural equation model hypothesizing antecedents and/or consequences of the composite, and
3. An estimator that can estimate the parameters of the structural equation model (and eventually the prescription) simultaneously, combined with an assessment of model fit.

The first building block relies on abductive reasoning. It is a prescription, a recipe, or any other norm of construction that specifies how the composite should be formed. It mainly consists of a specification of the composite's parts as well as a prescription for dimension reduction (Dijkstra and Henseler, 2011). A simple technical implementation would be a linear combination of parts. The part-weights can be proposed a priori by a researcher, or they can be determined using some optimization criterion. The parts and their part-weights mark the solution space that is explored by the design (Lawson, 2006). Many psychometricians would not regard a composite model as a model, because it does not have testable implications. Simply speaking: If someone proposes a certain combination of ingredients, it is not possible to test hypotheses about this combination solely based on the ingredients. However, as soon the composite is embedded in an environment, it becomes possible to test whether it is the composite that relates to other variables in the environment or whether the elements have their individual relationships.

The second building block relies on deductive reasoning. Drawing from extant theories, which not necessarily have to be design research theories, one would identify possible antecedents and consequences of the focal composite, i.e. construct the composite's nomological net. Technically, this building block is realized as a structural equation model, which specifies linear causal relationships between the focal composite with other composites, manifest variables, and latent variables (Dijkstra and Henseler, 2015b).

The third building block relies on inductive reasoning. By means of empirical data, the model parameters can be estimated, and the model can be tested – both globally and locally. This building block of confirmatory

composite analysis relies on variance-based structural equation modeling (Henseler, 2012) as an estimator for parameters of the structural model. As is common in structural equation modeling, the model can be tested based on the discrepancy between the empirical and the model-implied covariance matrix. Inference statistics can be obtained using the bootstrap (Dijkstra and Henseler, 2015a; Bollen and Stine, 1992). In its current form, confirmatory composite analysis is limited to linear effects and combinatory rules. However, I am confident that it can be extended, for instance by means of fuzzy logic and curvilinear effects.

With its ability to model composites as well as latent variables, confirmatory composite analysis fits the holistic construal of design research like a glove. We anticipate that the use of confirmatory composite analysis will spill over to other scientific disciplines in which emergence plays a strong role. Examples would be systems sciences, such as management information systems research or environmental research.

## 4. PRACTICAL EXAMPLE

To illustrate the difference between a design that is more than the sum of its parts and one that is not, I refer to a famous speech of one of the best salespersons of recent history. It was given on 27 January 2010 in San Francisco to introduce a new product category:

“All of us use laptops and smartphones now. [...] And the question has arisen lately: ‘Is there room for a third category of device in the middle? Something that’s between a laptop and a smartphone?’ [...] The bar is pretty high. In order to really create a new category of devices, those devices are going to have to be *far* better at doing some key tasks [...] – better than the laptop, better than the smartphone. What kind of tasks? Well, things like browsing the web. That’s a pretty tall word. Doing e-mail. Enjoying and sharing photographs. Video, watching videos. Enjoying your music collection, playing games, reading e-books. If there’s gonna be a third category of device, it’s gonna have to be better at these kinds of tasks than a laptop or a smartphone. Otherwise, it has no reason for being. Now, some people have thought: That’s a netbook. The problem is: Netbooks aren’t better at anything – they’re slow, they have low-quality displays, [...] they’re just cheap laptops. And we don’t think that they’re a third category of device. But we think that we’ve got something that is. And we’d like to show it to you today for the first time” (Steve Jobs).

When Jobs introduced the product category, he implicitly made use of the composite model. Netbooks are presented as the sum of its parts: a laptop with decreased computing power, decreased display, decreased price, and for the fairness sake, we should also add decreased weight and decreased size. Figure 4.1 visualizes the application of the composite model to the netbook concept. The point that Jobs made is that, in the end, a netbook is not more than the sum of these parts.

In contrast, the tablet is introduced as a new concept with a strong nomological net. The parts making up a tablet (such as flatness, touchscreen, integration with music and app store, etc.) form a composite with unique consequences, for instance, the browsing or gaming experience (see Figure 4.2). I am confident that if one applied confirmatory composite analysis in this context, the tablet concept’s fit would surpass the fit of the netbook concept.

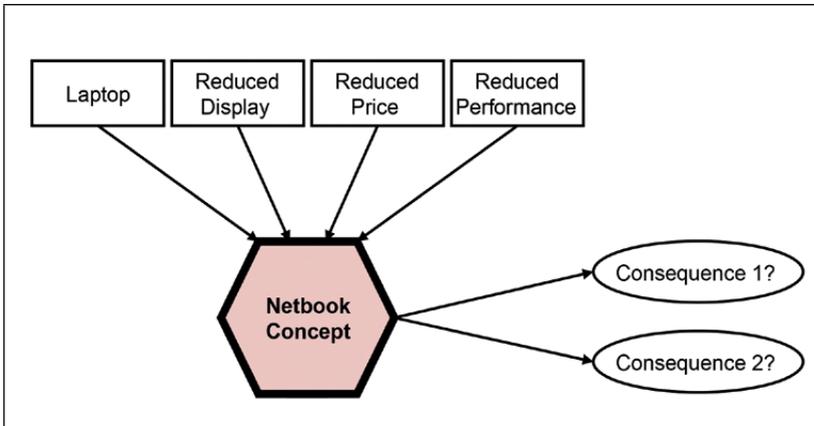


Figure 4.1: Applying the Composite Model to the Netbook Concept

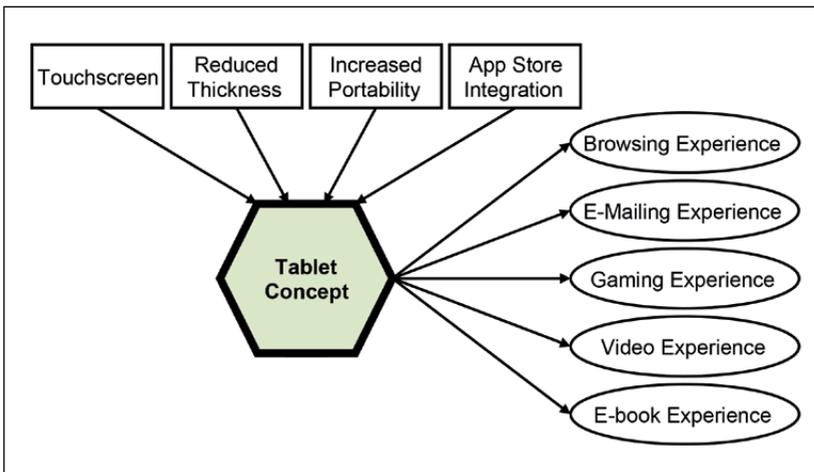


Figure 4.2: Applying the Composite Model to the Tablet Concept

Today, answering the question whether a netbook or a tablet is a better artifact has become quite obsolete: Millions of consumers have made their decisions and continue to decide in similar ways. However, years ago, when companies were deciding on how to allocate their R&D budgets and the marketing budgets, a solid answer to the question whether the whole is more than the sum of its parts would have meant an impact of multimillions in currency on some companies' bottom lines.

## 5. CONCLUSION

In conclusion, I wish to reiterate that marketing and design are different yet complementary. The strength of one discipline is the weakness of the other, and vice versa. This constellation provides a great opportunity for both disciplines to learn from each other.

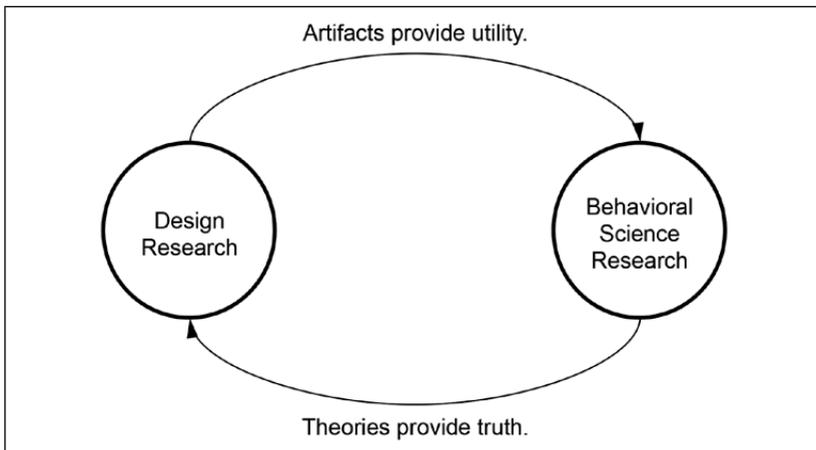
Design research can learn from marketing how to make use of a holistic construal to test theories of concept-driven design research. As could be seen, design research needs a nomological net of variables to assess the external validity of strong concepts and to empirically test design theories. Marketing concepts appear to be logical candidates for antecedents or consequences of design concepts. And why should design research not use marketing theories to deduct hypotheses for their own models? Thus, design research can benefit from marketing both through substantial and methodological support. The expected outcome is a higher level of scientific rigor for design research.

In turn, marketing can learn from design research how to develop tools, processes, and other artifacts. Embracing abduction as an additional form of logical reasoning may boost the knowledge generation process in the marketing discipline. Effective design can also make things/objects more or less understandable (Norman, 1988) and can help marketing to express itself. For marketing, it would be beneficial to acknowledge the value design research and its pragmatic paradigm could bring to the discipline. The expected outcome is a higher level of societal and business relevance for marketing.

Together, marketing and design can close the rigor-relevance gap generally found in management research (cf. Wolf and Rosenberg, 2012). Figure 5.1 illustrates how a field such as marketing, which contains both design research and behavioral science research, can increase both rigor and relevance. Instead of regarding design and marketing as two separate parts, it may therefore be worthwhile to understand them as a whole. This is the task I see for research and teaching in the Chair of Product-Market Relations.

Much of my research to date in marketing can be understood as design of tools that marketing executives can apply to achieve corporate goals. For instance,

- How to design community awareness campaigns to stimulate protective behavior on the part of citizens in light of the danger of earthquakes (Okazaki et al., forthcoming).
- How to design customer contact centers to improve relationships between companies and customers (van der Aa et al., forthcoming; van Dun et al., 2011), as well as the relationships between employees and companies (van der Aa et al., 2012; van Dun et al., 2012).
- How to design the information provision of mobile health monitoring solutions so as to increase their adoption among physicians (Okazaki et al., 2013, 2012).
- How to design a communication strategy to avoid negative behavior by taxpayers (Money et al., 2012).
- How to design the service proposal screening process (van Riel et al., 2011).
- How to configure sport sponsorships to maximize effects on brand equity (Henseler et al., 2007, 2011).



*Figure 5.1: The Complementary Nature of Design Research and Behavioral Science Research (derived from Hevner and Chatterjee (2010, p. 11))*

Concerning teaching, the interplay of marketing and design has already been integrated into University of Twente's Industrial Design curriculum. Students learn about design and marketing as well as their interactions. The program aims for students to develop products, services, and solutions that are functional, appealing, and efficiently manufacturable. Ultimately, the designed artifacts will become successful if they meet companies' financial and other objectives, satisfying or even delighting customers' needs, and contributing to the wellbeing of society – including that of the designer.

Methodological training will form a new part of the study program. I anticipate that the empirical methodology that I presented today will enter this subject. In my view, the holistic construal of design research and confirmatory composite analysis as its statistical workhorse have the potential to become the methodological backbone of empirical design research. The preferred algorithm to provide estimates would be partial least squares (PLS).

# WORDS OF THANKS

I wish to express my gratitude to people without whose support I would not be standing here today. First, thank you to those who had the vision for this chair, made it happen, and had the confidence to have me occupy it – especially the Dean of the Faculty of Engineering Technology, Geert Dewulf, the head of the Department of Design, Production and Management, Fred van Houten, and the Rector Magnificus, Ed Brinksma.

My move to the Faculty of Engineering Technology at the University of Twente was not a trivial endeavor. It meant getting acquainted with a new institution, a new city, and new people, as well as diving into a very different research paradigm. For a researcher, this is probably the greatest challenge of all. I thank my new colleagues for the very warm welcome, and I look forward to working with you more. In particular, my thanks go to Thonie van den Boomgaard, Maarten Bonnema, Leo van Dongen, Arthur Eger, Marco Groll, Roland ten Klooster, Eric Lutters, Geke Ludden, and Mascha van der Voort for the inspiring discussions and their help in acquainting me with design engineering research and teaching.

The interdisciplinary character of the Chair of Product-Market Relations suggests collaborations across faculties. I wish to thank my colleagues from the Faculty of Behavioural, Management and Social Sciences – particularly Petra de Weerd-Nederhof, Jos van Hillegersberg, Holger Schiele, and Celeste Wilderom – for building the figurative bridges between faculties. I look forward to our ongoing and future cross-faculty collaboration.

I would likely not be here today if my former colleagues from Radboud University Nijmegen had not brought me to the Netherlands. Thank you for introducing me to the Dutch culture and for more than nine happy and successful years at Radboud University Nijmegen. Special thanks to my former heads of department, Allard van Riel and José Bloemer, for their inspiring academic leadership and for giving me the freedom I so appreciated.

About 15 years ago, my academic career began at University of Kaiserslautern. My thanks to those who introduced me to the world of science: my promotor, Friedhelm Bliemel, and my then senior colleagues, Andreas Eggert and Georg Fassott. They not only introduced me to marketing and science, but also influenced my wish to one day become full professor.

Most of my co-authors and collaborators are from universities other than the ones I have mentioned. Thank you for your past and ongoing

commitments, the very pleasant collaboration, and – in many instances – your friendship. In particular I thank Theo Dijkstra, without whom neither confirmatory composite analysis nor consistent PLS would have emerged. I look forward to our next, brilliant coups.

Although a day such as today stands mainly under the sign of research, teaching, and other university activities, I thank my family and friends not only for making the long way to Enschede today, but for all their support on my long way here. You have all had individual significant impacts on who I am today. My thanks too for my wife Katrin – I am very glad indeed that you are in my life.

Dear Rector Magnificus, dear Colleagues, dear Ladies and Gentlemen, thank you for your attention. *Ik heb gezegd.*

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