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# Customer Profitability Analysis and Activity-based Costing in the Hospitality Industry: Data Requirements and other Implementation Challenges

A. Pesch<sup>1</sup>

<sup>1</sup>Department of Business Management, University of Latvia, Riga, Latvia  
(alexander.pesch@hm.edu)

*Abstract* – This paper shows what kinds of requirements in data collection are necessary in order to practically perform a detailed customer profitability analysis computed on an activity based costing model. This begins with methods of correct revenue allocation to respective key accounts including its limits of IT systems and human capabilities, goes on with the specific collection of expenses on account level or even on article level, and comprises benchmarking of process activities and its evaluation difficulties.

The implementation will help general managers, revenue managers, sales and marketing managers to make more efficient decisions in terms of time and cost spending to key accounts as well as in regard to fixing prices and production numbers during sales negotiations with travel managers.

In the past customer profitability analysis was based on segmentation level. The new thinking on key account level is challenging and requires new ways and rules for data collection in order to measure the return on marketing.

*Keywords* - Customer profitability analysis, activity based costing, assessment requirements, efficient marketing decision making, return on marketing, data collection, hospitality industry

## I. INTRODUCTION

Managers or executives who only rely on the highest revenue generating key accounts when making strategic or operational marketing decisions consider only half the truth; they are totally neglecting the cost implications caused by their customers. In order for hospitality enterprises to survive in the long run a reasonable profit is essential. Revenue consists of two components: quantity of sold products multiplied by the price of the product. With a homogenous product and a consistent cost structure the assumption might be correct that the customer with the highest revenue will contribute the highest portion to profit. This is the case looking at airlines. In the hotel industry it is different: various products which can be combined with nearly any other products, such as different room types combined with various food and beverage services, spa and wellness services and/or other services. Heterogeneous customers ask for heterogeneous products which also have heterogeneous cost structures. (Noone and Griffin, 1997). Cooper and Kaplan described that a customer with the highest sales volumes generated the highest losses (Cooper and Kaplan, 1991).

The focus of marketing has changed from a product focused perspective to a nowadays market respective customer oriented perspective (Kotler and Armstrong, 2010), (Ryals, 2008). As the customer is the cause for profit, the profitability of the customer should be measured and evaluated. Two main instruments are often cited in this context: the customer profitability analysis (CPA) and the activity-based costing (ABC) method. In theory these tools can be easily applied: allocate costs and expenses to the customer (Riebel, 1994). In the industry sector, e.g. automotive and pharmaceutical industry it is common practice. However, in the service sector, in particular the hospitality sector it is far from implementation. The application of these instruments in the hospitality industry is restricted only to single case studies which concentrates on customer segment level, but not on customer level. (Nordling and Wheeler, 1992), (Noone and Griffin, 1997), (Krakhmal, 2007), (Dalci et al., 2010). While high efficient enterprise resource planning (ERP) systems in the industry sector collect millions of data and are able to calculate the profitability on a customer level, the hospitality industry shows a lack of data collection. Furthermore, the allocation of revenues, costs and expenses including big amounts of fixed costs and overhead expenses to a single customer is often impossible due to missing requirements in the property management systems (PMS: IT software to manage the administrative processes of the guest stay as well as guest and company profiles including their accounts). Based on six case studies (small and medium sized hotel enterprises), minimum data requirements for assessing a customer profitability analysis (CPA) are presented.

## II. DATA REQUIREMENTS

Data requirements are the logical segmenting and coding of guests and customers as well as certain ways to structure revenues, costs and expenses which will be explained in the following paragraphs.

### *Segmentation*

The first requirement in order to have a clear picture of the business mix is to sort guest in categories which are guest segments. The business mix will tell what kind of guests stay at the respective hotel. This information will lead to the possibilities of creating marketing and sales activities for target groups, invested money and therefore

transmitted information that reaches the potential guests who are willing to stay. It does not make sense to make advertisements for target groups that will never make a reservation.

A most simple and very rough segmentation is sorting guests into three main segments:

- transients
- groups
- others

Transient guests are individual travellers, e.g. singles and couples, business travellers, individual tourists etc. Groups are mainly defined when ten rooms are booked for a certain purpose, such as business meeting, conferences of governmental or private associations, bus groups and so forth. Air crew members, long stayers with a length of stay longer than 14 or 21 nights (up to the definition of the hotel), guests with complimentary room rates and trade out guests (guests who had a reservation at another hotel which was overbooked and thus walked the guest to this hotel) are counted to the main segment “others”.

This rough segmentation will already allow the managers to analyse their main business mix. But a sophisticated analysis is at this stage not possible. Therefore all large hotel companies have a differentiated sub-segmentation (table 1):

TABLE I  
GENERIC GUEST SEGMENTATION

Main segment	Segment	Sub-segment
<b>Transient</b>	Leisure	non-contracted
		contracted
	Corporate	non-contracted
		contracted
<b>Groups</b>	Leisure	non-contracted
		contracted
	Corporate	non-contracted
		contracted
<b>Others</b>	Air Crews	contracted
	Long-stayers	non-contracted
	Complimentary rooms	non-contracted
	Trade out	non-contracted

Source: by author

If a hotel uses guest segmentation as displayed in table 1 the business mix becomes much more transparent. Now it is possible to make detailed analysis about the guest structure: is it a hotel with mainly individual travels or groups; is it a leisure hotel or a business hotel; are rates mainly contracted or not, etc.? Each Sub-segment can list the number of rooms nights, the average room rate (ARR) and the revenue by multiplying the room nights with the ARR. Compared month by month shows a shift of the

business mix, e.g. in months with no public holiday the business segments might be more prominently while in months with summer holidays leisure or long-stayers may be more distinctly. But also the month of the previous year(s) can be compared with the actual month. This is also possible with quarters. Table 1 displays twelve sub-segments. In big hotel companies it is quite common to operate with 20 sub-segments each displaying room nights, ARR and revenue. But not only actual data is shown, also data from the last year(s) and upcoming data, such as reservations on the books, constraint forecasts and budgets. The number of information growths with every new period and hence allows more analysis by revealing trends of the business mix. Budgeting and forecasting of rates will be possible and will strengthen the managers in negotiation meetings.

#### Codes

Codes allow as second requirement the allocation of the guest data to certain criteria. A coded guest can easily be grouped and it is possible to learn more about the top ten or twenty of the hotel customers. - A customer is mainly a company, such as a travel agency, a tour operator, an enterprise, etc. that makes a reservation for an upcoming guest / client (tourist) or a company employee or invited business partner. – There are several codes which are directly linked to the guest profile and / or customer profile:

- country code (very often used in practice and mixed up with source code)
- source code and channel code (in practice often confused with segmentation code or country code)
- segmentation code (often thought to be source code)
- rate code (in small and medium sized hotels often not used at all)

The country code is an acronym for the country where the guest comes from. In the hotel business this code is not used consistently. The country code always stands for the place where the guest permanently and privately lives despite where he or she works or of which nationality the guest is. Very good property management systems (short PMS: IT software to manage the administrative processes of the guest stay as well as guest and company profiles including their accounts) integrate all three kinds of country codes: nationality, private home, and working place. Country codes display the feeder market, in other words, markets or countries that feed the hotel with guests. This answers from where the guests are coming, but much more important, from where not. This information can tell, if important and / or growing markets are not represented in the guest portfolio. For the marketing and sales department it opens new opportunities for new markets if existing markets remain static or even diminish.

The source code reports through which booking channel the reservation was made. For example, a

company has various ways to book a hotel room, either by telephone, by fax, by e-mail, through a travel agency, through internet agencies, through the hotel web site, etc. The source code is not linked to a segment. Room reservations of a particular sub-segment can be booked by different sources. Therefore the source code reflects the booking channel or in other words the source through which the reservation came. This information about the sources of a reservation channel is important: firstly to know what are the main sources, secondly to keep transaction expenses of the booking channels low. For example, bookings through third parties such as HRS, Expedia, hotel.de, etc. are quite expensive whereas bookings through the hotel's website are comparatively low. Negotiations with customers should lead to booking channels which on the one hand are easy to handle by the customer and on the other side are less expensive for the hotel. In case the reservation came through an internet agency the channel code, which is a sub-code of the source code, will capture which internet agency exactly made the reservation, as commission percentages vary.

The segmentation code is an acronym for the guest segments exemplary listed in table 1. Companies can make reservations that require different segmentations. For example, an individual business traveller with contracted rate will be categorised in segment transient – corporate – contracted. Two weeks later e.g. the same guest joins a shareholder conference of his or her company. In this case the guest booking will provide the segmentation groups – corporate – contracted. However, the rate of the guest's earlier visit will be higher as the second visit, because group rates include a volume discount due to a higher number of room reservations for all conference members.

The rate code combines several information items. Whereas the previous code types have a maximum length of three to four digits, the rate codes may have a length of eight to ten digits, a combination of letters and figures. Within the eight to ten digits of the rate code, letters and figures are clustered. These clusters represent certain information elements:

- First three to four digits: who makes the booking? Did the guest book by him- or herself or did the company (travel agency, enterprise, etc.) the booking for the guest? As mentioned in chapter 1, all bookings of a company must be allocated to one main company account. If a wrong rate code is used, the statistics of the key account will be wrong, too: the overall room nights and revenues booked by the company will not match anymore.

- Next two digits: is it weekday rate or weekend rate? Revenue managers and later on sales managers need to understand what kind of rates were more often booked. Depending on the type of hotel, weekday rates will differ from weekend rates. For example, business hotel generally have higher rates during the week than at weekend according to the demand: a higher demand during the week in contrast to the weekend is followed by

a higher rates from Monday to Thursday in comparison to Friday to Sunday.

- The next two to three digits: what services are included in the room rate? Special packages negotiated with the companies are reflected in these digits. The most known acronym is BKF which means that the room rate includes breakfast which is not additionally charged to the invoice. Other acronyms tell about half- or full-board, all inclusive, laundry, internet, etc.

- The last two to three digits: what kind of room category is booked? The room category explains what kind of room is booked: standard room, deluxe room, junior suite, garden view or sea view, etc. Not all hotel companies include the room category in the rate code as they have the possibility to track this kind of information separately.

All these codes should be truly inserted in the property management system (PMS) in order to retrieve valid and reliable data from the system. Each booking will contain at least six additional elements of information: country of the guest, source of booking, segment, reservation made by guest or by customer in particular by which customer, weekday or weekend rate, included services. These elements are all stored in the data base of the PMS. A short example: a hotel has 250 rooms, an average occupancy of 70%, and an average length of stay of two days. In average there are 2,625 bookings per month times six additional codes is 15,750 additional entries in the data base summing up to 189,000 data entries in one year, additionally to the previously existing data. Therefore these big data packages must be managed, analysed and interpreted which will lead to action plans for hotel and marketing managers.

#### *Uniform system of accounts for the lodging industry (USALI)*

The task of the accounting department is book-keeping. The purpose of book-keeping is to record all relevant business transactions, convert them into figures by reducing the complexity of the reality and display these figures in models named balance sheet, income sheet and cash flow. The income sheet reports the profit or loss of the hotel for a certain period, therefore this report is also known as profit and loss statement. In order to calculate profit (or loss), only two values are needed: total revenues and total expenses by deducting the total expenses from the total revenues, the easiest and the most important formula of managers. But it makes a lot of sense not only to use two accounts for calculating the profit. Each account reflects a part of the business reality. Using only two accounts means to see the business activities quite diffuse. By increasing the number of accounts in a reasonable way, the picture of the hotel's transactions become clearer and clearer. Each single account represents, metaphorically speaking, a facet of an insect's compound eye. The more facets, the clearer the picture.

The Uniform System of Accounts for the Lodging Industry (USALI) is a logically structured system of hotel accounts which allows making detailed analysis of revenues, costs, payroll expenses and other expenses. The advantage of the USALI is that it is internationally used and as it was established in 1926 permanently adapted to actual needs of the lodging industry in a fast changing world. Following the structure of the USALI without consolidating certain accounts, which quite frequently happens in small and medium sized hotels, will lead to detailed profit and loss statements of all important profit and service departments, such as the rooms, food and beverage, spa, general and administration, sales and marketing, repair and maintenance and last but not least utility department. The more details the profit and loss statements of the departments contain the more statements about relating costs to customer accounts can be made. The USALI is a tool. With its application it can provide crucial information in order to assess the customer profitability margin. This margin defines how much a customer contributes to the hotel profit. In case of rate rebates during negotiations sales managers can evaluate with the profitability margin to which extend they can lower the rates. A really important requirement for this is to have a well-structured chart of accounts in place, well-defined booking rules and lots of space on the data server.

### III. CONCLUSION

If marketing managers in the hospitality industry want to investigate which customers (key accounts) are profitable or not, they need to set up their IT systems. A consistent and logical guest segmentation matrix is required to distinguish customers from (one-time) guests. In order to allocate the revenue of guests to the respective key account the guest profile must be coded with country code, segmentation code, source and channel code and rate code. Last, but not least, all revenues, costs (of sales) and expenses including statistical data should be traced in a well-structured accounting system which allows tracking all entered data by time, department, sub-department, and article or product. The next step will be to set up standard allocation rules. These rules, which define and standardise processes, will allocate time and resources, and in the end expenses to each individual key account. The question will still remain, if processes in the hospitality industry, e.g. check-in of a guest at the front desk, in order to apply activity-based costing, can be standardise due to an individual guest orientation? The lack of data collection and the difficult set-up of allocation rules might be the reason why in the hospitality sector research papers were only based on case studies and the assessment of profitability only on segmentation level instead of customer level.

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# Open Strategy – as a new and barely explored strategy tool?

## A topic introduction and critical review

A. Wulf<sup>1, 2</sup>

<sup>1</sup>Department Strategic Management, University of Plymouth, Plymouth, United Kingdom

<sup>2</sup>University of Applied Sciences Munich

**Abstract – “[...] if you don't let the revolutionaries challenge you from within, they will eventually challenge you from without in the marketplace [1].” The world is moving faster due to technological movements and economic effects. High- velocity environments, strong competition, multiple priorities and multiple stakeholders are additionally putting pressure on organizations strategies. A new movement arises in strategy making that seem to offer benefits within strategy formation. Opening up an organisations strategy to internal or external stakeholders in order to better reaching company goals such as sustainable success seem to become a new direction within organisational environments. The promising prospects of open strategy suffer missing linkage to existing strategy models and a strong scientific foundation. Although the development of strategy in a historical perspective offers many aspects that facilitate better understanding of the opening of strategies. The historical development of strategy, strategy characteristics and goals as well as dimensions of strategies shall help to find gaps in current open strategy approaches and outline interesting and necessary aspects for future research in open strategy. This paper will provide an introduction of the open strategy term as well as a critical review of aspects that influence the open strategy approach and that are influenced by it.**

**Keywords – open strategy, strategy history, open strategy characteristics, strategy aspects**

### I. INTRODUCTION

The work presented in this paper is motivated by a desire to question critically the new upcoming trend of opening up strategies by examining open strategy in front of a traditional strategy background. Open strategy research is just developing from current open innovation research and with the rise of open strategy many unanswered questions emerge. A critical review on the rising subject attempts to create additional value for practitioners, theorists, and those who study strategy. As the topic is very complex and its analysis is challenging, the goal is not to provide a comprehensive overview of the topic, as the topic still needs to be investigated in more detail and related to traditional strategy in a greater extend but to create a first insight to the aspects that are

discussed in conjunction with open strategy. The structure and the approach of the review shall be discussed in the methodology part. The importance of the subject has developed rapidly in recent years. However, a systematic challenging of the topic has not been done so far, and should be subject to further research as outlined the following. This critical review shall not only display an introduction to the topic of open strategy but will also introduce a short review on strategy history and how certain strategy aspects developed out of a traditional strategy background. The paper shall point out weaknesses in current research and suggestions for future investigation. Furthermore, our goal in this article, and in this special issue as a whole, is to stimulate the development of open strategy theory on total quality.

### II. METHODOLOGY

#### A. Research objective of the article

It is the aim of this paper to provide a critical review of open strategy, placing of open strategy within traditional strategy dimensions as well as relating open strategy aspects to traditional strategy aspects in order to support and outline further research. Based on impacts that influenced strategy in the past and based on the forces that are supposed to lead to more openness within strategy in the future the intention of the article is to refer to current literature and traditional strategy development, aspects of strategy and strategy dimensions and relating them to open strategy. A critical summary of some strategy aspects that lead to openness, that influence openness and that might facilitate or complicate openness shall be provided.

#### B. Structure and approach

In order to better understand the evolving subject of opening up strategies the article aims to relate traditional strategy developments and traditional strategy patterns to the open strategy approach. As no official definition of open strategy exist but only fragments are provided by different authors the article continues, after providing a short overview of historical developments and the term strategy, with a defining of open strategy and its strategy patterns. After having identified key patterns of open strategy they are related to traditional strategy structures and their relation to openness is critically discussed followed by the outlining of further research topics. The article shall provide a first critical overview of the open

strategy topic and shall relate it to traditional strategy as well as concentrate on a possible future research agenda. The review is supposed to be a first selective overview and is therefore by no means a complete literature review. “This, in other words, is a field review, not a literature review [2].”

In order to take a first step into the research process of open strategy the article provides a basic overview of literature that is directly related to the term of open strategy. The basic literature review has been done by a search of the term “open strategy” and included closely related terms in academic databases, using Science direct, Elsevier and Emerald. Only Journal contributions were listed, except one article published in a proceeding band. All articles found were examined, as well as their reference list by studying articles that were related to crowd sourcing strategy, open innovation in a strategy context and democratizing strategy. The list of key literature directly related to openness in a strategy context can be found below.

### C. Critical Review

This critical review is not meant to be a comprehensive overview of all aspects related to (open) strategy. But shall be seen as an attempt to list historically developed strategy patterns that influence open strategising and that facilitate or hinder the approach, in front of a traditional strategy background. In order to show current limitations in research a traditional strategy frame is used to structure the open strategy patterns and to show which areas of traditional strategy are still untapped in research of open strategy. Potentials as well as possible pitfalls of open strategy shall be critically outlined to show potential in future research. The critical review refers to the lack of critical approaches in that area, as existing studies tend to reflect a positive stance. Positively influenced approaches fail to deeper analyse and critically question open strategy by reflecting it to existing models and therefore are likely to be superficial in outcome. Current positivism shall be challenged by a critical approach [3]. Authors that are approaching research from a positivist side try to detect correlations and causation. Critical approaches accept if no coherence is discovered [4]. They rather work with different point of views “worlds” on the subject [3]. Criticism is characterised by believing that a single mind cannot understand the complete reality and that every reality is influenced by the mind that investigates it [5]. Therefore, the article aims to look at open strategy from a view that is related to traditional strategy and allows a relation to existing patterns and structures. Social science must be critical: “In order to be able to explain and understand social phenomena, we have to evaluate them critically [6].” As the open strategy approach is a social science phenomena and the aim is to understand its full potential in future research and its possible pitfalls a critical review of the topic is essential to outline perspectives in research.

### D. Structure literature review

The current literature selection is based on lateness of active research, on being correspondingly to the topic and on basic strategic literature. Of course this literature review can by no means considered to be complete and will be done as a deeper and more structured analysis in planned future research. Little evidence can be found so far on the topic of opening up strategies and there are only a small number of articles that are working on the open strategy term or on topic related to openness within a strategic context. There are some other authors dealing with open strategy related topics such prediction markets, crowdsourcing, co-creation, collaborative strategies [7], which are topics very closely related to the open strategy approach. They are not necessarily referring to a strategic context, therefore were not considered for our review. In order to concentrate on topic of interest the development significant aspects is essential [8].

TABLE I  
OVERVIEW ARTICLES OPEN STRATEGY

Authors	Used terminology	Article Title
Prahalad, C. K. 1995	Democratizing strategy	New view of strategy: An interview with C.K. Prahalad.
Hamel, G. 1996	Strategy as revolution	Strategy as Revolution.
Chesbrough, H., Appleyard, M. M. 2007	Open strategy	Open Innovation and Strategy.
Newstead, B., Lanzerotti, L. 2010	Open-sourcing strategy	Can you open-source your strategy?
Whittington, R., Caillaud, L., Yakis-Douglas, B. 2011	Open strategy	Opening Strategy: Evolution of a Precarious Profession.
Gast, A., Zanini, M. 2012	Crowdsourcing strategy	The social side of strategy.
Dobusch, L., Müller-Seitz, G. 2012	Open strategy, collaborative strategies	Strategy as a practice of thousands?
Stieger, D., Matzler, K., Chatterjee, S., Ladstätter-Fussenegger, F. 2012	Crowdsourcing for strategic dialogues, democratizing strategy	Democratizing Strategy: How crowdsourcing can be used for strategy dialogues.
Dobusch, L., Kapeller, J. 2013 “under review”	Open strategy, collaborative strategies	Open strategy between crowd and community: Lessons from Wikimedia and Creative Commons
Matzler, K., Füller, J., Koch, B., Hautz, J., Hutter, K., 2014	Open strategy	Open Strategy – A new strategy paradigm?
Matzler, K., Füller, J., Hutter, K., Hautz, J., Stieger, D. 2014	Open strategy	Open Strategy: Towards a Research Agenda



### III. STRATEGY-HISTORICAL BACKGROUND

The term strategy has been borrowed from military and political terminology [9] and became popular in business after Second World War, when companies started to react to growing economies and needed the military way of developing large and long term decisions [10]. Barnard did first steps to divide organizational matters from leadership matters and he made the first attempt to change company goals from efficiency influenced industrial revolution goals to more environmental fit [11]. His considerations later had been consistently reflected by other strategy coining authors when the environmental view on strategy gained popularity. As the environmental inclusion build a basis to develop strategy considerations on environmental influences Drucker started to include the customer perspective into company's strategy [12].

The advanced view of the strategy environment then lead to several developments constantly shaping the term of strategy. Selznick introduced the term "distinctive competence" and again related this term to Navy based practises of differentiating themselves from other services [13]. Chandler provided a first split of business strategy in four components [14] and tried to develop a fit between the external and internal environment [10]. Chandler emphasized again the importance of taking a long term perspective: "Strategy is the determination of the basic long-term goals of an enterprise, and the adoption of courses of action and the allocation of resources necessary for carrying out these goals [14]." He also followed the notion that company structure has to follow the company strategy. Later, Andrew combined the idea of Selznicks "distinctive competence" and Chandlers four components trying an external and internal environmental fit. He developed "[...] a framework, which came to be referred to by the acronym SWOT, was a major step forward in bringing explicitly competitive thinking to bear on questions of strategy [15]." Mintzberg called Chandlers, Selznicks and Andrews approaches the 'design school' and explains it as a school that in its original perspective "[...] sees strategy formation as achieving the essential fit between internal strengths and weaknesses and external threats and opportunities [2]." This was the basis for the development of the SWOT analysis that tries to integrate companies Strengths and Weaknesses, Opportunities and Threats in its environment as a fit between internal capabilities and external possibilities [16].

Parallel to the ideas of the "Design school" a "Planning school" developed, being highly influenced by Ansoff [2]. Ansoff build on Chandlers ideas but "provided a more systematic model of the strategic decisions, characterized by detail and definition in its 'planning' process [10]." His work was influenced by the notion that the gap between company goals and reality should be reduced [17]. He started to analyse companies in a very detailed way and he tried to combine the external and internal reality with the company goals [15]. Ansoff considerations were more formal, focussing on the planning side of strategy [2]. He not only developed tight steps of strategy, he also raised

the importance of planners and middle managers. During that time the strategic planning evolved and was separated from leadership strategy.

"However, the chief strategy architects (Chandler, Andrews and Ansoff) had established the modern concept of strategy [...] quickly spread and developed by the consultancy professionals and organizational planning teams who provided new techniques with which to facilitate its practical implementation (e.g. BCG,PIMS, Shell's scenarios) [10]." The focus on strategic planning started to cause troubles when economic draw backs forced companies to cut back activity in the 1989s [2]. During that time they found out that planning separated the planners from strategy and that the consultants had isolated positions within the companies. Wilson addressed that problem by publishing seven deadly sins of strategic problem, which involved the problems between staff and process as well as equation of strategic planning and thinking [18]. In order to react to the difficulties and to environmental changes a more analytical process of strategy making came up. Mintzberg even talks about the "Grand fallacy of strategic planning [2]" as "analysis is not synthesis, strategic planning has never been strategy making [2]." This shows that strategic planning and strategic making were newly defined at that stage. "Planning is not rejected but seen as one of many enablers of strategic change [10]."

With Porters analytical approach a new perception of strategy developed. Coming from the economical side of strategy the observance of the role of competitors evolved [19]. The structuring of strategy and its position within the company were now complemented with a new focus on the strategy content. Porter stressed the idea of positioning companies within their industries and that strategy within those industries can be considered as generic strategies [19]. With Porter the term of competitive advantage emerged. "Porter saw the root of competitive strategy as linking the firm to its environment. Industry structure, to be analysed by the famous five forces, determined the extent of competition and so the profit potential [10]." Cost strategy or market share were the main strategies to reach competitive advantage but research throughout the years showed that this approach has been too superficial [20]. Porter's Value chain approach to strategy was, beside the five forces, another framework, that suggested a completely new way of strategy making. "In managerial terms, one of the breakthroughs built into Porter's framework was that it emphasized "extended competition" for value rather than just competition between existing rivals [15]." The value creation through the company's value chain meant a new concentration not only on the company's general environment but also its specific value chain based environment. In his works, which Mintzberg frame as the 'Positioning school' Porter suggests that the CEO need to remain the chief analyst and strategists to be analysts rather than planners [2] and with his approach [...] took a strong hold in board rooms and business schools [10].

Still, the focus of Porter's view on strategy was an outside-in approach without the inclusion of the internal environment of the company. Cool and Schendel addressed a main point of criticism to Porter's considerations. They found out that specific factors of the company form the differences between firms within that sector and these individual factors can result in differences that are possible to create the desired competitive advantage [21]. A resource based view of companies' capabilities evolved and with this view the notion that generic strategies in industry sectors no longer or better said not always fit. From the developments described above it can be seen that the awareness raised that strategy needs to be tailored to the individual case and that every company has its own strategic requirements. The resource based view of strategy soon showed complexity and a difficulty to keep strategic advantages and therefore raised and still raises a lot of challenges. "Transferring and monitoring resources between firms was thus made difficult, denying rivals the chance of replication and so securing superior returns [10]." This problem was soon addressed by Prahalad and Hamel with a suggested development of core competencies: "Management's ability to consolidate corporate-wide technologies and production skills into competencies that empower individual businesses to adapt quickly to changing opportunities [22]; [1]."

The resource based view of strategy integrated another important point into strategy considerations, the internal environment inclusion. Looking back to the main strategy authors and their research on strategy it is evident that main basics were laid by all of them to understand fundamental specifics of strategy. All strategy patterns that had been discovered as the inclusion of internal and external environment, the analysis of company strengths, weaknesses, opportunities and threats, the defining of strategic thinking and planning, the importance of gaining competitive advantage and a strong positioning within industry as well as concentrating on value creation are contributing to a great extent to current view of strategy in business.

From formal design and conception, formal planning and analytical positioning, strategy considerations became more focused on the question of how strategic management is actually done. Plans and positions moved to the background and build a frame for more visionary and cognitive considerations. From that point many different descriptive views of strategy emerged and the focus in the following shall lay only on the most influential ones.

During the 1990s a strong technological change evolved that influenced sociological changes as well. The strong influence technology could have on strategy has been recognized early by Toffler [23];[24] and Drucker who developed the term of "Age of Discontinuity" in 1960s [25]. Even though the technological influence became evident at that time its consequences on strategy had not been addressed at that stage.

Besides a strong influence of marketing subjects on strategy such as customer concentration and the "loyalty effect [26]" Scientists started to investigate on company specifics and what makes a good company in its specific surroundings. After a long term analysis of 19 companies Collins and Porras found out that underlying key principles and a core ideology was the frame for successful companies. The company vision became important [27]. Pascale pointed out that strategy is a dynamic process that requires continuous reinventing [28] Hamel underlined that idea by discussing that the value of strategies decays over time [1].

In order to deal with change as a strategy characteristic, some strategists started with scenario planning. They argued that change and uncertainty make it impossible to predict strategic outcome [29]; [30]. Beside approaches that try to deal with consistent change, several strategy approaches raised dealing with capabilities, potential and knowledge gaining within the company. This way to access strategy is rooted in the resource based view. Stewart raised the term of "intellectual capital" and describes it as the knowledge investment within the company [31]. Senge suggested a learning company [32] and Castells worked with the idea of a network society, influenced by globalization that will structure companies as a network [33]. Jarillo wrote about company networks and their ability to reduce costs and to gain knowledge [34]. Nambisan and Sawhney picked up the idea of network centric organisations and included organisation's stakeholders into the suggested network structure. They extended the idea of environment inclusion to external actors that are not necessarily connected to the company by the value chain [35]. The question of knowledge communication between company levels was addressed by Jarzabkowski who observed a lack between practice and theory being a threat for strategy processes [36]. Her strategy as practice approach shows a significant lack of information between upper and lower company level.

Some researchers see technology developments as a possibility for knowledge gaining and information flow between company members and company networks [37]. McKenna argues that technology development will lead to a "real time experience" that will have great impact on company structure as well as on competition strategy [38]. Summarising the short historic overview on the strategy topic it becomes evident that strategy is not only influenced by environmental changes and organisational requirements, but it is also a subject to constant change, with a blurred definition and a wide range of characteristics. In the following the definition of strategy and the pattern and characteristics of strategy shall be discussed briefly.

#### IV. STRATEGY ASPECTS

##### *A. Approaches to Strategy*

Bea and Haas categorise all the aspects above, which have historically been developed to be part of strategy, in three

different views of strategy. Strategy development started with a market based view, which is based on an “outside-in perspective”, later lead to a resourced based view that is based on the “inside-out-perspective” and the evolutionary view which defines a company to be too complex to concentrate only on one strategy approach [39].

Bowman, Singh and Thomas offer a similar perspective and argue that strategy from a historical perspective shows at least three types of academical developments that co-exist today even though their relevance has changed constantly. They called the first group the field researchers and institutionalists, which introduced a very structured and descriptive way of looking at strategy with a view from inside the firm to the outside environment concentrating on success factors to be found outside the firm. The second influence came initially from Porter, further developed by other authors, when he introduced economical sciences and coined the institutional area with an industrial approach to strategy. This approach is based on economic assumptions and contains competitive rivalry, resource allocation, economies of scale, profit maximization. The third main approach to strategy came from behavioural scientists mainly gained momentum in the 1980s and 1990s. Their view broadened from the inside-out view to recognition of aspects outside the firm, the industry or the industry’s environment. They included the management of company resources, which contained the behaviour of employees, knowledge gaining and organizational networks. Over time the views were integrated and modified but still build a profound basis of strategy [40]. Therefore, all strategy views and approaches are part of strategy itself, making strategy very complex. Even though, some authors made the attempt to define strategy, although often restricted to their perspective.

### *B. Strategy definition*

When looking on the two major approaches to strategy, Porter certainly plays a major role within the industrial approach. Naturally, following his more limited view of strategy being based on the goal of gaining competitive advantage, Porters definition is based on competitive strategy. In “What is Strategy? [41]” he explains that: “Competitive strategy is about being different. It means deliberately choosing a different set of activities to deliver a unique mix of value.” He furthermore points out that: “[...]Strategy is the creation of a unique and valuable position, involving a different set of activities [...] make trade-offs in competing—to choose what *not* to do. [...] creating “fit” among a company’s activities [41].” The behavioural approach to strategy contains more aspects and elements which are reflected by strategy definitions that came up especially in the 1990s. In strategy safari Mintzberg explains strategy as a word that cannot inevitably be defined and that is a pattern that is “consistency in behaviour over time [2].” Strategy safari attempts to structure strategy in five components that

Mintzberg calls the five ‘Ps’, he calls strategy a plan, a pattern, a perspective and strategy as a ploy. This reflects the notion that strategy can only be explained by combining the different streams and aspects it contains not only a different set of activities but also a lot of different aspects and patterns that all are part of strategy itself. Strategy seems to be a term that contains a complex web of different patterns, which can be of different nature depending on the organisation itself.

### *C. Strategy characteristics*

Related to developments throughout history and to the different patterns of strategy, certain strategy characteristics can be identified. Traditional strategy is shaped by the following characteristics: [42]; [43]; [44] Change, Uncertainty, Complexity, Integration, Relationships and networks, Operational decisions and organisational requirements [43].

These characteristics can not only be derived from strategy development throughout history and can also be found in different structures and contexts mentioned by several authors such as mentioned above. Strategies are likely to be: “complex in nature, made in situations of uncertainty, affect operational decisions, require an integrated approach and involve considerable change [42].”

## V. TOWARDS OPENNESS

Having identified certain strategy characteristics such as change, uncertainty and complexity amongst other and looking back at how strategy changed constantly throughout history the influence of macroeconomic developments on strategy become evident. Strategy as a topic has been developed at earlier times in order to better face environmental requirements [40]. Change, the reaction to uncertainty and the reduction of complexity are at the centre of strategy making [43] and have been back in history. In Porters industrial approach strategy was further developed to better face growing competition [19]. The industrial shaped approach was then further developed to a behavioural approach which concentrated on company’s resources. “Perhaps the most provocative finding, however, is the growing emphasis on organization and culture as critical ingredients in the execution of strategy. This change represents a recognition that the values, motivation, and behaviour of the organization’s members are critical determinants of corporate performance-and so of success or failure in implementing strategy [18].”

With the new social aspect of strategy further changes applied and a trend can also be observed by recognising the move from market-based industrial views to more organisational resourced and knowledge based view, including internal and external integration into the strategy term. The external integration was extended already in the late 1980s when network alliances became important. Jarillo explained strategic networks to be inter-organisational relationships [34]. The importance of

company networks has been recognised early as being a part of broad external inclusion into strategy. Networks become even more important today as we face strong changes in macroeconomic pressures [45] as usage of new technologies, the high information level, an increase of social influence [35]; [46]. “The new century comes with further evolution towards networks-the rise of the knowledge worker and the knowledge-based organization, and the creation of flatter organizations. It is also the time for internet-based corporation [...] [40].” Today, this seems to be an important driver for the new strategic views [45].

High- velocity environments, strong competition, multiple priorities and multiple stakeholders as well as the “Progress in information, communication and multimedia technologies and the increasing expansion and use of the internet [37]” are additionally putting pressure on organizations strategies. Today “the importance of networks, partnerships and alliances between firms and other agents is crucial [47].” Some authors therefore point out that a further step from raising network alliances to a network based company structure is needed. Nambisan and Sawhney call it the company’s ecosystem [35]. Others argue that a new view of strategy is required: “If we are to make strategic sense of innovation communities, ecosystems, networks, and their implications for competitive advantage, we need a new approach to strategy-what we call ‘open strategy’ [48].” Chesbrough and Appleyard point out that the current development to a more community and network based society includes a greater inclusion of these communities to strategy. Today’s community based society, that has been proofed to successfully participate at the development of innovation strategies [45] might also be beneficial for other strategy processes [46] and the inclusion of the company’s network as its ecosystem might facilitate important knowledge creation [35]. The new and more open view of strategy has been addressed by some authors in different ways that shall be explained in the following.

#### *A. Open strategy definition*

Chesbrough and Appleyard refer to open strategy as: “Open strategy balances the tenets of traditional business strategy with the promise of open innovation. It embraces the benefits of openness as a means of expanding value creation for organizations [48].” Whittington’s explanation of an open approach to strategy is not narrowed down to a subsequent of open innovation but concentrates on the degree of inclusion: “We continue by developing our theoretical concept of ‘open strategy’, reflecting two critical dimensions of strategy work: an openness in terms of inclusiveness, in other words the range of people involved in making strategy; and an openness in terms of transparency, both in the strategy formulation stage and, more commonly, in the communication of strategies once they are formulated. However, our title – ‘opening strategy’ – refers to a

process rather than a final state [45].” Inclusion and transparency are the key considerations here and Matzler builds on that notion by developing a framework consisting of the degree of inclusion and the phase of the strategy process. In “Open strategy- towards a research agenda [49]” he developed an “archetypal model of open strategy based on the two dimensions ‘phase in strategy process’ (strategy development and strategy implementation) and ‘scope of open strategy’ (internal versus external community) [49]. Other authors referring to openness in strategy making used different terms for open strategy. Prahalad introduced the term “democratizing strategy” and emphasized that “Democratizing strategy creates a new way of thinking about a process for pooling collective knowledge and commitment in an organization and channelling it [50].” Gast and Zanini talked about “Crowdsourcing your strategy [51]”. The inclusion of communities by using the idea of crowdsourcing seem to be a core idea of open strategy and finds observance in Stiegers “Crowdsourcing for strategic dialogues” where he points out that: “More recently it has been acknowledged that the paradigm of collective intelligence and crowdsourcing can be applied inside a company as well [52]. An increasing number of companies are using prediction markets to forecast demand for a product. Social networks and collaboration software enable companies to tap into the crowd of their employees on a greater scale than ever before, even in strategy formation and can also increase the employee commitment [52]. Borison and Hamm have a comparable idea of the inclusion of individuals. They argue that: “decision makers and other stakeholders will not want to rely on a single individual. Collecting information from multiple individuals will better reflect the true state of knowledge and will be easier to justify and defend.” The decision theory approach is at the bottom of their consideration, which they label “prediction markets [53].”

Taking the different views of the authors into consideration core aspects of open strategy seem to be an extended internal or external inclusion, inside and outside of the company to communities or networks in order to reach better value creation and value capturing of strategy as well as tap into knowledge and create identification and understanding of company goals. This approach can also be labelled democratizing strategy, social strategy, crowdsourcing strategy, prediction markets or open sourcing strategy.

As mentioned above in the methodology part the topic of opening up strategies has just raised in literature of strategy science. In order to better understand the causes for open strategy that has been mentioned in literature so far, we aim to provide a short overview of mentioned factors that seem to lead to more openness in strategy making, apart from the environmental and historic changes that have been explained at the beginning of this article. Chesbrough and Appleyard claim that different strategy directions are important to understand business

strategy but no existing approaches are taking technology developments into account. They point out that the strategy focus lies: “[...] within the firm, or within the value chain in which the firm is embedded. None take much notice of the potential value of external resources that are not owned by the firm in question [48].”

They see these external resources as sources of value creation and emphasise on the lack of recognising this important sources in old strategy models. “Looking into the future [...] the opening of strategy is by no means secure [45].”

The question rises what benefits open strategy really offers. The reaction to environmental change cannot be the only reason for a change in strategy approach from a closed to an open way of strategising. Borison and Hamm claim that the inclusion of individuals in idea generation can reduce uncertainty in the strategy development process [53] knowledge creation being at the centre of that idea [51]; [45]. Furthermore it sounds promising that Gast and Zanini claim that social strategy “[...] inject more diversity and expertise into your strategy process, to get leaders closer to the operational implications of their decisions, or to avoid the experience-based biases and orthodoxies that inevitably creep into small groups at the top, it may be time to try shaking things up [51].” Value creation, value capturing [48], increasing innovativeness and better inclusion of stakeholders [52] as well as widening “[...] the search for strategy ideas and improve commitment and understanding in strategy implementation [45].”

Following that view, opening of strategies might facilitate to gain competitive advantage and added value (created “user value [54]”) for the organisation, as two possible drivers for open strategy. The open approach therefore seems to be promising but has a number of potential pitfalls [46] which will be addressed in more detail in the following chapters of the article. Even though, some authors see the limitations of traditional business models in combination with open strategy the aim of the article is to relate open strategy to traditional strategy patterns and traditional strategy characteristics questioning the promising benefits of open strategy. Furthermore some additional aspects shall be highlighted that will have a huge impact on the approach of open strategy and that need to be addressed in further research.

### *B. Traditional strategy and open strategy*

“The challenge for strategists will be to search for patterns in this complexity; to start with uncertainty; to embrace conversation and stories [...] [10].” In order to better understand the term open strategy and to find patterns that are significantly relevant for the open strategy approach by examining articles dealing with the term of open strategy or related term such as mentioned in the table below.

The relevant open strategy articles were listed in table 1 in conjunctions with the used terminology. Table 2 shows aspects that have been mentioned repeatedly in the

context of open strategy and in combination with the traditional strategy history it becomes evident that all patterns of open strategy relate to traditional strategy as well. Only the extended idea of internal and external inclusion, the reaction to technology change and the knowledge creation through crowdsourcing are specific open strategy patterns named here key open strategy patterns. The idea of this article is to critically review the key open strategy patterns and as well identify important considerations that have been part of traditional strategy making since the beginning of business strategy.

As the term strategy throughout history learned the importance of internal and external inclusion, the idea as such is not a new one. Internal integration and network alliances, the resource based view with the idea of knowledge creation through internal integration came up already in the 1990s. The notion of open or collaborative strategy is an extended view of internal or external inclusion that contains the company’s external environment or ecosystem [35]. One possible tool for internal or external inclusion is the idea of crowdsourcing [55]. Some authors suggest including the whole company ecosystem or restructuring the company to a network centric organization [35]. Some argue that a group of selected individuals can create knowledge and added value for the company [53]. Crowdsourcing seems to be at the centre of open or collaborative strategies [55] and current literature praises the tool as an opportunity to even gain competitive advantage. Creating social strategy [51] contains not only the introduction of a crowd and an extended definition of internal and external resources it will also have a great impact on company structures.

Looking back to strategy development in history it can clearly be seen that strategy is influenced by the strategy characteristics such as change, uncertainty, complexity, integration, relationships and networks and operational decisions [43]. Strategies are likely to be: “[...] complex in nature, made in situations of uncertainty, affect operational decisions, require an integrated approach and involve considerable change [42].”

As open strategy developed from traditional strategy these characteristics apply for open strategy as well and many of the open strategy patterns can be related to the influence of change, uncertainty and complexity, even fostering an open approach to strategy.

In traditional strategy an understanding has been developed on what contains good strategy. Asking the question if open strategy can be a good way of strategy making, the answer again is found in traditional concepts. Lynch proposed a test that values good strategies in a retro perspective [43]. His considerations are consistent with Rumelts explanation of a good strategy [56]. Both explain that strategy need to be consistent within the company goals, the strategy must offer consonance as an adaptive response to the external environment; the strategy must offer advantage and needs to be feasible within the resources [56]. That shows that a good way of (open) strategising can only apply when certain aspects

that have been learned throughout strategy history, [10] are addressed within the open strategy approach as well. Summarising traditional patterns of strategy and comparing them with open strategy the external and internal inclusion as a key factor (driven by environmental changes, mainly technological changes) becomes obvious. In the following the key open strategy patterns shall be first critically examined by relating them as well to traditional strategy characteristics, such as being dependent on change, containing complexity and unpredictability and by relating them to aspects for a good strategy.

TABLE II  
(OPEN) STRATEGY CHARACTERISTICS

	Traditional Strategy patterns	Key open strategy patterns
Characteristics	<ul style="list-style-type: none"> <li>• Change: Environmental influences</li> <li>• Unpredictability</li> <li>• Complexity: Social and cultural influences</li> <li>• Integration and relationships</li> <li>• Organisational aspects</li> </ul>	<ul style="list-style-type: none"> <li>• reaction to environmental pressures</li> <li>• an extended internal and external inclusion (crowdsourcing)</li> </ul>
Goals	<ul style="list-style-type: none"> <li>• Value creation</li> <li>• Value capturing</li> <li>• Knowledge creation</li> <li>• (Competitive) advantage</li> </ul>	<ul style="list-style-type: none"> <li>• value creation and capturing through knowledge gaining (e.g. crowdsourcing)</li> <li>• (Competitive) advantage</li> </ul>
Good strategy	<ul style="list-style-type: none"> <li>• consistent within the company goals</li> <li>• consonance as an adaptive response to the external environment</li> <li>• offer advantage (profit driven company: competitive advantage)</li> <li>• feasibility</li> </ul>	

After having identified key open strategy patterns and characteristics, the question raises if the open strategy approach responds to the complexity of strategy. Looking at De Wits and Meyers approach to history the lack of complexity within the open strategy approach becomes visible. De Wit and Meyer approach strategy in four dimensions that are strategy context, strategy purpose, strategy process and strategy content [57].

As shown in the table below open strategy is so far only addressed within the strategy process, mainly for strategy formation. Strategy context, strategy purpose and strategy content have not been addressed so far. Open strategy is not put into the “context consistent with the overall strategic paradigm [34].” Additionally to the fact that the open strategy approach is not consistently put into the context of a conventional strategy paradigm, an official and recognised definition of the term of open strategy is still missing. Even though the open approach is already praised as a new strategy paradigm, no exact borderlines

can be drawn around the terminology. Open strategy is a “fashionable topic [34]” that has a “lack of depth [34]” and is therefore very hard to define.

This article therefore attempts to refer to the importance of a holistic approach to open strategy by considering traditional strategy context, strategy purpose and strategy content. After having defined key open strategy patterns by referring to different authors, the concentration will be laid on aspects within the dimensions of De Witt and Meyer that are particularly relevant within the open strategy approach. The aim is to point out possible obstacles and singularities that should be considered in future research within the strategy dimensions.

Dimensions that are very closely related to key open strategy patterns such as the organisational context, the organisational purpose and the questions of strategy levels as well as the network strategy shall be critically discussed in the following.

TABLE III  
DIMENSIONS OF (OPEN) STRATEGY  
According and related to Reference [57]

strategy context	strategy purpose	strategy process	strategy content
Industrial context Organisational context International context	organisational purpose	Strategic thinking Strategic formation Strategic change and Implementation	Business level strategy Corporate level strategy Network strategy
open strategy context	open strategy purpose	open strategy process	open strategy content
Organisational context Inter-organisational aspects	organisational purpose: Organisational differences	Strategic change formation: <b>internal and external inclusion, crowdsourcing</b> Strategy Implementation	Business or corporate level strategy Network integration and impacts on organisational structure

As mentioned in the beginning strategy can only be explained by combining the different streams and aspects it contains. Not only as a different set of activities but also by taking into account strategy dimensions, patterns, characteristics and goals that all are part of strategy itself [40].

## VI. STRATEGY PROCESS AND OPEN STRATEGY

“Strategy process defines how strategy should be formed, who should be involved and when it should be made [57].”

### A. Strategic change -reaction to environmental pressures, such as technology change

Economic changes have been a main influence on strategic changes and they are, to some extent, the foundation of the open strategy discussion. As described

above the changing environment of an organization has influenced the organizational behaviour ever since. In the 1970's the environmental circumstances even led to the development of the strategy term itself. Compared to the 1970's when the environment has been very unstable and challenging [58] the environment today is influenced by fast innovations, especially in the technology sector [59]. The invention of new technologies "drives all of society and corporations to work faster, create and manage more interdependencies, and operate on global markets [60]." Globalisation creates a worldwide and free market which fusions local markets to a global one. This increases the competition between firms and changeability and uncertainty environments are experienced as turbulences that require flexibility and responsiveness within the company. Customer orientation is getting more important as well as the need to turn ideas into products as market interdependencies lead to a global customer market, too. "Therefore, information and communication technologies can be considered today as strategic technologies, and knowledge is considered as technological capital of the enterprise [60]." This leads to a "global, complex, dynamic, highly competitive, and extremely volatile [61]" organisational environment. It is believed that the today's economy "has created a more complex and dynamic environment in which most firms must learn to compete effectively to achieve sustainable growth [62]; [63]; [61]."

"In all of this, strategic planning might be said to have reflected the turbulence, change, and uncertainty of the times in which it has been evolving [18]." Whittington, Chesbrough, Appleyard therefore argue that the opening of strategies is a consequence of current development of advanced technology [45] and the shift towards the social side of organizations [51]. "[...] values, motivation, and behaviour of the organization's members are critical determinants of corporate performance" [18] and the shift towards the social side of organisations can provide important resources. "Information and knowledge are becoming strategic resources [60]." Additionally, the high speed development of technologies and removed barriers of geography is facilitating the accessibility of crowds and individuals [35].

Environmental shifts towards technology and community based societies are obvious but must they automatically lead to more openness within the organization? Grant worries that "The need for flexibility in organizational capabilities poses complex issues with regard to firm boundaries and choices between internal and external knowledge integration [64]." He mentions that issues may apply in company structure and knowledge transfer. If tacit knowledge as untapped knowledge should be uncovered it needs to be taken into account that this knowledge is acquired and shared by individuals. An increase and depth of knowledge implies a reduction in breadth of the individual, as always only a certain amount of knowledge can be gathered. Knowledge transfer is always costly and the effectiveness depends on the knowledge basis and the company structure. Grant argues

that knowledge, which is not related to a certain product, can only be transferred in network structures. He also points out that, if knowledge transfer boundaries within the company are not set, the potential of knowledge gaining will not be fully used. [64] The structure of the company is therefore essential for the success of knowledge transfer and not every company can provide that structures without facing complex issues.

Clear borders and structures are not only important for successful knowledge transfer. Abell argues that a certain extend of decentralization "has to be accompanied by new managerial frameworks and "glue" from the top. In other words decentralization should beget centralization [65]." More openness and inclusion alone is doubted to bring true advantage to the organization but should be accompanied by centralized aspects. Montgomery as well points out that throughout the years of strategy development it was always thought that: the chief executive office is "the person with overarching responsibility for setting a company's course and seeing the journey through [20]." Specialists today are not only "armed with frameworks and techniques, eager to help managers analyze their industries or position their firms for strategic advantage [20]" they are also specialists in their fields [66].

It seems that the changing environment itself can't be taken as a main argument for the opening of strategies as the proposed decentralized strategy approach can be easily seen as a hindrance of effective strategy making as the strategic competences are considered to be still with the strategic elite. Still, Mintzberg points out that today strategy need to seek "a fit between resources, future opportunity, leadership purpose, and leadership responsibility [67]." Throughout the years of changing environmental pressures it has been learned that "strategy making is not an isolated process [67]." Non isolated strategy processes might be interpreted as opened strategy processes, for example by an extended notion of internal or external inclusion.

#### *B. Strategic formation: internal and external inclusion*

Following the idea of internal and external inclusion of individuals into strategy processes and knowledge creation as well as the role of networks in organizational context we come to the reflection of the "wisdom of the crowd [68]" effect. Yi, Styvers, Lee and Dry define the phenomenon as follows: "The 'wisdom of the crowd' phenomenon refers to the finding that the aggregate of a set of proposed solutions from a group of individuals performs better than the majority of individual solutions [68]."

This notion of mass intelligence mainly developed through the use of technology and because of better accessibility of bigger groups [35]. Besides the internet, the facilitating access to groups and group think the idea of network integration based on Web 3.0 is becoming more important. Web 3.0 is a semantic web that is able to combine several information on a higher information

level. The semantic web understands information in its complexity and can conclude meanings by combining information. The current Web 2.0 – being an interactive and collaborative part of the internet- offers an easier access to groups and communities already. The web 3.0 proposes an even more intelligent system of combining knowledge and therefore offers great potential to detect untapped knowledge created by crowds [47].

Wisdom of the crowd is still a quite vague term that is reflected by the ideas of crowdsourcing, prediction markets and swarm intelligence. “Crowdsourcing, also known as “massive outsourcing” or “voluntary outsourcing”, is conceived in this study as the act of taking a job or a specific task usually performed by an employee of the company or contractors, and outsourcing it to a large group of people or a community (crowd or mass) via the internet, through an open call [47].” The phenomenon explains that a group of individuals can deliver better solutions than individuals on their own [68]. The idea of prediction markets can be considered similar with a more exact defined crowd. “Prediction markets are “smart” markets that are capable of accurately predicting outcomes of uncertain future events [69].” In order to have well working prediction markets, the crowd needs clear goals and prepositions as well as a big number of people involved [69].

To use mass intelligence within a strategy context is rather new. Gast and Zanini point out that the open strategy approach seem to offer many advantages using the crowd wisdom: “One is improving the quality of strategy by pulling in diverse and detailed frontline perspectives that are typically overlooked but can make the resulting plans more insightful and actionable. The second is building enthusiasm and alignment behind a company’s strategic direction [51].” As well Bonabeau and Meyer believe in the collective behaviour that emerges from a group and label it “swarm intelligence [70].” A group is considered to be intelligent in their behaviour, relating it to complex social behaviour of insects working without supervision but in largely self-organized teamwork [70].

Considering that the exact benefit of wisdom through a crowd and the terminology of crowdsourcing, prediction markets and swarm intelligence in strategy context are still blurred, the true advantage of that approach for strategy making still needs to be discovered. Today, there seem to be as many opinions of the topics and its advantages and disadvantages as articles published and there are many possible negative effects to be taken into account.

Swarm intelligence, for example, “[...] has helped several companies, including Unilever, McGraw- Hill, and Capital One, to develop more efficient ways to schedule factory equipment, divide tasks among workers, organize people, and even plot strategy [70].” Still, the efficiency of swarm intelligence in the area of strategy is relatively unexplored, but the group behaviour itself is subject to

scientific exploration, such as the importance of group size and the costs of decision making [71] which will apply for crowdsourcing as well. Knowledge gaining through a crowd can save the company money in idea sampling [47]. Whereas the costs of knowledge transfer could outweigh the cost benefits, if the company structure doesn’t fit to the requirements of the individual knowledge transfer. [60]

Advantages and disadvantages of crowds apply for different not solely strategy contexts. Additionally to the ambiguous definition of openness and crowd wisdom, the lack of strategic application can cause negative effects [72]. Opening up strategy to a greater crowd using swarm intelligence can be rather challenging: “The field of swarm intelligence faces several obstacles. Many people have great difficulty understanding how swarm intelligence can work [70]. Those who are not used to group behaviour and that are not prepared to the outcome can experience negative surprises [49].

Indeed, there are some negative aspects that need to be considered in order to successfully open up strategy processes and gain additional, tacit, knowledge. “It is remarkable how little social influence is required to produce herding behavior and negative side effects for the mechanism underlying the wisdom of crowds [73].” People in crowds are highly influence able and can only deliver independent opinions when they are not affected by other opinions in their network. This is underlined by King, Cheng, Starke and Myatt who found out that there is a bias in the wisdom of the crowd effect “when the people have access to the last persons guess [74].” People also have a tendency to follow best individuals. If the last guess was accessible but the group was smaller the quality of decision surprisingly was then better, as it was then more likely that group decisions have been done. (King, Cheng, Starke and Myatt, 2011) The value of individual knowledge seems to be rather high but the circumstances under which the knowledge is created needs to be evaluated and the concept needs to be well prepared before usage [73].

The idea of using crowds “predicting outcomes of uncertain future events [69]” is the idea of prediction markets [53] and a possibility to react to the strategy characteristic of uncertainty which is even more relevant in economical uncertain times. On the other hand, Harrison suggests that businesses need a clear leadership during times of great uncertainty. “Where there is considerable uncertainty and business conditions are difficult the need for clearly defining the firm’s objectives and strategies is as great if not greater than ever [75].” And Lynch even worries that the trial to predict uncertainty as an “idealised series of wish statements [43].” Mintzberg even talks about the fallacy of prediction as one reason why strategic planning is not as successful as it was supposed to be [67].

As leadership is a strongly discussed subject in strategy context [76], the importance of leadership within the



context of open strategising and the wisdom of the crowd effect is essential. One of the most cited authors in strategy matters possess the opinion that a company can only be led by its CEO [77]. Looking back at the historical development of strategy the role of the CEO within its company is evident [2]. Abell as well presents the point of view that during complex changing a strong leadership should take place. "The growing leadership challenge is to make sense of a complex changing world before others, and to realign the organization, internal functional activities, and business system activities, to be ready to take advantage of new opportunity [65]." Taking these arguments into account the wisdom of the crowd does not seem as an ultimate response but as a possible way to react to a changing environment.

Thinking of the crowd as a group of strategist would surely be a mistake. Crowd wisdom is not able to take over the leadership or the direction of a company and the role of leadership should not be disregarded through a "democratizing strategy [7]" approach. There is a "[...] unique role leaders play in the process of formulating and implementing strategy [20]." It is essential that strategic decisions are taken by the organizational leader. The crowd can still play an important role within that construct as even the "most effective managers rely on some of the softest forms of information, including gossip, hearsay, and various other intangible scraps of information [67]." Untapped knowledge could be delivered by employees, or stakeholders, as well as by a group of people involved externally or internally, when integrated into a working leadership model. When looking at the role of the crowd within the organizational context an open strategy approach can only work within certain rules and restrictions. Knowledge of a crowd seems to offer many advantages, the goal and the leadership still should not become lost. "He or she must keep one eye on how the company is currently adding value and the other eye on changes, both inside and outside the company, that either threaten its position or present some new opportunity for adding value [20]."

### *C. Strategic formation: open strategy formation and included actors*

"The industry actors are those individuals and organizations that perform value-adding activities or consume the outputs of these activities [57]." Open strategy follows the notion that all organisation's actors shall be included into an open strategy approach which aligns with a turn to practical issues can be noticed in theory research [78] since the beginning of the 21<sup>st</sup> century. The integration of employees is not a new idea [36] it just hasn't been done systematically on all company levels with all employees.

"Recently, concern over the gap between the theory of what people do and what people actually do has given rise to the 'practice' approach in the management literatures [36]. Strategists have concern to develop good

practise and the awareness of tacit knowledge that might help for better strategy development is an essential part of the strategy as practise approach. The open strategy approach incorporate the notion of an extended inclusion of stakeholders, which also refers to employees and the lower management levels [46] which might facilitate the uncovering of tacit knowledge. The approach also enables to focus on all contributors of strategy development and execution and not only on some elite few. "Strategy development has traditionally been the domain of the Csuite, employing structured tools for analysis and tightly managed decision making [79]." Still, all company levels are influenced by the pressure on a high quality strategy development. The lack between practice and theory is a thread for strategy processes [36]. "Strategy setting sometimes suffers from insufficient diversity and expertise, with leaders far removed from the implications of their decisions and hampered by experience-based biases [51]." Particularly, as social practises within the organisation are formed where the work is executed and the strategy is influenced [80]; [81]. The open strategy approach follows the notion of the importance of employee inclusion, especially in order to detect tacit, untapped knowledge and to develop sustainable competitive advantage that enables not only value creation but also value capturing [48]. The strategy as practise approach is an important organisational aspect within the movement to more strategy openness and underlying concepts of that approach should be considered for future research.

The inclusion of internal and external actors brings complex changes into common strategy processes and into the organisation's structure, especially in organisations that are not used to openness and inclusion of actors: "Particularly relevant, we shall argue, are a crumbling of organizational boundaries and hierarchies; a societal shift towards managerial egalitarianism and mobility; a cultural popularization of strategy; and new technologies that set information free [45]." Strategy must fit into the organisation and the organisation must fit into the strategy. An effective strategy needs to be consistent within its competitive environment and "also must be communicated and widely understood throughout the organization [81]."

"The downsides of openness can also be considerable, although there is less focus on this in the literature. Openness can result in resources being made available for others to exploit, with intellectual property being difficult to protect and benefits from innovation difficult to appropriate [82]." Especially property rights are essential for companies as: "intellectual property rights (IPR), venture capital (VC), and technology standards allow for organization to trade ideas [82]." Imitating of ideas in a strong global environment of competition can have disastrous impacts on the performance of the company. Especially in open approaches, when the sharing of ideas is part of the method, the right timing to protect

intellectual property rights might save a company's existence [83]. In current open strategy literature the importance of property rights, especially in combination with crowdsourcing is not stressed in depth. "[...] acts of 'unfair competition' are becoming increasingly common [...]. As a result, IP (Intellectual Property) is becoming one of the most valuable business assets [84]." Lemper suggests that timing plays a pivotal role in the protection of property rights in order to avoid early spreading of ideas. The topic of intellectual property rights will bear another risk in open strategizing, as the source of the idea might lie outside of the company and the protection of the intellectual property might prove to be impossible [46].

Instancing the protection of intellectual property, it can be noticed that even though open strategy is already in use, less attention is paid on the actual impacts of open strategy so far. One reason might be the lack of knowledge and communications between the organisation's levels. "Strategy setting sometimes suffers from insufficient diversity and expertise, with leaders far removed from the implications of their decisions and hampered by experience-based biases [51]." As strategists and senior management suffer from a distance to lower levels of the company and therefore do not always understand what kind of practical impacts decisions have. Another risk for the successful opening of strategies is bad strategy implementation and insufficient internal acceptance [85]; [52]. One example for such effects is explained by Gast and Zanini, who describe possible problems of the open strategy approach: „Closer inspection revealed that people were acutely aware of the strategic importance that senior management attached to this innovation and nobody wanted to wreck the party by openly sharing the prevailing doubts [...] within a few months of being launched, the new product was declared a failure [51]." Generally, competitive advantage reached by a certain strategy is an advantage that should not be shared offhandedly. "An integral part of competition is to deny rivals access to proprietary technical knowledge [86]." An open approach in order to reach competitive advantage can easily lead to the contrary with a major risk of losing the strategic head start. Furthermore, the opening of organisational capital, which can be a strategically or technological advantage, can lead to unclear property rights and value capturing as well as increased coordination costs [87]; [88]. An open model of value creation might be too costly to bring real benefit to the company. Greenstein argues that openness enlarges coordination costs as it requires the leading of a cooperation of multiple actors [87]. Almirall and Casadesus-Masanell support this notion by pointing out that additional costs apply by the suboptimal coordination of processes that were clear and controllable under a closed approach [88]. The outcome and the success of open approaches are therefore even more important in order to cover additional coordination and controlling costs. The strategy implementation and the actual

outcome of strategy are consequently a core element of a successful strategy approach.

#### *D. Strategy implementation- the importance of successful open strategy implementation*

Considering that value creation is a core element of strategy, the value capturing with the aim to create competitive advantage for the organization is the next reasonable step [48]. Strategy implementation is often disregarded even though this step of value capturing is very important for the strategy success. "The habitual mode of poor strategy implementation shaping the next round of strategy formulation weakens the subsequent planning cycle [89]." Bearing in mind that open strategy underlies similar patterns as traditional strategy the importance of open strategy implementation becomes evident. Furthermore, when considering the importance of strategy implementation within the strategy process it is not astounding that Newstead and Lanzerotti emphasize on openness in all strategy stages including strategy implementation: "Open-sourcing strategy brings the customer inside to shape and support strategy from conception to execution [79]." Current literature on opening strategies is as well mainly focusing on the idea development phase and the formation of open strategy even though implementation shows the success and outcome of strategy making. "Many executives argue that brilliant execution is more important than brilliant strategy [90]." In order to better understand the challenges an open approach has in the strategy formulation and implementation phase it is essential to understand what traditional strategy formulation and strategy implementation entail as "firm performance is strongly influenced by how well a firm's business strategy is matched to its organizational structure and the behavioral norms of its employees [90]." The conventional way of conducting strategy formulation and implementation needs to be understood to evaluate successful and failed strategies. In traditional strategy personnel barriers can be seen as the core problem of change. Implementation management is barrier management and the core problem is personnel barriers [91]. Krüger point out that strategy implementation is hindered by company-wide barriers, management barriers and employee barriers. "Effective implementation can prove difficult, as it requires the coordinated and appropriate efforts of individuals throughout an organization [90]." If employees lack knowledge about the company's strategy, it is unlikely that proper implementation will occur, which in turn leads to poor financial performance [89]. Especially the role of senior management is crucial at that stage of strategy making: "Thus, a critical task for senior managers is to define the key success activities for their organization's strategy and develop an organizational system that promotes those same activities [90]." Crittenden and Crittenden also point out that the formation and implementation cycle needs to work accurately or it is "hard to tell if weak performance is due to good

implementation of a bad strategy, or the result of poor implementation of a good strategy [89]. When introducing a new strategy approach, such as the open strategy approach, to the company, the awareness of the importance of strategy implementation, the knowledge of existing barriers, the role of senior management for key activities and communication and the need for an applicable formation and implementation cycle are essential for the success of the approach.

## VII. STRATEGY PURPOSE AND STRATEGY CONTEXT

How can strategic goals be reached through an open strategy approach? This is, amongst others, depended on the company's purpose the "purpose that firms want to achieve" and the "organisational context" [57]. The purpose of the company is influenced by the company direction, whereas this is dependent of its strategy and organisational context. "The strategy context is the set of circumstances surrounding strategy making [57]."

Looking at the organisational context, there are enormous differences between organisations in regards to funding, stakeholder or shareholder orientation, environment, size, product orientation and goals, naming just a few [42]. "A stakeholder is defined as any person, group or organization that can place a claim on an organization's attention, resources or output, or is affected by that output [92]." The differences in structure and the different focus on profitability or social responsibility influence strongly the strategic goals of organisations [43]. Thus the question rises if every organisation will automatically benefit from an open strategy approach no matter of company purpose and no matter of funding, size, product orientation, environment and goals. Current literature mentions implications how the company purpose might affect the success of open strategy making but doesn't evaluate that topic to a great extent. "Implications of open strategy are not the same for all organizations. Privately held companies are under less pressure from external shareholders and financial market regulations [45]."

Will openness in strategy making be affected by the funding and environment of the organisation? Certainly there are big differences between organisations acting in private environments to organisations that are based in public environments. Stockholders within privately owned companies put a different pressure on strategy goals than stakeholders within public companies. Still, a shift to a more stakeholder orientated worldview takes place in both sectors. "It has long been gospel that corporations have obligations to stockholders, holders of firm's equity that are sacrosanct and inviolable" but there have been a shift in worldview from stockholder to stakeholder due to the concern of social involvement in business [93]. Talking about stakeholders, the private sector is not as integrated in a big network of stakeholders

as the public sector is. "Employees, but customers and suppliers, stock and bond holders, and regulators can be counted to their network. In the public sector, these stakeholders can include many, most, or even all citizens [53]." The network of stakeholders is therefore as relevant as the funding of the company as it means that changing a system, which includes many stakeholders, might be even more complicated than within a system including fewer stakeholders. It needs to be considered how the relationship between organization and its stakeholders would change [93]. Besides the funding of the company that can be through public funds or private funds with a great impact on company goals, the orientation of the organisation and therefore its structure will be essential for a success of open strategy. Stakeholders can put pressure on company goals but they can also act as external or internal actors, being part of the company network [35] and consequently important for an open strategy approach. As opening up strategy requires the inclusion of either external or internal stakeholders, the organisation structure will need to change to a greater extend of openness [35]. Organisations will change their processes and will get their ideas through communities such as for example: external agents, e.g. users, business partners and universities [88]; [48]; [45]. Companies are "are also networks of people, working towards a common goal [57]." The network of people will be essential for the company structure and therefore for the company purpose.

Looking at the organisations size the opening of strategies and its success is also depended on the ability of the company. Small businesses can offer a great mix of actions, organisational structures and management styles [94]. Sawhney and Nambisan support the idea that the recognition of possibilities is not depending on organisation's size. "Similarly, more and more business recognizes that there are a lot more capabilities for innovation in the marketplace than they could try to create on their own, no matter how big and powerful the company [35]." Besides size, the company sector or industry context [57] might play a certain role. "[...] the pressures for open strategy apply across many kinds of sectors, high- tech and low-tech, private and public [45]." Some companies especially such that are related to high-tech products or research are more frequently tapping into the high velocity environment of innovations and are therefore using more often open strategy approaches. Naming the high velocity environment of organisation's especially dealing with innovations as their products and taking into consideration that unsteady surroundings such as irregular changes and rotating competitors, changing technology, or government rules [97] have an effect on the open strategy approach, the environment of the organisation can be considered to be extremely important [98]. Businesses in different environments need to focus on different aspects. "In stable environments, for example, optimization and incremental improvements are given a greater emphasis than in fast-moving

environments, where survival and speed of adaption become more dominant issues [99].” The company goals are particularly influenced by the environment and by the funding depending in public and private organisations. Strategic success means to align strategic behaviour with environment [17]. Public organisations and non-profit organisations are affected by vague and contentious goals whereas private organizations define their goals by “profits, investments and earnings [100].”

Wondering “[...] in which environments open strategy and open innovations are better suited and in which environments they are not [82] [...]” it is essential to place the open strategy approach within the company purpose and the underlying structures. The strategy purpose is shaped by individually shaped demands “Demands are placed on the firm by shareholders, employees, suppliers, customers, governments and communities [57].” Consequently, open strategy needs to fit into organisations purpose and will essentially shape the strategy context and the company structure when it is applied. Not every company (with its strategy purpose and with its company structure) might be suitable for an open strategy approach [81].

## VIII. STRATEGY CONTENT AND STRATEGY LEVEL

### *A. Open strategy and strategy level*

“While the strategy process defines how strategy should be formed, who should be involved and when it should be made, strategy content explains what the strategy should be, the course of action a company should follow [57].” Taking in mind that strategy can be created in a very theoretical way by elite few [79] or as a practical approach from the middle management it becomes evident that the strategy content needs to be communicated on different strategy levels [42]. The communication of strategy on different strategy level is very important for the impact of the strategy, as strategies on a corporate level are the frame for the strategies on business unit or functional level [43]. Most organisations have various levels, making it necessary to ensure the internal fit of strategy at each level of aggregation of the firm. Traditional strategy making and open strategising on a corporate level will therefore influence the whole company. Consequently open strategy making needs to be discussed on different company levels and will have diverse and divergent influences on distinct organisation levels. Open strategy approaches in literature have not been addressed exclusively to a certain strategy level so far. Considering the creative part of strategy making and the structured approach that is suggested for lower level strategies, it needs to be discussed in future research where the open approach would be best suited within company levels. This question is essential for an open strategy approach in order to secure the internal fit of

strategy within the company. Especially, as strategy faces different issues on different organisation levels. De Witt and Meyer explain that organisations on a business level face the issue of competitive advantage, whereas the corporate strategy level faces the question of corporate configuration and the network level the issue of inter-firm relations [57]. The product of business level strategies faces completely different strategic requirements than requirements of the corporate level as “the highest management level” [67]. Both levels could be a potential strategy level for an open approach as they contain creativity as well as planning aspects. “Corporate strategy can be seen as the linking process between the management of the organisation internal resources and its external relationships with its customers, suppliers, competitors and the economic and social environment in which it exists [43].”

“Many Companies however, have diversified into a number of businesses. This involves a distinctly different level of strategy that we term corporate strategy. [20]” A business unit in contrast to corporate strategy: “[...] is an organizational entity with its own unique mission, set of competitors, and industry [101].” and is specialised on the organisational context and structure.

In the question raises, if open strategizing can take place on all strategy level of a company, even on a functional level or on the level of vision creation. So far, the matter of strategy level has not been investigated. The different creativity level and to certain extends the need for leadership are creating distinct possibilities for an open approach on the various levels.

### *B. Open strategy and organisational networks*

As shown in the paragraphs above, the company’s purpose as well as the internal and external fit are factors that influence the company ability and therefore on its ability to open up strategy. Considering the economic factors that lead to opening up strategies while bearing in mind that opening up strategies will restructure organisations the importance of network level strategies emerge. “Unstable market conditions make knowledge gaining very important. Networks, either of firms or of individuals, may be well-suited to the transfer and integration of such knowledge [64].” There seem to be organisations that gain better results from openness than others [86] and it can be questioned if these organisations are already used to more open approaches to strategy by using network strategies. Companies can have network level strategies, which are part of the strategy content and the internal fit of the company. Network level strategies mean that a group of companies can have a strategy together [57] Nambisan and Sawhney even extend the idea of a group of companies to a group of stakeholders being involved into a network centric company [35]. This view of a network centric organization is specific and requires a lot of structural changes to a company ecosystem. The idea of including relational actors [57] seems to be more feasible for company’s not used to

network strategies. As this topic is not stressed in detail in open strategy articles and in order to have a better insight on open strategy within organisations and organisational networks the importance of the topic shall be addressed further in the below.

The opening of strategies as an intercompany interaction is not new and can create advantages: In particular, this (open strategy) approach can help firms more closely align their activities with the interests of their communities, be they customers, suppliers, or even colleagues [79] but can also lead to a greater pressure from the stakeholder and create or emphasize on a multiple stakeholder environment [45]. Some organizations might be used to the integration of multiple stakeholders in their business but some companies might be dramatically challenged by this new approach. Especially organizations relying on confidentiality will have more difficulties in openness and are afraid of a loss of control [79]. A stakeholder analysis, De Witt and Meyer call them “relational actors [57]” should be integrated into an organisations strategy. The organisation’s “web of relational actors [57]” needs to be analysed and addressed very well in order to get a structured and valued outcome. Stakeholder or relational actors can help gaining important knowledge and “[...] knowledge is the preeminent resource of the firm [64].” This emphasizes that organizations networks can, as soon as explored, offer high quality and company related knowledge [35]. Especially companies that are already working with innovations are sharing ideas to a greater extend and provide openness and have often an advantage in infrastructure. “[...] so that the wheel never has to be re-invented. The basics are already there and agreed-upon by the global community [35].” The network approach as the organisation’s ecosystem is not a new one but a more structured proceeding is aimed for. “Implicitly, external knowledge is considered to be ‘out there’ ready to be harnessed by firms, and we have limited understanding of the process of sourcing this into corporations [82].” Company networks also gained popularity as they can lead to “lower overhead costs, increased responsiveness and flexibility and greater efficiency of operations [102].”

In contrast to that perception Lorenzoni and Barden-Fuller question a natural organisational ecosystem and point out that a lot of companies view “[...] their joint ventures and subcontractors as existing beyond the boundaries of their firm [102].” They do not consider including them as potential holders of tacit knowledge. Jarillo explains that: “The main theoretical difficulty is that networks do not fit well the basic models of strategy, as has been said. Firms are normally regarded as ‘complete entities’, operating in an environment that is implicitly defined in a rather negative way, as ‘everything that is not the firm’ [103].” Therefore, possible pitfalls concerning company’s networks and their integration need to be taken into account in order to effectively include and manage networks. The use of new technologies and Web 3.0.

should not be underestimated, as the “potential of new technologies cannot be conceived without the participation of people who live, interact, learn and create via the web [47].” Companies not used to the usage of new technologies will have enormous difficulties with gaining advantage from them [49]. “Competitive dynamics in connected open networks are very different from those in unconnected closed networks [86].” People that are used to the use of open networks are familiar with those dynamics. Furthermore: “In such an environment, firms have to innovate continually and sponsor their technologies to promote system viability [...] [86].” The company should not miss technology innovation at that stage of network integration.

Even though a network level strategy including the web of relational partners [57] seems to be promising, especially in order to gain better knowledge and in order to include internal and external crowds, the impact of a restructured approach to traditional value creation within the organisation needs to be taken into account. Depending on the organisations structure the step to a network centric structure might include strong impacts of distinct power that cannot yet fully be estimated.

## IX. CONCLUSION

Current literature seems to praise the opening of strategies as a very useful strategy tool. By examining the open approach a critical view was chosen in order to question the potential of open strategy. Having derived traditional strategy patterns from historical development of strategy and having discussed the nature of strategy the relation of open strategy and open strategy patterns to traditional strategy patterns became evident. The nature of a changing environment has influenced and will influence the discussion of strategy in the past and in the future. Open strategy differs to traditional strategy only in the degree of internal and external inclusion and the way the inclusion is reached. Typical strategy characteristics, goals and the requirements for a good strategy apply for open strategy just as well. After analysing articles and definitions of open strategy it became evident that the idea of open strategy so far has only applied for the strategy process. Within the strategy process the idea of change as a driver for open strategy and the degree of internal and external inclusion are at the centre of open strategy. The strategy process, looking at traditional strategy structures, is part of a complex strategy framework which is influenced by strategy content, context and purpose as well. Within the strategy process the focus in open strategy research is currently laid on the strategy formation even though the strategy implementation plays a pivotal role for the success of a strategy. Critics of open strategy as well dispute that open strategy being not implemented carefully and then managed insufficiently will lead to simply emphasizing the existing organisational dynamics and ways of communication [104]. Ericson as well calls for a more conscious way to

think about strategy and to ask the question “how change occurs and what constitute ‘success’ and ‘failure’ [105].” The potential and limitations of open strategy as well as the impact of the approach within strategy content, context and purpose haven’t been addressed so far in literature even though a more holistic approach to open strategy would be needed as the impact to the company’s structure and its organisational purpose will be enormous. The article therefore tried to outline important aspects within the strategy process that have been disregarded or not yet been addressed in depth as real benefits can only be found by examining what in detail is done differently using an open approach in comparison to traditional strategy. Potential restrictions of open strategy within the strategy purpose, the strategy content and the strategy context have been outlined without claiming to provide a comprehensive overview but a possible research agenda.

Within the strategy process the essential underlying idea of open strategy is the potential of the changing environment. The changing environment of strategising seems to offer new opportunities to organizations but taking into account the different viewpoints displayed; change will not automatically lead to openness in strategy making. Even though the changing environment is one of the main reasons for opening up strategies, it might also require centralised and closed approaches. Opening of strategies could be only one possible way of responding to the changing environment as uncertainty and complexity could even lead to a conversed reaction, as for example the call for more and stronger leadership. The core of open strategy within strategy formation is the extended idea of internal and external inclusion. Several aspects need to be taken into consideration to experience the real benefits through inclusion of the crowd. As discussed true knowledge can only be achieved when certain aspects are fulfilled and the tasks are consistent within the strategy context. The success of the inclusion of a crowd is also threatened by different possible pitfalls such as communication of the task, composition of the group and the management of group complexity as well as access to the opinion of different group members. The way companies address strategy and how they develop strategy, either in a very theoretical way by including elite few, or as a strategy as practice approach including the views of all company levels, create a different basis for open approaches as well. Companies that are including their middle managers and employees already in their strategy making will have a distinct basis for an open approach. It needs to be pointed out that current strategy streams need to be included in further research.

Open strategy needs to fit into the organisational context and the organisational purpose. Organisations differ in many different aspects, such as size, funding and environment. With this differentiation they also vary in their goals and in the company’s purpose. The aim was to outline the different aspects that need to be considered where and in which company an open strategy approach might be suitable. So far there is no existent framework or

model of companies that might have a particular suitable environment or organisational context. The opening of strategies will have no matter of the organisational context, a big impact on the strategy and organisational purpose. Additionally to the considerations above, the strategy content needs to ensure and internal fit within the company. Strategy must fit to strategy structure and openness depends to a great extent to the composition of the organisation and can have different impacts on already existent structures. Therefore, the possibility of approaching strategy in an open way relates strongly on the company’s abilities. Some companies seem to profit more from openness than others. The organisations fit to open strategy can only be discovered by examining the traditional strategy background of the organisation and question what and how can be done differently by using the open strategy approach. “It is of little benefit to find that ‘strategy is done differently’ since we wish to know what is done differently, how it is done differently, why it is done differently and, most importantly, what is the point of generic similarity [36].” Communities and stakeholder as the company’s network can be integrated in different ways depending on the starting point of the organisation. Network centric approaches or open company cultures will have less structural problems than companies that follow a very traditional way of strategizing. Distinct company backgrounds can either facilitate or hinder open approaches. Current literature is not referring to the strategy level at which open strategy shall take place even though this question is an important one, as strategy issues are different on different company levels.

Open strategy is not automatically successful strategy tool that offers a good strategy and the reach of strategy goals such value creation, capturing and (competitive) advantage to every organization. A consistent approach to existent strategy structures within the organizational context is required to make open strategising successful. What Jarillo said earlier on strategic network is valid today for open strategising: “But, important as the topic may be, it lacks a generally accepted conceptual framework, with enough theoretical depth to help understand the plentiful anecdotal evidence, and particularly to put the phenomenon in a context consistent with the overall strategic paradigm [103].”

## X. FURTHER OUTLOOK

The review started with a structured and restricted view related to strategy patterns influencing open strategy and that are influenced by the open approach. It then provided an integration of open strategy in traditional strategy dimensions and structures. The next chapter will provide a further outlook on key questions that rise when examining the approach.

### A. Conceptualising open strategy

As stated above, even though opening up strategy is an upcoming approach, the terminology of open in a strategy context is still blurred. There is careful defining within the strategy terminologies needed and there are several boundaries to be set out in order to get a better understanding of the term open within strategy-making [82]. Presently no usable roadmap for opening up strategy processes can be found; “it's simply too early for one to exist [51].” Leading us to the need of classification of open strategy in a framework and the evolution of an acknowledged definition, within the context of traditional strategy making. Developed models and frameworks need to be “feasible” [106] to be considered for future research. Feasibility can be understood as the possibility that organisations can apply developed frameworks and models. In order to have applicable frameworks and models, to have an adaptive outcome, research needs to be generalizable and be drawn from “informationally representative cases [107].” As most research of the open strategy topic is executed as qualitative case studies that depend highly on the context where it takes place. As discovered in the article a lot of different strategy and organisational specifics influence open strategy and are influenced by the approach. This endangers the findings to be exceptional and threatened to become “little islands of knowledge [108]”. “A danger appeared that the individual studies could not be matched [107].”

Summarising the above first of all an official definition of the term open strategy needs to be developed, based on conventional strategy making and strategy characteristics. The open strategy phenomena should moreover be investigated in structured way, taking into consideration that the traditional way of strategising needs to be related to the new process in order to understand its advantages and possible pitfalls. Furthermore, organisational circumstances of every open strategy case need to be analysed in detail to relate them to existing knowledge of strategy and to make them understandable and accessible to all audience

### *B. Open strategy and the reach of company goals*

The core of open strategy is the extended external and internal inclusion under the assumption of the wisdom of the crowd [55]. Swarm intelligence again is the essential idea of generating knowledge from crowd behaviour and interaction [70]. The term crowdsourcing as well as the wisdom of the crowd have been mainly used in open-source and technological topics and applied only in very special context, as with the Wikimedia case [55]. Apart from the fact that special cases are hardly generalisable [107] the idea of swarm intelligence and crowd wisdom have not been explored in depth in the context of strategy making. Some companies already worked with crowds and gained successful ideas [46] and especially in the area of open innovation the idea generation through crowd inclusion reached popularity [106]. Still, successful crowd inclusion will be essential for an successful open strategy approach and beside the fact that there is proven evidence

that crowds can solve simple and complex issues and that groups are smarter than individuals [68] a true wisdom of the crowd effect within strategy processes still needs to be discovered in depth and will be a central question of a applicable open strategy approach. Considering that the exact benefit of wisdom through a crowd and the terminology of crowdsourcing, prediction markets and swarm intelligence in strategy context are still blurred, the true advantage of that approach for strategy making still needs to be discovered. The fact that crowd wisdom has been effectively applied in open innovation approaches makes the same effect feasible for other strategy purposes [48]. Company goals such as the each of (competitive) advantage, value creation and value capturing can only be reached when the crowd delivers undetected knowledge, as already learned above. Open strategy can therefore only reach company goals when the central part of the strategy is successful with strategy context. Companies that are not used to openness and that are not well enough prepared for the approach might experience negative surprises [49] and might not be able to reach company goals. If open strategy has the potential to be a good strategy approach can only be proved by effectively using crowds within a holistic strategy approach, unveiling untapped knowledge.

## XI. CONCLUSION

Summing up open strategising can be a real challenge for every organisation no matter of organisations goals, structure, funding, vision and the organisations network as well as the environment. One of the major challenges is possibly identifying the individual specifics of every organisation and evaluating how the open strategy approach can be successfully executed in order achieve the company goals. So far the effects of open strategy are so to say still „open“ and a lot of companies are using the strategy approach without knowing about its definite impacts and without having analysed neither their organisational environment or their strategy dimensions such as organisation and strategy purpose, content, context and the strategy process. No scientific findings exist how deeply open strategy actually affects strategy processes within the organisation and the outcome of a new developed strategy. Furthermore, depending on the preliminaries of the organisation, the on-going process of aligning open strategy to the traditional strategy process and integrating the organisations network into strategy development and strategy considerations, a successful execution is a long way to go. The success of an open strategy is not depended one single initiative but demands a change strategy making style towards empowering people, letting go traditional top-down management, questioning present leadership and cultural norms and allow more transparency in processes. Still the impacts of opening strategies and the risks are not totally discovered. Benefits that may arise but also negative attending ills might materialize that can change the organisation and its culture.

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# Investigations on High Temperature Fibre-optic Sensing with Regenerated Fibre Bragg Gratings

L. Polz<sup>1</sup>, H. Bartelt<sup>2</sup> and J. Roths<sup>1</sup>

<sup>1</sup>Photonics Laboratory, FK06, Munich University of Applied Sciences, Munich, Germany

<sup>2</sup>Fibre Optics Research Department, Leibniz Institute of Photonic Technology, Jena, Germany  
(lpolz@hm.edu)

*Abstract* – Currently, fibre Bragg gratings (FBG) are used as temperature- and strain- sensors at temperatures of up to a few hundred °C. A new type of FBGs, the so-called regenerated FBGs, have the ability to expand the usable temperature range up to 1000°C or even above. Regenerated FBGs have the advantage of a small sensor cross section, light weight, electromagnetic immunity, multiplexing capabilities, high sensitivity and low costs. Therefore, they are ideally suitable for multipoint quasi-distributed sensing applications. Here, we report on investigations on production and characterisation of regenerated FBGs. It was found, that the regeneration process was influenced by the type of optical fibre and the different pre-treatment conditions. High temperature sensing applications are, for example, in aircraft turbine test facilities and gas turbines for electric power generation.

*Keywords* - regenerated fibre Bragg grating, high temperature sensing, multipoint temperature sensing

## I. INTRODUCTION

The performance of electric sensors is often limited by electromagnetic interference (EMI) and temperature-induced material deterioration. Fibre-optic Bragg grating (FBG) sensors have advantages when compared with conventional electric sensors, because they are immune to EMI, show small form factors and have a unique multiplexing capability. Due to the small diameter of the fibre and the multiplexing capability, a large number of sensor elements can be operated by one feed through and one lead fibre. This allows a high spatial resolution combined with a moderate cabling effort.

Fibre-optic sensing of high temperatures is a challenging task with numerous potential industrial applications e.g. in the aerospace and energy sectors. Optical silica glass fibres are, in general, well suited for use at high temperatures and in harsh environments, but Type I FBGs show a pronounced decay at elevated temperatures [1]. In the last decade, significant research efforts have been expended on the investigation of high-temperature stable FBGs. Thereby, regenerated FBG have been found as a suitable sensing approach for temperatures up to 1000°C or even above.

## II. FIBRE BRAGG GRATINGS

In an optical fibre, light is guided due to a difference between the refractive indices of the fibre core and cladding. This difference is achieved by doping the fibre core and cladding with different elements. Frequently, germanium is used to increase the refractive index of the core.

A fibre Bragg grating is a periodic variation of the refractive index of the fibre's core along the axis of the fibre (Fig. 1). Due to the periodicity of the index changes, an FBG shows a wavelength-dependent transmission and reflection behaviour. At every refractive index step, a small part of the input light is reflected on the basis of Fresnel's law. If all these reflected partial waves are in phase (constructive interference), a great amount of light is reflected by the grating. This constructive interference appears only at a certain wavelength, which is called the Bragg-wavelength  $\lambda_B$ . Other wavelengths are almost unaffected by the grating and are transmitted.

$\lambda_B$  is related to the period  $\Lambda$  of the refractive index structure by

$$\lambda_B = 2 n_{eff} \Lambda \quad , \quad (1)$$

where  $n_{eff}$  is the effective refractive index.

### A. FBG as a sensor

An FBG can be used as a sensor due to the fact that the reflected Bragg wavelength is proportional to the grating period. So, if the grating period is changed due to a change in temperature or strain, this results in a shift of

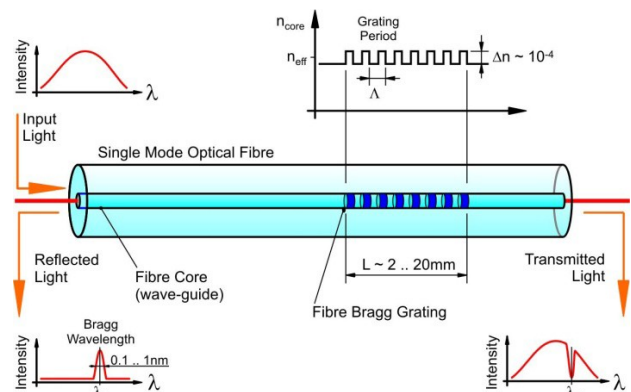


Fig. 1. A fibre Bragg grating (FBG) is a periodic structure inside the fibre's core which reflects only a specific wavelength of the input light.

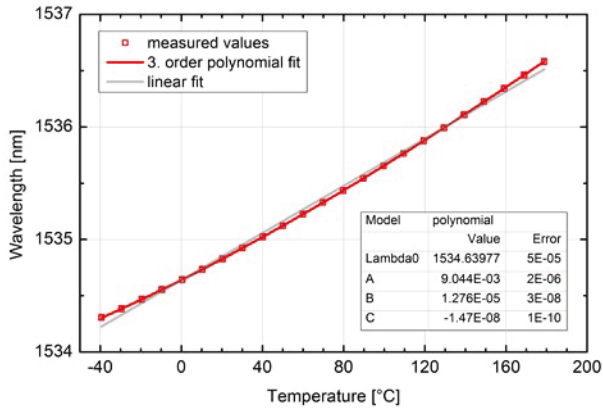


Fig. 2. Temperature characteristic of the Bragg wavelength of a Type I FBG between  $-40^{\circ}\text{C}$  and  $180^{\circ}\text{C}$ . A third order polynomial fit was used to describe the temperature dependence of an FBG.

the Bragg wavelength. In fact, not only the grating period changes with temperature and strain, but also the refractive index  $n_{eff}$  is sensitive to these environmental factors.

The grating period  $\Lambda$  and the refractive index  $n_{eff}$  depend linearly on strain. So, there is direct proportionality between the applied strain  $\varepsilon$  on the fibre and the change in Bragg wavelength  $\Delta\lambda_B$ ,

$$\Delta\lambda_B = \lambda_B k \varepsilon \quad (2)$$

with  $k$  being the proportionality constant between strain and Bragg wavelength change  $\Delta\lambda_B$  [2, 3]. For different kinds of fibres, this constant is normally in a range of 0.78 to 0.8 [3]. It is smaller than one, due to the decrease of  $n_{eff}$  when the fibre is stretched.

For temperature variations  $\Delta T$ ,  $\Lambda$  changes linearly with  $\Delta T$  due to the thermal expansion of the fibre. However, the thermo-optic effect, which changes  $n_{eff}$  with temperature, is known to be non-linear. Therefore, to describe the temperature characteristic of  $\lambda_B$ , at large temperature intervals, (1) has been replaced by a Taylor series,

$$\lambda_B = \lambda_B(T_0) + A\Delta T + B\Delta T^2 + C\Delta T^3 \dots, \quad (3)$$

with  $A$ ,  $B$ ,  $C$ , being Taylor coefficients, which have to be determined by fitting (3) to experimental data. In Fig. 2, the measured Bragg wavelengths of an FBG at different temperatures are shown. To describe the temperature characteristic of an FBG in the range of  $-40^{\circ}\text{C}$  to  $180^{\circ}\text{C}$ , a third order polynomial fit (red line) is used. However, for less precise evaluations, a linear fit (grey line) can also be used which leads to a sensitivity of the FBG of about  $10 \frac{\text{pm}}{\text{K}}$ .

### B. Type I FBG fabrication

FBG formation in single mode optical fibres was first demonstrated by K. Hill et al. in 1978 [4]. In this experiment, an argon-ion laser at 488 nm was launched into a germanium-doped silica fibre. After several minutes, an increase in the reflected light intensity occurred, and increased further. A first transverse holographic method was applied by Meltz et al. [5], to

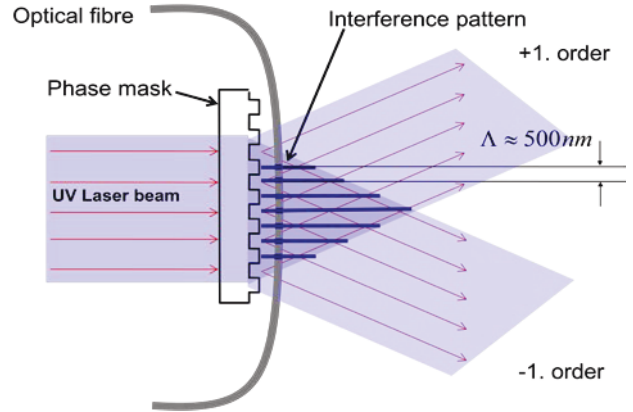


Fig. 3. Phase mask inscription technique for the fabrication of type I FBGs. In the overlap area of the  $-1$ . and  $+1$ . order beams, an interference pattern is formed and transferred into the fibre due to its photosensitivity.

fabricate gratings, whose period and bandwidth could be chosen independently. Meanwhile, a huge variety of laser sources and manufacturing techniques have been demonstrated for FBG fabrication [6]. The most common way to produce FBGs is to use a nanosecond excimer laser, such as the 248nm krypton fluoride (KrF) laser source. This type of laser, together with a phase mask technique [7], was employed here. Using this technique, the UV laser beam was diffracted in two directions ( $\pm 1$ . order), due to the structured surface of the phase mask (see Fig. 3). This formed an interference pattern of bright and dark fringes with a periodicity of about 500nm in the overlap area of the  $+1$  and  $-1$  diffraction order. The fibre was placed inside this pattern. By means of photosensitive processes, the pattern was transferred into the core of the fibre, forming a refractive index structure with the same periodicity as the interference pattern [8].

### C. Thermal stability of Type I FBGs

FBGs which are inscribed by photosensitive processes, as described in Chapter I.B, are so called Type I FBGs. At high temperatures (above approx.  $300^{\circ}\text{C}$ ), the reflectivity of these Type I FBGs decreases over time,

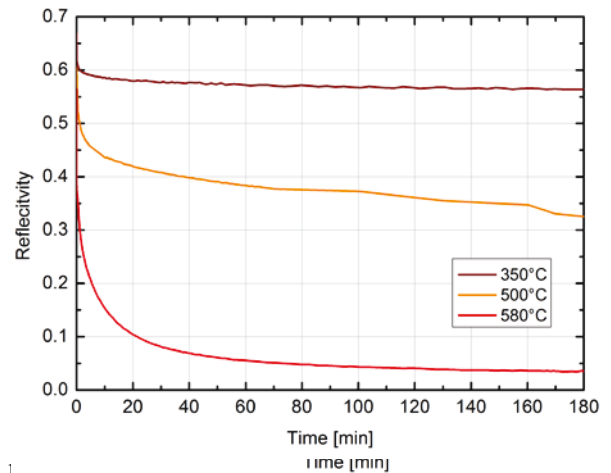


Fig. 4. Thermal decay behaviour of type I FBGs in a photosensitive GF1B optical fibre measured at different temperatures.

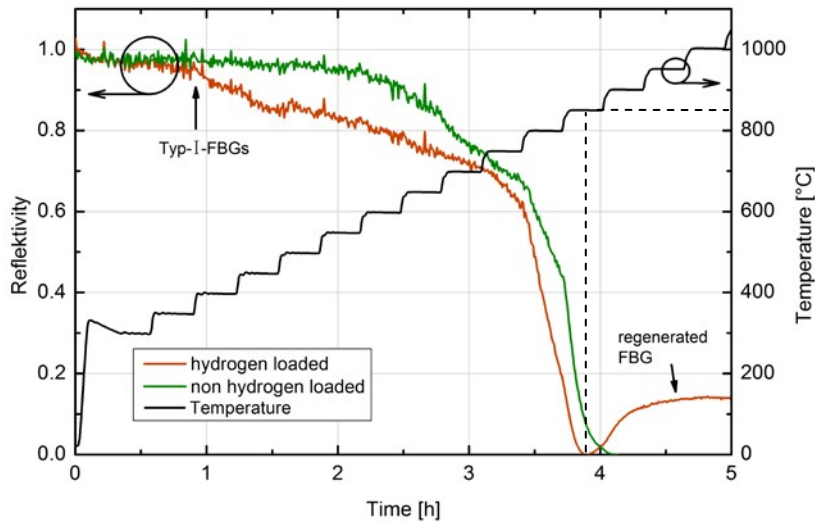


Fig. 5. Regenerated FBG made from a hydrogenated Type I FBG, by a slow thermal annealing process. In contrast, the non-hydrogenated FBG does not regenerate after its erasure at high temperature.

not thermally stable [1]. In Fig. 4, experimental results are shown for Type I FBGs, that were produced in the Photonics Laboratory of Munich University of Applied Science, and which were annealed at different temperatures. All gratings had a reflectivity of about 65% at the beginning of the experiment. During the annealing process at a constant temperature, the reflectivities of the FBGs showed a strong initial decay and ended up at lower reflectivities, which approached constant values later on. This stability after annealing is maintained for temperatures up to almost the annealing temperature [9]. This means that Type I FBGs can be thermally stabilized by a pre-annealing process, which makes them, to a certain extent, usable as sensors at elevated temperatures. Nevertheless, for operating temperatures above 500°C, a pre-annealing process is difficult, because the Type I FBG will become very weak and the sensor drift increases [10]. Therefore, for sensing tasks at very high temperatures, FBGs with improved thermal stability have to be used.

### III. EXPERIMENTS WITH REGENERATED FBGS

#### A. Hydrogen loading

Regenerated FBGs (RFBGs) were fabricated using hydrogenated Type I FBGs in combination with a thermal annealing process. For our experiments, this hydrogenation was achieved by storing the fibres in a high-pressure hydrogen atmosphere for several days. During this time, the hydrogen molecules diffused into the amorphous glass structure of the fibre. After the hydrogen loading, the fibres were taken out of the pressure chamber and a Type I FBG was inscribed as described in Chapter I.B.

The role of hydrogen loading for the regeneration process becomes apparent in Fig. 5, where the thermal decay behaviour of two FBGs inscribed in hydrogen loaded and non-hydrogen loaded fibre, respectively, is

compared. Both FBGs were slowly, stepwise heated to high temperatures. The reflectivity of the Type I FBG in the hydrogen-loaded fibre started to decay in a similar way as the Type I FBG in non-hydrogen loaded fibre. At very high temperatures, however, when the grating in non-hydrogenated fibre was totally erased (green curve), the reflectivity of the FBG in hydrogenated fibre (brown curve) increased again directly after its erasure. This effect of grating re-formation at high temperatures is referred to as the “regeneration” of the FBG. Actually, two theories explaining the formation of RFBGs are under discussion in the scientific literature. One is based on chemical reactions of hydrogen [11], the other is based on stress-dependent crystallisation [12] [13].

So, for the production of an RFBG, a hydrogenated Type I “seed grating” can be heated slowly to above the so-called regeneration temperature, at which the Type I FBG is erased and the RFBG is formed. After this thermal regeneration process, the RFBG is featured by its smaller, but stable reflectivity over the whole temperature range up to the regeneration temperature.

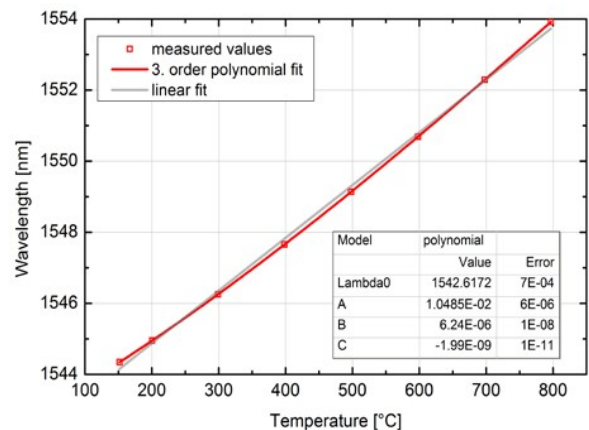


Fig. 6. Temperature characteristic of a regenerated FBG between 150°C and 800°C.

### B. Temperature characteristic

After regeneration, the reflectivity of the RFBG is stable, at least up to the regeneration temperature. Therefore the RFBG can be used as a sensor up to this temperature. In Fig. 6, the temperature dependence of a RFBG between 150°C and 800°C is shown. This measurement was performed in a high temperature furnace with good thermal stability and a calibrated reference thermocouple. The measurement points were taken during both the heating and the cooling cycle. No hysteresis or drift was observed. Also for the RFBG, a third order polynomial fit function was used, in order to describe the temperature characteristic. The linear coefficient was found to be similar to the Type I FBG (cf. Fig. 2). This means, that the RFBG shows a similar sensitivity than a Type I FBG.

### C. Regeneration in fibres with different germanium concentration

A comparison of the regeneration behaviour of two FBGs in fibres with different germanium concentration in their cores is shown in Fig. 7. The hydrogenated seed gratings with similar initial reflectivity had been annealed in a slow stepwise temperature profile (black line) similar to Fig. 5. For the experiment, a standard telecommunication fibre (blue) with 4% germanium and a highly doped fibre with 18% germanium (green) were used. The two FBGs reached their point of zero reflectivity at different temperatures. This indicates that the regeneration process starts, decreases with the amount of *Ge* inside the fibre, which was also observed by other researchers [14]. Also, the maximum reflectivity of the RFBG was reached at a lower temperature for the high-germanium doped fibre. The maximum attainable reflectivity of the RFBGs, in contrast, was similar for both kinds of fibres.

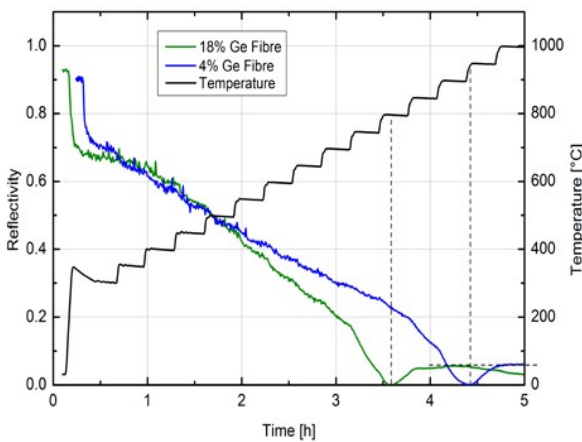


Fig. 7. Regeneration of FBGs in hydrogenated fibres with different concentrations of germanium.

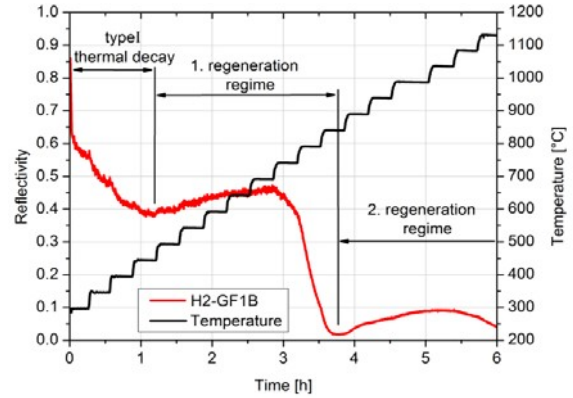


Fig. 8. FBG in a special hydrogenated GF1B fibre during regeneration. The FBG shows two regimes of regeneration.

### D. Fibre with two regeneration regimes

A thermal decay and regeneration behaviour, which is different to that of FBGs in fibres which are only doped with germanium, has been found for FBGs in a hydrogenated special GF1B fibre. This GF1B fibre has a complex inner structure with multiple dopant components (germanium, fluorine and phosphorus). The reflectivity evolution of an FBG in hydrogenated GF1B during a slow stepwise annealing profile (black line) is shown in Fig. 8. The reflectivity evolution of the FBG (red) shows a small, but clear increase at temperatures between 500°C and 700°C. This behaviour was interpreted as a first regeneration regime. Above 700°C, the gratings again started to decay up to 850°C. At 850°C the FBG started to regenerate for a second time, leading to a second regeneration regime. This was the first clear evidence for the existence of two regeneration regimes in special fibres [15] [16].

## VI. SENSOR APPLICATION

In real performance tests of aircraft engines, both the complete engine as well as selected parts of it, as for example a compressor stage, are instrumented with several hundred sensors, for detecting pressures, total temperatures, component temperatures and vibrations. The tests help to detect vulnerabilities in the performance of each component and are necessary for verification of computer model calculations. The quality of a performance test is often limited by the spatial resolution of the measurement sites. As there is limited space inside a turbine, the size of the sensor probes as well as the number and the diameters of the wires limit the number of sensors that can be installed and hence the spatial resolution of the measurements.

A very important parameter in testing the performance of a compressor stage of an aircraft engine is the total temperature (stagnation temperature), because it represents, together with the total pressure, the energy of

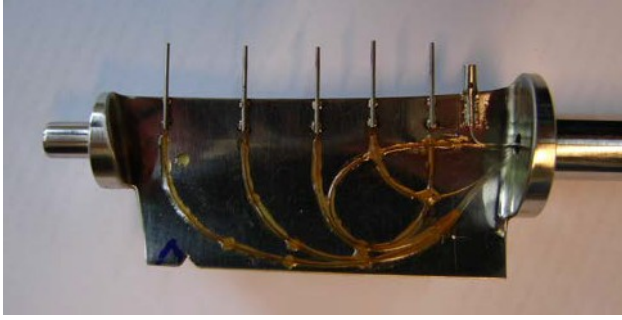


Fig. 9. Aircraft turbine vane instrumented with five FBG-based total temperature probes and one conventional thermocouple-based total temperature probe.

the air stream [17]. In each compressor stage, the air stream through the turbine is compressed, which leads to an increase in the temperature of the air stream. Thus temperatures of up to 900°C can be reached. Based on data of the total temperatures measured before and behind a compressor stage, the efficiency of the stage can be calculated from the energy of the stream, which is given by its total pressure and total temperature.

In Fig. 9, a preliminary model with applied FBG total temperature sensors on a turbine vane is shown. For this, an aircraft compressor vane was instrumented with five Type I FBG- and one thermocouple- (TC) total temperature probe [18]. The standard design for a total temperature probe consists of a temperature-sensing element, which is located inside a stagnation tube (see Fig. 10). Conventional TC-based total temperature probes have stagnation tubes with diameters of typically 2.0mm. Due to the small size of the FBG sensors, a stagnation tube with a diameter of only 0.7mm was realized. This means a reduction of the sensor cross-section area by a factor of eight. A smaller cross-section area will lead to less distortions of the air stream by the probe. For mounting the sensor fibre, a special technique was developed, to make sure that the sensor element is located centrally within the tube, without any contact to the tube wall. This is important to avoid any bias to the temperature measurement due to mechanical strain.

The applied total temperature probes were tested in an open jet test bench, where air was blown on the vane with streaming velocities of up to Mach 0.8. In this experiment, the Type I FBG-based transducers have shown their suitability for the use in such a high vibration environment. Similar experiments are planned with RFBG based total temperature probes.

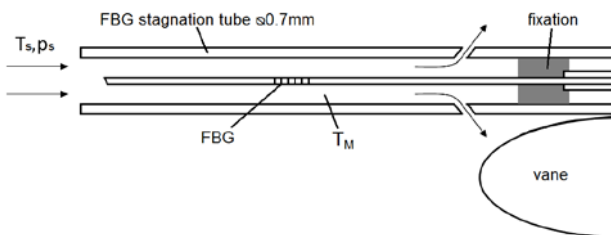


Fig. 10. Schematic of a FBG-based total temperature probe.

## VII. CONCLUSION

We produced and characterized RFBGs in different types of optical fibres. Our observations are in accordance with the known dependency of regeneration temperature on the content of germanium and the relation between seed grating strength and RFBG strength [14]. A special germanium, fluorine and phosphorus co-doped optical fibre showing a second regime of grating regeneration at lower temperatures was found. The temperature characteristic of the Bragg wavelength of an RFBG was measured without any hysteresis or drift. It shows a high sensitivity at higher temperatures, which makes the RFBG suitable as a temperature sensor for high temperatures.

RFBG sensors can show their advantages especially when a small sensor cross section, electromagnetic immunity or high multiplexing capabilities are required. They are therefore ideally suited for multipoint temperature distribution sensing applications in harsh environments with long wiring needs and small feed through, as in aircraft engine tests. Another obvious application of RFBGs is for gas turbine monitoring. The efficiency of a gas turbine increases with its operation temperature, which brings the existing materials to their limits. Cooling mechanisms must be applied and thermal insulation coatings protect blades and walls. In order to go closer to the thermal limits, it is necessary to measure the temperature distribution inside the turbine very accurately. This allows early recognition of heat leakage, which could be caused by cracked or damaged engine parts [19]. Arrays of RFBGs, for example, can be used to measure the complete circumferential temperature distribution in the exhaust stream of the turbine [20]. However, for the use in a harsh industrial environment, specific packaging solutions have to be developed.

## ACKNOWLEDGMENT

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# Simply Asking? - How to evaluate educational treatment for employee environmental behavior in work settings

D. Kühner<sup>1</sup>

<sup>1</sup> Faculty for Applied Social Sciences, University of Applied Sciences, Munich, Germany  
(kuehner@hm.edu)

*Abstract* - Fostering environmental performance in companies has long-since been an issue for management or environmental departments, yet – especially in the manufacturing industry – was mainly achieved through technical developments. During recent years, acknowledging social factors like employee environmental behavior is starting to gain importance. In this paper, I draw attention to the development and evaluation of employees' necessary competencies to improve environmentally sustainable behavior at work. Unfortunately, theoretically sound and transparent methods evaluating this development in work settings like manufacturing companies are not yet available. Therefore, a new concept as part of a quantitative survey is brought forward. After introducing the notion of experience-based subjectifying work as theoretical concept for an intervention the development of a general evaluation concept is proposed. Then, following an extensive review of literature, a theoretical model for environmental behavior in work settings is suggested.

*Keywords* – environmental behavior, environmental concern, evaluation, manufacturing industry

## I. INTRODUCTION<sup>1</sup>

According to the Federal Statistical Office about 20% of Germany's CO<sub>2</sub> emissions can be accounted for by the manufacturing industry, just as much as the accumulated emissions of all German households<sup>2</sup>. It is obvious that there is a huge potential for resource efficiency gains at the end of consumer good production.

Yet, few years ago it seemed like a paradox: Manufacturing industries looking for more sustainable ways of production [2]. This has changed quite a bit, obviously due to heavily increased resource prices but also to environmental concern in the public sphere. The need for more sustainable solutions has also become apparent for manufacturing companies.

Naturally, many attempts to reduce energy consumption in companies have been concerned with technical possibilities to promote energy savings. In

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<sup>2</sup> Raw data by [1], further calculation by DK.

Germany we find quite a few initiatives fostering technical development for example the Innovationsplattform Effizienzfabrik ([www.effizienzfabrik.de](http://www.effizienzfabrik.de)), the Mittelstandsinitiative Energiewende ([www.mittelstand-energiewende.de](http://www.mittelstand-energiewende.de)) or the Blue Competence-Initiative ([www.bluecompetence.net](http://www.bluecompetence.net)) to name but a few. Less has been done fostering pro-active behavior in companies. One obvious reason for this can be found in the difficulties in accounting resource efficiency to employee behavior. Yet, integrating employee environmental behavior can add significantly to resource reduction as has already been investigated during the mid-90s [3].

In our research project ProNaK we are decisively interested in those potentials of employees in manufacturing companies to cut down resource wastage. In the next section I will therefore describe the theoretical approach for so called experience-based subjectifying work that builds a foundation for the qualification of employees in ProNaK.

## II. FOSTERING SUSTAINABLE BEHAVIOR IN THE WORK PLACE

Looking at ways to foster sustainable behavior at work we find this mostly to be the duty of management or environmental departments [4]. On this level, it is assumed, appropriate steps can be taken most efficiently. Therefore, we find a considerable amount of manuals, guides and even courses for managing sustainability in companies addressing this target group, cf. [5]–[9].

To unlock another potential in manufacturing companies we opt for a rather different approach. That is, addressing manufacturing employees and their competencies at the shop floor to let them act in an environmentally concerned way.

There is some literature considering changes on employees' behavior, partly stemming from the question how to make people in general act more environmentally friendly. I will shortly introduce two commonly referred ways and afterwards try to describe a third alternative in more detail.

One widely used possibility is advertising certain behavior and therefore making it more aware. This can be done by information campaigns – a preferred method because of its ability to address a wide audience at low cost. Campaigns and trainings made to enhance environmental knowledge is for example encouraged by

Kaiser, Roczen, and colleagues [10]. They differentiate system knowledge, action-related knowledge and effectiveness knowledge, stating a lack of knowledge in German society, especially regarding knowledge effectiveness, cf. [11]. Though this lack can be conceded it is problematic to conclude a direct link between environmental knowledge and environmental behavior. In fact, environmental scientists find a so called knowledge behavior gap indicating that building up objective environmental knowledge is at least not sufficient for fostering environmental behavior [11]–[14]<sup>3</sup>. Yet, it might not even be necessary to know much about environmental coherences.

Another approach, that is looking at behavioral change from a different angle is stating that people don't need to know much about why they should change their habits, i.e. concerning resource wastage, once the surrounding organization of things is driving them towards more sustainable behavior cf. [15]. For example, deciding to not install air-conditioning in a building while at the same time loosening dress code restrictions can be a useful way to change employees' behavior wearing a short-sleeved shirt instead of regulating room temperature.

The first approach is heavily focusing on the creation of new knowledge and trying to open the so-called "black box" of behavioral effects in the workplace. The other one tries to leave the black box as it is but rather focuses on why certain daily routines that are obviously not sustainable have been established and how an organizational form can be changed so that routines change naturally towards a more environmentally friendly way of acting.

In ProNaK, we draw from a third position that is not so much focusing on objective knowledge, still it is fostering individual knowledge at the level of the workers at shop floor level. We need to account for experience-based subjectifying work (EBSW). This notion was brought up by Böhle cf. [16]–[18] in an attempt to promote the importance of individual experiences for work-related behavior.

#### A. Subjectifying Ways of Acting

This approach argues that all senses are activated by working and take part in shaping a concept of the structured interactions between environment and worker. Four dimensions can be differentiated: (1) Sensual perception of the environment, (2) interconnectedness to the environment, (3) dialogical dealing with the environment, and (4) the role of emotions in acting with environment cf. [16, p. 25ff.].

To understand the idea we will examine the approach more closely in the following paragraphs. (1) Sensual

perception includes a holistic concept that incorporates various senses. It is embedded in the human body through which senses are enacted. The body is therefore linking subject and environment, forming a unity between those entities. This is possible because environment is experienced through the interacting body as an extension of the body itself. Through sensing so called intuitions with and through one's body the environment is not perceived as alien and external, but the body and therefore the subject with its senses is acknowledged as part of the environment and taking part in it. Hence, recognizing features of the environment is a highly subjective process dependent on the intuitions perceived. Those again are dependent on the way the body participates with the environment.

(2) The connectedness between subject and environment is a result from the conjunction of body, nous, and intuition mediated by the latter cf. [16, p. 28]. But in which way can this interconnectedness be understood? Acting is aligned to merge subject and environment by synchronization cf. [16, p. 28]. Essentially that means environment being anthropomorphized: In subjective acting those aspects gain relevance that are important for the subject with its experiences, those the subject can connect to. Recognizing the environment is always mediated through personal experiences, interests etc. which mainly are not consciously responsive but accessible via intuitions.

(3) The result of this interconnected process is elusive at the beginning with regard to its outcomes. Since both, subject and environment, are to be seen as complex entities the actual relationship between both is constantly reshaped, processes are developing in the course of events. The acting person is influencing its environment by embarking on the reactions of it cf. [16, p. 32].

(4) Finally, these dialogic dealings with environment foster the development of dispositions. Those are understood as schemata organizing actions and cognitions (i.e. appraisals, estimates and perceptions) on a usually unconscious and therefore uncontrolled and unobjectified level.

#### B. Contextualization and Implications

The depicted illustration highlights some of the key aspects of EBSW. It is considered to be on one pole while objective ways of acting are assumed to be standing on the other end. Subjective and objective knowledge are both considered to be important in work settings. Yet for the most part, subjectifying knowledge and acting is not prominently addressed at work. The same is true if we look at the strategies used to promote environmental behavior in work settings. Many implementations in work settings use objectified instructions on how to behave. Those instructions are couched either by management or environmental departments mainly omitting experiences and intuitions of shop floor employees that are dealing with the machines, with the environment that is causing wastage. In fact, one can assume that knowledge doesn't

<sup>3</sup> For certain samples explained variance in environmental behavior can be higher than the usual 5% [15]. This might especially hold for samples that are used to traditional knowledge acquisition, i.e. students.

imply being motivated and able to connect to a specific idea. Exactly this is being an important part of subjectified experiences. The essence of subjectifying aspects of the environment is establishing personal meaning to it and therefore being concerned not only in a rational but also emotional way.

Before, I also mentioned another way of addressing environmental behavior, that is not trying to open the black box of complex interstices between knowledge, motivations, and behavior, but trying to work a way around it via consideration of structures in the social, technical, and natural environment. Therefore one should analyze different organizational and technical structures that relate to different modes of wasteful behavior. It is important to incorporate experiences of workers considering the technical environment of the shop floor as well as socially relevant procedures. Thus, the analysis of organizational structures in work settings as well as their experienced characteristics on the shop floor has been one of the major concerns in EBSW.

In sum, for ProNaK we therefore propose to analyze the subjectifying interrelations between employees on the shop floor and their actual work environment and develop an educational intervention to establish environmentally sustainable interconnections between workers and their environment at work.

Yet, apart from the effective embodiment of those abstract notions, we find several other problems that still exist considering sustainable behavior in private life as well as at the work place.

First, technical upgrades are more transparent in their potential resource conservation. Providing trainings and advertising environmental behavior is empirically not linked directly towards actual behavioral change. Thus, even if such an intervention might be intuitively effective, there is still some monitoring to come to prove its validity. Second and connected with this first argument, evaluating new machines is easier than evaluating change in employees' behavior. The following section will therefore describe a concept to link energy savings to changes in employees' environmental concern and their behavior.

### III. EVALUATION

To evaluate an educational intervention we must consider measures of outcomes and dependent variables being influenced by the intervention. In addition, we need to test whether it was the proposed intervention that brought about a change in behavior as well as a change in emissions or another external factor beyond the influence of this educational approach. It has to be stated that this is a rather difficult endeavor. As Boiral [19] points out evaluating employee involvement "...and the precise organizational changes that caused them were difficult to identify, measure and foresee" [19, p. 339].

I suggest a triangulation of several measures that are brought together. The aim of triangulation is gaining data

from different perspectives to enrich the results of each other. Nevertheless it is necessary to look at the measures individually in more detail and show their strengths as well as their weaknesses. Afterwards, I want to look at some general facets of evaluating behavior in work settings.

What is tried to be established during the educational intervention is supporting participants in accomplishing competencies they need for environmental behavior<sup>4</sup>. To evaluate this we use two groups that are being studied, an intervention group as well as a control group. These focused groups will be a certain department at the shop floor in a factory to assure comparability. I will accompany workers that are taking part in the intervention by joining and observing the intervention workshops. Additionally there will be qualitative interviews after the workshop period. Thus, it will be possible to analyze changes that can be observed during and after the intervention period. This analysis of developments is a commonly used way to study the contribution of employees on an organizational level [20]–[22] although generally accomplished in a less detailed manner.

During aforementioned workshops participants are supposed to develop their own exploration projects. Those projects can then be estimated for their resource reduction it has brought about. With this data we will be able to directly relate their activities to measures such as estimates of energy consumption. We will obtain a first qualitative impression about what is possible with using an approach based on EBSW.

Yet, this first glance needs to be enhanced. In a quantitative approach we will use a questionnaire to test workers before and after the intervention and find out more about their resources and concern to act environmentally friendly. Thus, it will be possible to decide whether the intervention does have any effect on those aspects.

In a second step the educational intervention will be transferred to a wider audience in the manufacturing site. At the same time, the questionnaire addressing dispositions towards environmental concern and personal resources to act environmentally friendly will be applied to the manufacturing site as a whole. Thus, it will be possible to assure the effect on individual behavior for other departments. Resource consumption can then be extrapolated from the results of the smaller group in the beginning.

Monitoring total resource output would be another option to evaluate changes. Yet, there are too many factors inside manufacturing sites that are an obstacle to this strategy.

I already mentioned several aspects that should be considered in more detail at this point because they highlight important set screws in an evaluation. First of all, it is not possible to make any claims about effectivity of an intervention without knowing the difference

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<sup>4</sup> We will look at those competencies in more detail in chapter IV.

between states of behavior before and after an intervention. Yet, it is obvious that there are various ways why behavioral change could be recognized. Controlling influential factors isn't possible in every situation, especially not during investigation of a manufacturing site longing for optimal production piece output. It would be preferable to relate the intervention group to several other groups, for example one without any intervention as well as others obtaining different intervention modes to decide which intervention might be most effective. In our case it is possible to compare an intervention group to a control group consisting of workers coming from the same department. It can be assumed that both groups will communicate with each other. Yet we neither have the possibility of comparable departments that might be related to each other, nor do we have the resources to conduct different educational intervention forms. Nevertheless, relating department groups to their own former performance will be a good option to receive an acceptable comparison.

But what are important resources that are influencing environmental behavior in work settings altogether? To be able to propose a questionnaire evaluating environmental behavior and its necessary resources we need to look at ways this has been operationalized. To do this the remaining chapters will consist of an extensive review of studies addressing environmental concern and environmental behavior as well as the proposition of a theoretical model as a point of reference.

#### IV. REVIEWING ENVIRONMENTAL BEHAVIOR SURVEYS

The aim of a questionnaire looking at effects of an intervention method could be looking at specific behavioral aspects that might have changed at work. However, showing environmental behavior, understood as ways to act more resource friendly, saving energy and other resources, or implementing ideas for more efficient work processes seem to be not the only important aspects when deciding for the effectiveness of an intervention. Environmental scientists therefore started to look at other dimensions – wrapped up under the notion of environmental concern – that can be understood as important prerequisites for showing environmental behavior. Another strand of research focuses on resources or competencies that are necessary to show environmental behavior.

Thus, the next paragraphs will discuss different ways to ask for necessary environmental competencies, and it will look at the linkages made between the notion of environmental concern and environmental behavior. As stated before, there is no focus on employees' environmental behavior at work. Therefore, the following review will concentrate on general environmental behavior, mainly studied for private households. If available, further results regarding work environments are included.

I will then argue for a theoretical model that incorporates the most important dimensions derived from this literature.

##### A. *General Environmental Concern and environmental behavior*

Environmental concern has been studied first in the USA, later the concept also made its way to Europe. In a widely accepted definition by Dunlap and Jones "...environmental concern refers to the degree to which people are aware of problems regarding the environment and support efforts to solve them and/or indicate a willingness to contribute personally to their solution"[23, p. 485]. According to those authors there is a vast number of operationalizations, yet most of them adhoc and atheoretical cf. [23, p. 482].

An early and commonly known systematic approach was conducted by Maloney and Ward [24] (i.e. cited in [23, p. 43]) with four different scales: knowledge, affectual dimension (emotional concern), verbal commitment (intention), and actual commitment as environmental behavior<sup>5</sup>. Many instruments took the conception of this starting point and constructed items for at least three different dimensions: cognitive, conative and affective components are assumed to be combined when speaking of environmental concern. Cognitive components comprise knowledge as well as beliefs and norms cf. [23, p. 490]. Affective components ask for personal feelings in relation to environmental problems [ibid.]. Conative components comprise aspects of actual behavioral expressions.

Most studies use multiple topics to ask for environmental concern. One topic may be recycling, another energy consumption etc. Those various topics can cause problems. For example, an item considering the intention to use more public transport might not be correlated at all to the question, whether one intends to isolate the roof of one's private residential building, let alone whether one has already done that.<sup>6</sup> From this point of view we cannot assume an underlying concept of environmental concern.

Schahn [27] addresses the issue of confounding dimensions by using items for one environmental topic for each of his four scales (knowledge, affect, verbal commitment, actual commitment). Thus, topics are evenly spread across conceptual dimensions. This systematic approach can be used for environmental topics. Yet, this can add up to a rather big questionnaire. Schahn proposes an instrument taking up to 45 minutes [27, p. 10].

Another proposal is brought forward by Kaiser and colleagues [28]–[30], that is assuming motivation for and

<sup>5</sup> Amelang [25] (cited in [26, p. 45]) made it available in German.

<sup>6</sup> In addition, underneath a general topic there are more specific subtopics like recycling of paper vs. recycling glass. Even those yield different results both on an intentional level and a behavioral level.

attitudes towards environmental behavior as a function of actual environmental behavior<sup>7</sup>. So looking at conservational behavior they conceptualize conservation performance as goal directed behavior which is favorable if it is less demanding, for example in terms of time, money, and effort spent.

“In turn (...) the popularity of a behavior is anticipated to be a function of two components: (a) the disposition (or motivation) to act conservationally and (b) the composite of all the costs involved in the performance of a particular act. To date, research has unanimously found that, with these constituents, even seemingly diverse acts such as glass recycling and ownership of private solar panels belong to one behavioral class” [32, p. 62].

Thus, the more a person is acting environmentally friendly the more it is assumed she is motivated (and thus concerned). Using a multidimensional extension of the Rasch model Kaiser and Wilson [30] are able to evaluate the difficulty of different items and therefore different levels of motivations on an individual level leading towards a general idea of environmental motivation or concern.

This does sound promising, indeed. It would mean that environmental concern can indeed be derived from every aspect of environmental behavior. Furthermore, it is not problematic but favorable to include different aspects of environmental behavior. We just need to include different levels of difficulty concerning the behavior being shown.

Yet, one assumption of Rasch-type models is that difficulties in modes of behavior should be the same for every person it is applied to. Unfortunately, it doesn't seem plausible to assume this being the case. At least it seems rather unlikely that the statement “I bought solar panels to produce energy” is going to be equally difficult to achieve for a manager owning his own home vs. an unemployed person who is happy to get by with the money she got. Looking at the shop floor level at manufacturing sites we are confronted with different roles and work places, different leeways and responsibilities, making it obvious that we cannot assume the same base-difficulty for specific modes of action. Thus, it still will be necessary to ask for environmental concern.

Another option would be using general statements when asking for environmental concern. Hence it is possible to include and compare people with different backgrounds and resources. However, reliable and valid formulation of statements is essential in this case. This is one reason why many studies investigating environmental concern yield different results. Applying verified questionnaires that have been tested by confirmatory factor analysis and been replicated can help in solving those issues. Questionnaires like the one used by Maloney and Ward or the New Environmental Paradigm (NEP)

[33], [34] use very general items. Yet one needs to be careful, since environmental issues have been changing over the last decades due to technical and knowledge development<sup>8</sup>.

I conclude, following [36], it is useful to rely on a basis of general but well confirmed items that need to be enriched by more specific aspects according to the particular work context employees are dealing with. Those items need to be carefully constructed, appropriately to theoretically assumed factors.

For the general part I propose using items constructed by Diekmann and Preisendörfer [37] for a German questionnaire. Up to 2006, the scale was also used for the Umweltbewusstseinstudie, a biannual representative survey in Germany that is looking at environmental behavior in private households [38]–[43]<sup>9</sup>. Some items have also been used in the 2010 wave of the International Social Science Panel.

Besides the general level of environmental concern it is necessary to look at another strand of research dealing with assumed necessary competencies for showing such behavior. I will discuss them in the next section before bridging to a more detailed review of some of the most commonly used theoretically derived models considering determinants for environmental behavior in and beyond work settings.

#### *B. Competencies in education for sustainable development and sustainable economic activity*

In a first step I introduce dimensions stemming from literature about education for sustainable development. From there, I will proceed to competence dimensions explicitly addressing work settings.

Education for sustainable development has especially been brought into focus during the United Nations' World Decade of Education for Sustainable Development being proclaimed from 2005-2014. Important skills that are included into this notion are systemic and critical thinking as well as ability to participate and decision-making competencies. In context of school education in Germany, those aspects have been systematically and most prominently elaborated by de Haan with his colleagues cf. [47]–[50]. They take a rather different approach than the concepts we looked at so far. Most importantly they refer to less specific mental resources than what I addressed before. The idea relies on the more general concept of competencies. Following Weinert competencies can be defined as

“...bei Individuen verfügbaren oder durch sie erlernbaren kognitiven Fähigkeiten und Fertigkeiten, um bestimmte Probleme zu lösen sowie die damit

<sup>8</sup> This was the reason why NEP got introduced [35].

<sup>9</sup> The items changed considerably when there was a shift by the realizing scientific institution, leaving more general items aside in favor of different dimensions of specific actions [44]–[46].

<sup>7</sup> This is termed Campbell paradigm [31, p. 10].

verbundenen motivationalen, volitionalen und sozialen Bereitschaften und Fähigkeiten, um die Problemlösungen in variablen Situationen erfolgreich und verantwortungsvoll nutzen zu können.”[39, p. 27f.]

De Haan envisions a central competence for sustainable development called Gestaltungskompetenz [47], [50]. It comprises ten sub-competencies ranging from “being open and developing knowledge by integrating new perspectives” [50, p. 32] to “being able to motivate oneself becoming active” [ibid.]. Those competencies do have the advantage of being able to catch situational unspecific aspects of environmental behavior determinants. In this regard they are specifically interesting for accounts like the one proposing EBSW. Here it is also stated that actions are only substantiated in a specific situation. What is encouraged is the resource availability in general, so that a person can act according to those resources in a specific situation.

Schlömer builds on the concept of competencies for sustainable development and puts it into the context of economic behavior [52] (for a summary cf. [53]). Building on a qualitative study with employees and executives at a manufacturing site producing plastic pipes he establishes a model of eight different competencies necessary in work settings [52, p. 98ff.]: Gestaltungskompetenz (interpreted as implementation of one’s own ideas and concepts in professional acting), methodical competence (this enables strategically and goal-oriented implementation of knowledge and beliefs), professional expertise, competence to abstract (i.e. contextualized knowledge to transfer it to a general mental model), social competence (ability to interact in a social environment), and last but not least moral-ethical competence (addressing social equality, fairness, solidarity etc.). Those competencies are linked which means they depend on and influence the development of each other.

We can see that this approach comprises a lot of different indicators influencing sustainable behavior in work settings. Yet, it hasn’t been fully operationalized in a standardized instrument.

A general model to do this has been established by Erpenbeck and Rosenstiel with an instrument called KODE®[54]. KODE® is based on the conflict between qualification and competence in educational science as well as in companies [55], [56]. Competencies, understood as dispositions to willingly and intentionally act in a self-organized manner in complex situations [55, p. 119], are growing more and more important especially at work. Employees are supposed to react in a complex environment facing new situations. With classic concepts of qualification and explicit knowledge this is not achievable. KODE® is an evaluation tool to measure competence gains in companies on an individual level. It is composed of four different dimensions: social and communication competence, personal competence, professional competence, and action competence [57, p.

115]. Within each dimension there are 16 particular competencies that can be accounted to it. Each competence is operationalized with specific items. Commonly the tool is used in the economic sector. Thus, say, if the management of a company knows which competencies are most important for a job position they can use exactly those items to find the person most suitable according to KODE® and KODE®X which is a tool for tailoring competence combinations. Yet, both instruments are also used in universities to analyze merits and flaws of students and being able to adequately train them [6], [57]. Unfortunately, since items are not publicly available they cannot be tested by independent scientists for reliability and validity of items.

Nevertheless the tool has been brought into action, especially in terms of evaluating sustainable competencies: Grothe and Fröbel implemented it for evaluating students’ competence gain in lectures [6], [58], looking at increased disposition for Gestaltungskompetenz. In manufacturing environments they tried to establish the same evaluation scheme, partly building on theoretical aspects of aforementioned authors like Klemisch [59], [53], and Schlömer [52] while enriching it with pieces of advice by employee representatives that were to be trained [60]. It has to be mentioned that KODE® items have not been changed towards a more environmentally specific context. That means general competencies that are supposed to be important for sustainable acting are evaluated. Unfortunately, reported data has been rather scarce. In fact, only two employee representatives have been evaluated after the training which doesn’t say anything about its use in evaluating [60, p. 42].

In addition, Kaiser, Roczen and Bogner point out two theoretically and empirically significant aspects as a critique against general competencies [32, p. 61]: (1) general competencies can be taught or learned in various domains. From the perspective of an educational intervention it is unclear where possible competence gains might stem from. Even more important (2), since it is a general indicator it is more distant to actual environmental behavior. In consequence, measuring influences of general resources like aforementioned competencies is more difficult since they are mediated through other variables. Therefore

“... none of the general, ecology-unspecific abilities of modern environmental education has to date been found to be particularly behavior-relevant in terms of proportions of explained variance, at least to our knowledge. In other words, despite their theoretical plausibility, there is hardly any evidence that strongly links ecology-unspecific abilities to the ultimate real-life attainment of environmental education, being overall conservation behavior.” [ibid.]

This criticism also holds true for quite a few other recent models trying to utilize more general resources, i.e. [61]. However, I don’t suggest abandoning the notion of

competencies altogether. Instead, I believe it is necessary to use environmental instantiations as an indicative of underlying competency dimensions. We will see that it is possible to find items that are already usable as plausible indicators in the next sections.

### C. *Theory of planned behavior, norm-activation theory and model of action phases*

Theoretically derived models addressing environmental behavior can lead us towards determinants that are important indicators to recognize effects of an intervention method. In addition, those determinants might be included into a questionnaire as indicators of underlying competencies. Finally, the generality of a theoretical model leaves space for appropriate instantiations in specific areas, i.e. the work setting in manufacturing sites. Yet, we can still assume to use the most important variables according to recent scientific knowledge.

There are three main concepts I want to describe briefly: theory of planned behavior, norm-activation theory and the model of action phases that lately have been integrated into a model to test impact of intervention methods by Bamberg [62].

Theory of planned behavior supposes behaviors to be mainly driven by an intention towards that behavior which in turn is driven by attitudes towards a certain behavior or assumed outcome [63]. Those attitudes cover three dimensions of beliefs: behavioral beliefs, normative beliefs and control beliefs, comprising self-efficacy and perceived behavioral control [ibid.]. In fact, control beliefs are not only mediating behavior via influencing intention, but also directly influences behavior. Following Ajzen the concept of perceived behavioral control aims at dealing “with situations in which people may lack complete volitional control over the behavior of interest” [64, p. 666]. Self-efficacy in turn can be understood as “people’s beliefs about their capabilities to exercise control over their own level of functioning and over events that affect their lives” [65, p. 257] quoted from [64, p. 667]. Thus, self-efficacy is rather concerned with individual capabilities while behavioral control is also focusing on external factors outside the individual. Both aspects influence building of intentions. Explained variance for behavior by intention ranges from 19-27% [63], [66]–[68].

Another important strand of research is centered around personal norms and altruistic or prosocial behavior – norm-activation theory and, enhancing it, the value-belief-norm framework [69]. In this perspective, personal norms are defined by three beliefs: ecological worldview, awareness of consequences of an action, and self-ascribed responsibility [69], [14], [70]. Environmentally-relevant values are influencing ecological worldview which in turn influences awareness of consequences of one’s behavior. This leads to self-ascribed responsibility and in turn fosters environmental behavior. The model explains

comparable amounts of variance in environmental behavior [70] as does the theory of planned behavior.

Bamberg integrates both accounts in an attempt to explain car use [62]. In addition, he assumes different stages that people have to pass from establishing environmental goal intentions to actual behavior. In essence, he supposes four different stages: goal intention, behavioral intention, implementation intention, and finally new behavior. Each stage has to be passed one after the other to finally end in environmentally friendly behavior. The first two stages are assumed to be influenced by factors incorporated in theory of planned behavior and norm-activation theory. The model was tested with a standardized questionnaire addressing intention of reducing motor car use. The integration of both theoretical concepts yielded high explained variance of goal intention ( $R^2=.78$ ) and behavioral intention (.62), yet, only 12% of variance in actual behavior could be accounted for by the model, and there is no correlation between implementation intention and car use (there is only an influence of perceived behavioral control). Reason for this, according to Bamberg, is the fact that the current level of behavior is tested in a cross-sectional design. Since the theoretical concept is assuming several stages in an individual the used design can only be seen as a first step. Longitudinal studies need to be accomplished with people questioned several times to be able to make a distinctive judgment.

Another survey integrating factors from different previous models and also working with a stage model is the sustainability barometer conducted on behalf of Greenpeace [71]. Three stages are defined: (1) a motivational stage, incorporating attitudes, coping-style and problem awareness, (2) an intentional stage with items addressing self-efficacy and control beliefs, finally (3) a volitional dimension about types of engagement and participation. This survey has only been conducted for younger people, again as a cross-sectional study. Explained variance for volitional stage is yet quite a bit higher with about 19%. A replication hasn’t been performed yet.

### D. *Conversion to the context of work environment*

Looking at organizational settings at work norms seem to gain importance compared to private life, especially social norms assuming the importance of corporate values for environmental behavior [72]. Andersson therefore proposes to adapt the norm-activation framework by combining personal beliefs with beliefs about the corporation [ibid.], similarly [60].

In a growing literature about environmental activity in work settings Lo et al. [4] review further determinants for individual environmental behavior in organizations. Yet again, attitudes towards pro-environmental intentions and personal norms are being major factors. Effect sizes are varying which is not surprising, as do the items of the reviewed studies. However, it seems reasonable to

presume the importance of those factors also in work settings.

Another perspective linking environmental behavior and work settings can be found in an approach called “organizational citizenship behavior” (OCB), brought forward by Organ and his colleagues [74], [75]. This kind of behavior is not explicitly expected by the company, yet, it is necessary to keep processes running smoothly. Sometimes the knowledge working in the background is referred to by the notion of tacit, or personal knowledge [76], [77]. This kind of knowledge can hardly be explicated in instructions or manuals and is therefore bound to be used by employees on a voluntary basis. It is subjective since it is derived from practical experiences with the surrounding. Finally, it is known to be an important resource in the context of environmental behavior at work. Boiral conducted a qualitative study that revealed three main aspects of tacit knowledge helping to solve environmental issues by workers: “the identification of pollution sources, the [environmentally concerned] management of emergency [i.e. spills] and the development of preventive solutions” [77, p. 291].

In order to distinguish important organizational facets Boiral and Paillé identified three main types of organizational citizenship behavior for the environment (OCBE): (1) employee-driven pro-environmental initiatives, focusing on a pro-active role of employees, (2) eco-civic engagement, focusing on the commitment for company’s values, and (3) eco-helping, focusing on support for other members of the company [22]. Paillé and colleagues [78], [79] also found several antecedents that are stimulating OCBE in work settings. These antecedents such as perceived organizational support or commitment to the organization can be acknowledged as part of the perceived organizational structure in a company.

The findings fit very well with the results brought forward by Schlömer in section B, in particular reflecting the importance of Gestaltungskompetenz and social competencies in work settings. Helping colleagues and convincing them of the importance for environmental behavior draws on social competencies, taking a pro-active role in initiatives draws on Gestaltungskompetenz. Thus, I suppose some OCBEs and its antecedents can play an important role as an indicative of underlying competency dimensions and thus internal resources for environmental behavior that can be influenced by an intervention.

#### *E. Suggesting a new concept for environmental behavior surveys in industrial work settings*

To include the different aspects reviewed I propose the model shown in figure 1. This model should be understood as an attempt to integrate factors that can be regarded as important constituents for showing environmental behavior. Although many of the above models in section C and D have been (more or less successfully) put to a test, this one is not supposed to be

conceived as an instrument that is going to be tested or falsified. Rather it should be used to cut through the thicket of antecedents for environmental behavior applying a special focus on work settings. However, it remains too complex to be used as a falsifiable model. In fact, not all of the antecedents outlined can or need to be addressed by a single intervention; consequently, not all of them will need to be evaluated. Nonetheless, the model will be able to give an overview over important influences for potential interventions derived from already proven significant impact factors.

The model is deduced from stage models as the ones in [62], [71]. Compared to Bamberg’s approach it has been simplified: there are only three stages – motivation, intention and volition.

*Motivational stage:* As has been suggested in the norm-activation framework sensitizing for consequences of actions as well as one’s own behavioral responsibility will be important to build up a personal norm. Social norms, on the other hand, will be most important in a work setting. Following [73] the commitment for a company is mediating the strength of social norms for environmental behavior (i.e. energy saving) in work settings.

*Intentional stage:* Personal norm not only motivates for environmental concern but also shapes attitudes towards intentional environmental behavior (i.e. the attitude towards saving energy at work by switching of stand-by at machines). In this stage we also have to include perceived behavioral control (i.e. over the execution of work routines) and self-efficacy. I argue that perceived behavioral control is affected by organizational support a person receives at work. This is also an important determinant for OCBEs. However, it seems reasonable to assume mediation by perceived behavioral control during intentional stage. Both factors – perceived behavioral control and self-efficacy – will also directly influence environmental behavior.

*Behavioral stage:* Looking at the last stage I propose to distinguish two different areas of environmental behavior at work. On the one side, environmental behavior can be operationalized via EBSW directed at environmental behavior. Boiral’s findings concerning tacit knowledge can be used as a starting point. On the other side it will also be important to ask for OCBEs since they can be used as indicative for making use of internal resources such as social competencies and Gestaltungskompetenz. Finally, I assume OCBEs will show an effect on perceived organizational support as helping others in the organization with environmental actions is going to be affecting the organizational culture (indicated by dashed arrow in figure 1).

## V. DISCUSSION

Some aspects of the model should be highlighted here: By incorporating different approaches like norm-activation and theory of planned behavior the most



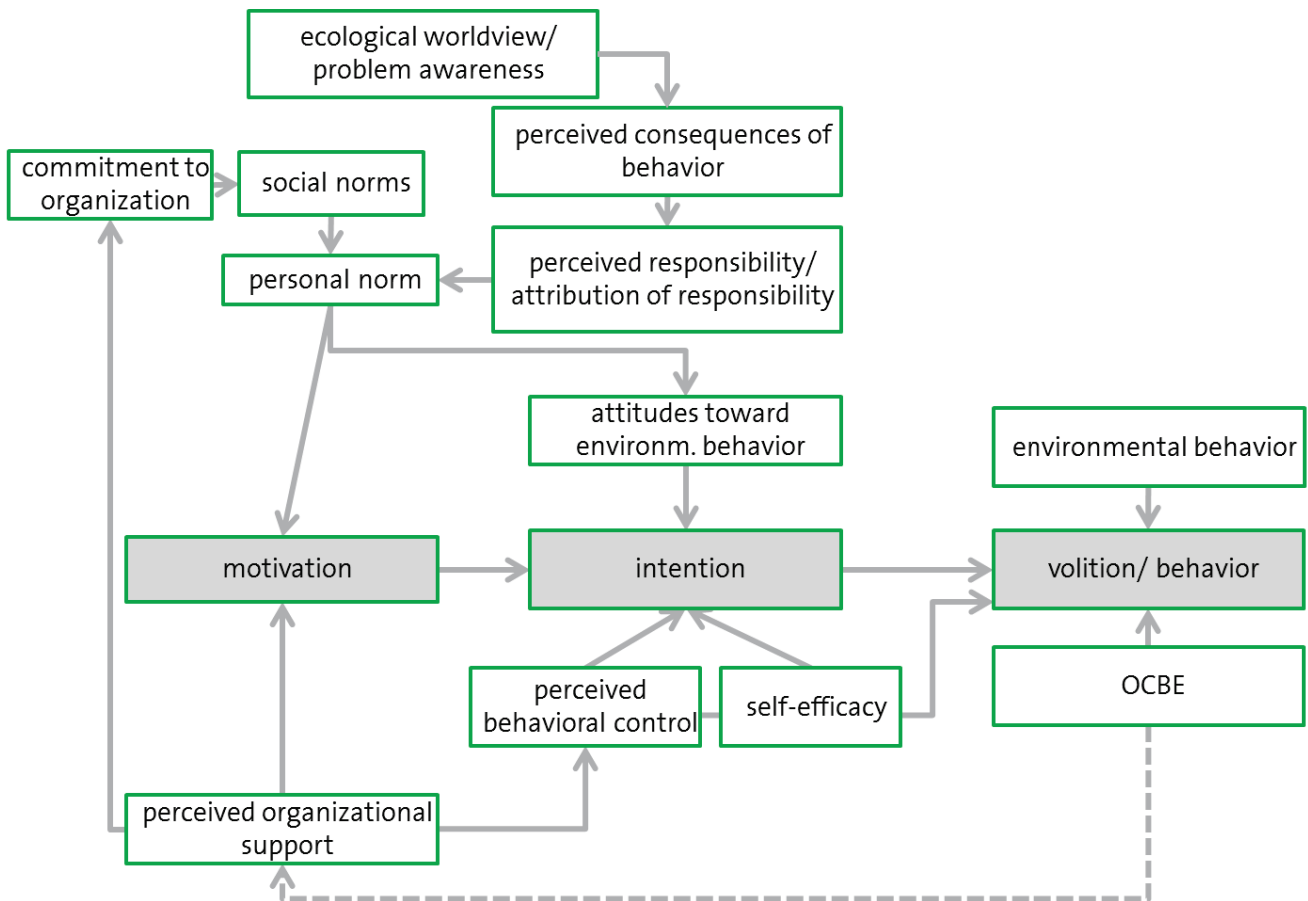


Fig. 1. Preliminary stage model for environmental behavior in work settings.

important factors of classic research on environmental behavior are included. Therefore, the most important indicators and its reaction to the intervention can be evaluated. Additionally, OCBE is included as well as variables of organizational structure and organizational culture that have been identified as important antecedents. Thus, the model is able to incorporate those aspects and hypothesizes on their interactions with well-known influence factors on the individual level. Both of those facets can be tackled by an intervention method using experience-oriented learning approaches. Yet, to my knowledge this is the first approach dealing with those interactions to gain a more detailed picture of environmental behavior in work or comparable organizational settings.

Most parts of the model have already been successfully tested in other psychological surveys. Yet, it will be necessary to examine empirical constitution of assumed interactions between individual environmental behavior and OCBE that have not been studied before.

An important assumption is the strengthening of perceived organizational support via visible organizational citizenship behavior for the environment. Many types of interventions that have been tested so far are only effective during limited timeframes. Mostly, already six months after an intervention environmental

behavior decreases again. With this model I argue for the possibility to trigger a reinforcing cycle. This cycle will be put into practice via OCBEs, especially drawing from employees' social and communicative skills as well as their willingness to engage themselves in publicly visible environmental behavior.

Finally, the different stages enable us to make a difference between employees staying in a motivational stage and those already at the interventional or volitional stage. According to this model I assume that for enhancing motivation different forms of intervention are necessary as compared to those for fostering behavioral intentions for environmental actions. Thus, it will be possible to differentiate between the needs of various groups. For example, following a first questionnaire it would be possible to tailor interventions according to the stage employees are currently in. This in turn could let interventions become more effective.

## VI. CONCLUSION

This article draws attention to the development and evaluation of employees' resources to improve environmental behavior at work. In the beginning I illustrated different ways to foster employee

environmental behavior, focusing on EBSW as a means to enhance workers margins for environmental behavior. This was followed by a proposal for an evaluation scheme that can be used to study the effects of intervention methods. This scheme will be implemented at a manufacturing site. Then, following an extensive review of literature, a theoretical model for necessary resources showing environmental behavior in manufacturing industries has been suggested.

Currently, qualitative studies are used in ProNaK to deepen our comprehension of environmental behavior, its potentials and barriers in industrial work settings. Building on those insights an intervention method is being developed. In completing this first stage it will be possible to compare insights of qualitative analysis with the model of environmental behavior in work settings proposed in this article. Preliminary results already yield the importance of behavioral control and self-efficacy especially regarding EBSW. In fact, there seems to be a rather high potential for optimizing resource efficiency, since many workers are interested in environmental issues, yet seem to lack possibilities how to pursue these issues at work. The next step concerning the evaluation will be to set priorities for operationalizations in an evaluating questionnaire.

In sum, although recent years saw a considerable increase in management activities fostering environmental behavior in manufacturing companies it should be obvious that we can still find a vast amount of potentials, especially when promoting employee environmental activities.

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# The sustainable yield of nature-based tourism in protected areas – theoretical impetus for a methodological framework

E. Butzmann<sup>1</sup>

<sup>1</sup> Department of Tourism, Munich University of Applied Sciences, Munich, Germany  
(*elias.butzmann@hm.edu*)

**Abstract** - This paper aims to set up a methodological framework for the evaluation of tourism products and market segments in protected areas from a cost-benefit perspective. For this purpose the sustainable yield approach (Lundie et al. 2007; Becken and Simmons 2008) will be applied to the context of national park tourism in Germany and will be combined with the discussion on cost-benefit analyses of national parks in general. One potential cost component is identified that most studies about the impacts of tourism in German national parks are neglecting, the external costs of greenhouse gas emissions.

**Keywords** – ecotourism, national park, nature-based tourism, protected area, sustainable yield

## I. INTRODUCTION

Nature-based tourism that per definition “encompasses all forms of tourism (...) which use natural resources in a wild or undeveloped form (...)” (Goodwin 1996, p. 287) has become an economically relevant tourism segment. There are several studies which prove this fact – even though these studies come to slightly divergent results due to different definitions of the phenomenon. For example the United Nations World Travel Organization (UNWTO) estimates that nature-based tourism has a global market share of about 20 per cent (UNWTO 1998). And it is even assumed that the market segment is expected to continue to increase in the future (UNEP 2011). One subsegment of nature-based tourism is ecotourism, which can be described as a sustainable form of the broader category (Arnegger et al. 2010). Fennell and Weaver (2005, p. 374) define three core criteria of ecotourism: namely the “emphasis on nature-based attractions”, “learning opportunities” and “management practices that adhere to the principles of ecological, sociocultural and economic sustainability”. The total global market share of that subsegment is estimated to be at about 7 per cent of international tourism (UNWTO 2007).

Protected areas are important destinations for nature-based tourism and ecotourism. A protected area is “a clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values” (Dudley 2008, p. 8). The best known subcategory of

protected areas are national parks. Currently there are 15 National Parks in Germany.

According to the International Union for Conservation of Nature and Natural Resources (IUCN) national parks do have certain objectives. The major objective is “to protect natural biodiversity along with its underlying ecological structure and supporting environmental processes, and to promote education and recreation.” (Dudley 2008, p. 16). A further objectives is that national parks shall contribute to local economies through tourism (Dudley 2008, p. 16). Hence national parks do have a double mandate of use and protection (Mayer et al. 2010). For example “use” through tourism to generate positive economic impacts for the region and local communities and “protection” by managing visitor use at a level which will not cause “significant biological or ecological degradation to the natural resources” (Dudley 2008, p. 16).

In addition to the discussion regional and local economic impacts of nature-based tourism there is a less considered debate about global environmental impacts, i.a. by greenhouse gas emissions. According to Becken and Schellhorn (2007, pp. 87ff.) most studies about the impact of nature-based tourism or more specifically on ecotourism are following a “reading glass approach” only looking on local or regional impacts of nature-based-tourism or ecotourism and ignoring global aspects. Environmental costs caused by tourism through the use of fossil energy and CO<sub>2</sub>-Emissions are often neglected. But the need to limit these costs “has been highlighted as a precondition for achieving sustainable tourism development” (Gössling et al. 2005, p. 414). Hence tourism in a sustainable form has the obligation to contribute to the mitigation of climate change.

Taking into account the double mandate of protected areas as well as the debate on the mitigation of climate change it is necessarily important that the promotion of tourism to protected areas is in line with the primary protection objectives of protected areas. Furthermore the promotion of tourism has to consider climate change impacts of travel as well. Hence it would be interesting for protected area management bodies or destination marketing organizations (DMOs) to target specific segments who comply with these obligations. One such segment might be that of ecotourists, the sustainable form of the broader category of nature-based tourism.

## II. STATE OF RESEARCH ON THE DEBATE ON IMPACTS OF NATIONAL PARK TOURISM IN GERMANY

The most profound body of literature on impacts of tourism in national parks in Germany, is focused on economic impacts (Job et al. 2009; Job 2010; Mayer et al. 2010; Woltering 2012). These studies come to the result, that national parks or more precisely tourism in national parks can create considerable income for the regional economy. For instance Job (2010) estimates that 50 million visitor days in German national parks generate a gross revenue of about 2.1 billion Euro per year. This is equivalent to the income of roughly 70.000 people.

Furthermore there are studies which evaluate national parks in Germany from a broader socio-economic and environmental perspective, for example for socio-economic monitoring (Kowatsch et al. 2011) or for a cost-benefit analysis (Mayer 2012, 2014). But these studies do not have a specific focus on the impacts of tourism, especially on the costs. Mayer's (2012, 2014) published the latest cost-benefit analysis of a national park which also includes benefits of tourism, namely the economic impact and the recreational value of visiting the national park. Mayer (2012, 2014) estimates the cost of Bayerischer Wald national park referring to a classification of Dixon and Sherman (1990). He calculates direct and indirect costs by the national park in general, i.e. for maintenance, equipment and management. Mayer comes to the result that the revenue from national park tourism compensates for its costs. But he does not consider environmental costs which are directly caused by tourism for example through the use of fossil energy and CO<sub>2</sub>-Emissions. In most studies on tourism in German national parks these direct costs of tourism are neglected. Hence Becken's and Schellhorn's (2007) observation of the "reading glass approach" does also apply to the research debate in Germany. One exception – even though looking on a "Naturpark" and not a national park – is a study of the carbon-footprint of tourism to the Naturpark Nordeifel (Deuber et al. 2013).

Additionally, concerning the costs and benefits of tourism, studies about impacts of national park tourism in Germany do not differentiate between tourism products or segments. This research gap is not restricted to protected area tourism in Germany alone: "Curiously, despite relevant research on the social impacts of tourism (...) and on its environmental impacts (...), little research has been undertaken to develop the concept of 'sustainable yield' or to measure the social and environmental costs and benefits on a segment-by-segment basis (...)" (Lundie et al. 2007, p. 504). The concept of sustainable yield is based on the concept of tourism yield, which describes the economic potential that different types of tourists have – depending on their spending patterns – to bring economic benefits to a destination (Lundie et al. 2007, p. 503). From an even wider perspective tourism yield can be defined

"as contribution to Gross Domestic Product (GDP), or employment generation" (Dwyer and Forsyth 2008, p. 156). If environmental and social value is included in the cost-benefit perspective in addition to economic value one can speak of the "sustainable yield" of tourism segments (Dwyer and Forsyth 2008, p. 156; Becken and Simmons 2008). This concept has been further developed by Becken and Simmons (2008) and Dwyer and Forsyth (2008). To the authors knowledge the concept has not been adapted to tourism in Germany nor to tourism in protected areas in general.

Tourists do not only create certain benefits or cost, but also have certain attitudes towards the environment and sustainability. Knowledge of these attitudes could allow national park authorities or DMOs to create sustainable tourism products which might improve the benefit-cost ratio of a specific segment. This could be termed the "potential sustainable yield", which might be high within the segment of "ecotourists". For differentiating and targeting a segment of ecotourists it is necessary to identify the tourist's environmental attitude, environmental concern as well as intended and actual environmental behavior (Mehmetoglu 2010). These concepts are not or just partly considered in studies about the impact of tourism in German national parks. For example Müller and Job (2009) surveyed national park tourists' general environmental worldview and their attitude towards the bark beetle in the case of Bavarian Forest National Park. But they do not have the intention to identify a segment of ecotourists. Within the international research debate there are several studies which empirically identify ecotourists (i.e. Hvenegaard and Dearden 1998; Kerstetter et al. 2004; Mehmetoglu 2010; Palacio and McCool 1997; Zografos and Allcroft 2007). These studies could be the basis for differentiating ecotourists in the context of national park tourism in Germany.

## III. RESEARCH FOCUS

Based on the literature review one can conclude that an analysis of the economic, social and environmental costs and benefits (sustainable yield) of nature-based tourism on a segment-by-segment basis in German national parks is still missing. Even though information about the costs and benefits of certain visitor segments caused by their spending patterns, behavior and their energy use as well as about environmental attitudes could be interesting for national park authorities or DMOs for monitoring or marketing purposes. Are there certain tourism products or activity segments that cause the highest benefits or costs? Or are there any segments who are willing to pay more for an environmental friendly holiday? To answer these questions a methodological framework for measuring the sustainable yield of nature-based tourism segments in protected area destinations will be proposed in the following section.

#### IV. PROPOSED METHODOLOGICAL FRAMEWORK

For measuring the sustainable yield of nature-based tourism in protected area destinations on a segment-by-segment basis tourism products or respectively market segments have to be differentiated. For the context of nature-based tourism Arnegger et al. (2010) developed a product-based typology, which could serve as a theoretical basis for the research approach here. The typology is based on two dimensions: A motivation dimension termed "nature as point of attraction" and a travel arrangement dimension named "individuality". Hence within the typology framework tourism products and market segments can be located and characterized by travel motivations and travel activities as well as by the fact how these activities were organized, for example individually or as a fully standardized tour. In this paper the typology shall not be explained further as the emphasis shall be given to the concept of "sustainable yield". For a discussion on a possible operationalization of the product-based typology for nature-based tourism see Butzmann and Schamel (2014).

Tourism products and market segments - as for example differentiated in the explained typology - are connected to a certain travel behavior. This behavior results in a sustainable yield with certain benefits and costs. For example direct benefits through tourists spending or the recreational value (the consumer surplus) for a tourist visiting the national park. Or for example direct costs, like those of carbon dioxide emissions. Starting point for the proposed framework on the costs and benefits of national park tourism in Germany on a segment-by-segment basis is the literature of cost-benefit analysis of national parks in general. From this research strand the potential cost and benefit dimensions and possible methodological approaches for quantification can be derived.

According to Dixon and Sherman (1990) there are direct costs of a national parks comprising expenditures for equipment, maintenance and management of the park. Indirect costs are caused by damage and economic losses incurred indirectly through the reserve, for example, by wild animals or "pests" such as the bark beetle in directly adjacent regions i.e. (commercial) forests. These costs could partly be referred to tourism segments, depending on their national park affinity or the frequency of national park visits. As an example may serve the study of Becken and Simmons (2008). They estimated the "public sector yield" consisting of infrastructure costs of specific segments of the incoming tourism to Australia depending on activities and visited attractions. Other direct and indirect costs could be environmental costs of tourism. For example Becken and Simmons (2008) and Lundie, et al. (2007) are calculating the "environmental" respectively "sustainable yield" of tourism based on energy use and greenhouse gas emissions. Becken and

Simmons (2008) calculate those emissions for different tourist types, using distance travelled by transport mode with specific emission factors. For measuring the carbon-footprint of tourism to the Naturpark Nordeifel Deuber et al. (2013) are using the emission factors provided in the Handbuch für Emissionsfaktoren (HBEFA) (INFRAS 2013).

Munasinghe (1992) developed the Total Economic Value (TEV) framework differentiating between different categories of economic values attributed to environmental assets. The TEV framework was adapted by Mayer (2013, 2014) in order to categorize different benefits of national parks. For estimating the benefits of tourism he calculates the economic impact based on expenditure data of tourists gathered through face to-face visitor surveys using the methodology by Job et al. 2009 and Mayer et al. 2010, a multiplier approach to calculate the direct and indirect income generated by national park tourism. Additionally Mayer (2012, 2014) estimates the recreational value of visiting the national park. For that purpose he uses the travel cost method (TCM) which goes back to an idea of Harold Hotelling (Ward and Beal 2000) and has become a commonly used preference-based approach to measure the economic values of recreation in natural settings (Fleming and Cook 2008; Mendes and Proença 2011; Chae et al. 2012; Mangan et al. 2013).

To empirically identify ecotourists or sustainable tourists several approaches have been tested (i.e. Cini et al. 2011, Fairweather et al. 2005; Juric et al. 2002; Mair 2011; Mehmetoglu 2010; Zografos and Allcroft 2007). These studies can serve as an impetus for differentiating ecotourists in the context of national park tourism in Germany and for describing the potential yield. For example Mehmetoglu (2010) developed a Nature-Based, Eco- and Sustainable Tourists (NES)-scale to identify the named tourism segments. The scale consist of seven items, which could also be adapted to the research context on national park tourism in Germany. Another scale which has often been used in tourism research to measure environmental attitudes, is the New Environmental Paradigm (NEP)-Scale by Dunlap et al. (2000). Environmental attitudes are the basis for environmental friendly behavior. Fairweather et al. (2005) use eight items of the NEP-scale to differentiate tourism segments and showed that these segments show divergent awareness and responses to ecolabels. Cini et al. (2011) identified a segment of ecotourists i.a. based on the NEP-Scale. Mair (2011) showed that tourists who are willing to participate in voluntary carbon offsetting have a more pro-environmental attitude measured via the NEP-Scale.

#### V. FURTHER STEPS FOR EMPIRICAL TESTING

The proposed framework for measuring the sustainable yield of nature-based tourism in protected area destinations will be tested by the author by means of a



visitor survey in Berchtesgaden National Park. The focus of the study will be on four yield indicators:

- *Tourism Yield*: Measuring the economic impact of national park visitors using the methods for economic impact assessments developed by Job et al. (2009) and Woltering (2012).
- *Social Yield*: Estimating the recreational value of a visit of a national park using the travel cost method applied by Mayer (2012, 2014).
- *Environmental Yield*: Calculating CO<sub>2</sub> e-emissions of transportation using the HBEFA (INFRAS 2013; Becken and Simmons 2008).
- *Potential Environmental Yield*: Measuring environmental attitudes and intended behavior of national park visitors by adapting the Nature-based, Eco and Sustainable Tourists (NES)-Scale of Mehmetoglu (2010) and Dunlap et al. 's (2000) New Environmental Paradigm (NEP)-Scale to the context of national park tourism in Germany.

These parameters allow to calculate several yield and efficiency indicators for describing the sustainable yield of nature-based tourism segments in protected area destinations such as: "Economic Impact per Journey", "Economic Impact per kg CO<sub>2</sub>e", "Recreational Value per kg CO<sub>2</sub>e" or "kg CO<sub>2</sub>e per Euro spent".

The Survey will be designed as an intercept survey (personal interviews) conducted at Berchtesgaden National Park during summer season 2014. The survey is organized in cooperation with Berchtesgaden National Park authorities and the Institute of Geography, Julius-Maximilians-University in Würzburg.

Berchtesgaden National Park was founded in 1978 and is the only national park in the German Alps. In an area of 210 square kilometers the park has famous natural attractions such as Lake Königssee or the Watzmann peak. In the region adjacent to the national park there are further tourist attractions like the Eagle's Nest, the Salzbergwerk Berchtesgaden or the Watzmanntherme. Hence there is a huge variety of different tourism products and attractions offered, which allow a high range of activities to be done and to be tested with the proposed framework.

## VI. CONCLUSION

This paper presents a framework for measuring the sustainable yield of nature-based tourism products and market segments in protected area destinations. The framework attaches to a research gap by looking at market segments in protected areas from a cost-benefit perspective as proposed by the authors of the sustainable-yield approach (Lundie et al. 2007; Becken and Simmons 2008). Additionally, approaches for cost-benefit analysis

of national parks such as the method developed by Mayer (2013, 2014) could be complimented by this framework. Therefore the discussion about the mitigation of climate change could be added to these approaches in order to overcome the "reading glass approach" criticized by Becken and Schellhorn (2007). At this point the framework is not exhaustive and must be further developed theoretically and be complimented with other possible costs and benefits. Also, suitable operationalizations have to be developed.

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# Corporate sustainable management of NGOs in heritage and nature-based tourism – A conceptual framework

C. Tölkes<sup>1</sup>

<sup>1</sup>Department of Tourism, Munich University of Applied Sciences, Munich, Germany  
(christina.toelkes@hm.edu)

*Abstract - Corporate sustainable management of NGOs in heritage and nature-based tourism – a conceptual framework*

**This paper aims at providing a conceptual framework for a model of corporate sustainable management in the service sector based upon the triple-bottom-line approach of sustainability. British NGOs in heritage and nature-based tourism serve here as a credible field of application. Qualitative and quantitative research such as in-depth interviews with managing directors and a survey will help identify the elements of sustainability in management structures which will be organized in a set by a factor and cluster analysis.**

**In addition, the conceptualisation will also throw a light upon marketing as a key factor for NGOs in binding stakeholders, a fact that is closely linked to the organization's image. A positioning analysis in accordance to the Trommsdorf "Competition-Image-Structure-Analysis" will elaborate the image dimensions regarding sustainability in the perception of stakeholders and will position the organization in their competitive environment**

*Keywords – Consumer behavior, heritage tourism, image analysis, nature-based tourism, non-governmental organizations (NGOs), nonprofit management, nonprofit marketing, corporate sustainable management, sustainable tourism management*

## I. INTRODUCTION

The tourism industry shows a tremendous growth: According to the United Nations World Tourism Organization (UNWTO) there were 1087 million international tourist arrivals in 2013, a figure which corresponds to an increase by 5%<sup>1</sup>. The number of tourist arrivals is even predicted to rise to 1.6 billion arrivals worldwide within the next 5 years<sup>2</sup>. Yet these positive effects are accompanied by a large set of negative environmental and societal impacts, as the tourism industry is known e.g. for contributing considerably to the worldwide emissions. Consequently, this industry does its share in aggravating climate change and threatening two essential resources of touristic attractions: heritage and nature (Gössling 2009, p. 17 and Pomering et al. 2011, p.

<sup>1</sup> <http://www2.unwto.org/facts/eng/vision.htm>, retrieved on 3rd June, 2014.

<sup>2</sup> <http://www.unwto.org/facts/eng/vision.htm> retrieved on 3rd June, 2014.

953). Heritage tourism and nature-based tourism form two key sectors for the European tourism industry now and in the future (see Schmude/Namberger 2010). Both types of tourism rely on very fragile and non-renewable resources: heritage and nature. These attractions require special treatment in tourism management in order to preserve its exceptional character for future generations (see Luger 2008, p. 22 and see du Cros 2001, p.166). So, the steady growth of tourism and its environmental consequences, in particular, have prompted calls for more attention towards sustainability in corporate management processes (see Pomering et al 2011, p. 953 f.).

## II. LITERATURE REVIEW

A literature review indicates that the German tourism research community mentions sustainability in the form of ecotourism, in particular, national park tourism. These investigations are based upon case studies highlighting the impact of ecotourism on regional development and the issue of environmental protection (Baumgartner 2008, Job et al. 2009, Job 2013, and Weber 2013).

Furthermore, the topic "sustainability" is considered in the context of destination management, such as with regards to environmentally-sensitive destinations such as the Alps (Bieger/Abegg 2013).

All these research approaches, whether ecotourism, national park tourism or destination management, show a one-dimensional view concentrating on the environmental consequences of tourism, but neglecting the social and economic dimensions of sustainability.

On the whole, one can conclude that until now tourism research has shown deficiencies in three-dimensional approaches. In addition, German tourism research is deficient in management approaches. Thus sustainability, from a managerial point of view, has been remarkably neglected, both in tourism research and service industry research.

With the beginning of the United Nation's Decade of Sustainability research in business management has started to strengthen its activities in this field, but it is the tourism industry that still lags behind. Starting out with a focus on environmental management and audit schemes, management research gradually began to integrate ethical aspects leading up to a whole-system triple-bottom-line approach in management theory (Müller-Christ 2013, 2012, 2010; Balderjahn 2013). It is important to note here that these management models refer to companies producing consumer goods and industrial goods only. Yet

those management concepts which integrate sustainability in a three-dimensional way, have been transferred neither to the service sector nor to the tourism industry. Besides, management research in Germany is a field that is traditionally dominated by a strong focus on industrial enterprises, an institutional distinction between profit-driven organizations and nonprofit organizations, such as non-governmental organizations is missing. Research on nonprofit organizations, in general, is a new development in Germany, particularly in tourism research. Whereas research on nonprofit organizations shows a long tradition within the English-speaking countries. Thus, “research on organizational sustainability derived from issues identified within an NPO context is an emerging yet substantially fertile ground for research” (Weerawardena et al. 2010, p. 355). All the more, because there is a strong lack of triple-bottom-line approaches in strategic management, a managerial framework on sustainability in the service sector and for NGOs is needed.

### III. THEORY

#### A. Heritage and Nature-based Tourism

Cultural tourism refers to “visits by persons from outside the host community motivated wholly or in part by interest in historical, artistic or scientific or lifestyle/heritage offerings of a community, region, group or institution” (Silberberg 1995). This category of tourism is based upon tangible or intangible heritage as their main attractions. In accordance to the Unesco’s definition “tangible heritage includes buildings and historic places, monuments, artifacts, etc., which are considered worthy of preservation for the future. These include objects significant to the archaeology, architecture, science or technology of a specific culture”<sup>3</sup>. Intangible heritage, whereas, “includes [...] traditional festivals, oral traditions, oral epics, customs, ways of life, traditional crafts, etc”<sup>4</sup>. Nature-based tourism “encompasses all forms of tourism – mass tourism, adventure tourism, low-impact tourism, ecotourism – which use natural resources in a wild or undeveloped form” (Goodwin, 1996, p. 287).

#### B. Sustainability

Sustainability is conceived as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (World Commission on Environment and Development 1987, p. 43). It is important to underline the triple-bottom-line approach sustainability is based upon constituting of environmental integrity, social equity and economic prosperity (Bansal 2005). The UNWTO sums up the requirements of sustainable tourism: "Tourism that takes

full account of its current and future economic, social and environmental impacts, addressing the needs of visitors, the industry, and the environment and host communities”<sup>5</sup>.

#### C. The Meaning of NGOs as Players in British Heritage and Nature-based Tourism

The United Nations define NGOs as follows: A non-governmental organization (NGOs) is a not-for-profit, voluntary citizens’ group, which is organized on a local, national or international level to address issues in support of the public good”<sup>6</sup>. Unerman/O’Dwyer go more into detail when considering NGOs “neither as a commercial organization nor a public sector body” (Unerman/O’Dwyer 2010, p. 476). These authors also underline the vital role these corporations play in furthering sustainability (see *ibid*). Several authors point out the emerging significance of NGOs in the promotion of sustainable tourism (Higgins 2001, p. 543; Halpenny 2003, p. 108, Wearing et al. 2005, p.427). They are conceptualized as key stakeholders in a sustainable tourism management process framed by the tourism industry, the host community, the government, experts and tourists (Swarbrooke 1999, p. 17).



Fig.1: Stakeholders in sustainable tourism management Swarbrooke 1999, p. 17.

In Great Britain heritage is the main attractor to inbound and domestic travelers (see HLF 2010, p. 6). British NGOs are important players in heritage and nature-based tourism (see Cook 2012, pp. 170 ff. or Hilton et al. 2012, p.53)

#### D. Corporate Sustainable Management of NGOs

Macharzina/Wolf (2010) refer to Corporate Sustainable Management “as actions that take account of the stakeholder’s expectations in the mark of corporate value creation” (Macharzina/ Wolf 2010, p. 9). Sustainable management from a functional perspective includes the element “sustainability” in planning and analysis of

<sup>3</sup> UNESCO: <http://www.unesco.org/new/en/cairo/culture/tangible-cultural-heritage/>, retrieved on 3<sup>rd</sup> June, 2014.

<sup>4</sup> UNESCO: <http://www.unesco.org/new/en/cairo/culture/intangible-cultural-heritage/>,

<sup>5</sup> UNWTO: <http://sdt.unwto.org/content/about-us-5>, retrieval on 24.03.2014.

<sup>6</sup> UN: <http://outreach.un.org/ngorelations/about-us/> retrieved on 03<sup>rd</sup> June 2014.

Human Resource management, Marketing, Organization and Controlling (see *ibid*, p. 9f.).

The St. Gallen Model of Management distinguishes normative, strategic and operational management in organizations.

At first, the organization has to define its mission statements and principles as the normative element of management. Corporate management of nonprofit organizations comprises the definition of its major goals and strategies in order to provide a managerial framework for the subordinate departments. The mission statement forms the basis for the identity of the organization and the deduction of its corporate strategies. The mission is the result of an analysis of the internal and external situation the organization is fielded in. The normative management is crucial in the context of NGO-management: It provides a framework for guidance of its employees, it motivates the staff, especially those who work without remuneration such as the volunteers, and it helps coordinate decentralized business units and is of a great external impact. Even more, all subsequent strategic and operational management decisions and organizational objectives refer to this mission statement. In the end, these will be implemented by operational measures (see Bleicher 1994, p. 17, see Dyllick 1992, p. 407; see Rüeegg-Sturm 2002, p. 34 f., see Balderjahn 2013, p. 82 -85, see Bruhn 2005, p. 151-155).

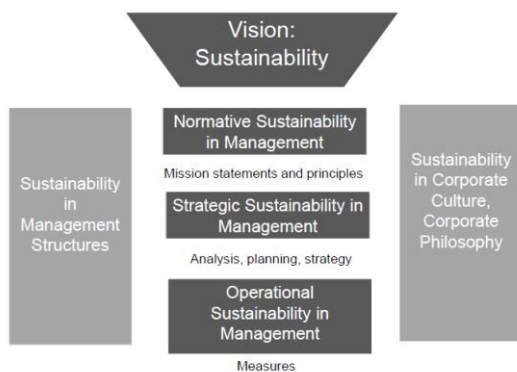


Fig. 2: Corporate Sustainable Management  
Own illustration based on Balderjahn  
(Balderjahn 2013, p. 85 in accordance to Bleicher 1994, p. 17 and Dyllick 1992a, p.407).

The strategic level of management constitutes of analyzing, planning and development of corporate strategies. These elements are closely linked to the company's objectives which can be divided up into performance targets, financial targets, potentialities, and influencing parameters. Performance targets focus on the organization's core business, financial targets safeguard the financing basis by optimizing revenues, and potentialities finally refer to human resources and the organizational structure. Influencing parameters mean

marketing aspects that lead to cognitive changes and action-related processes as far as the identification and awareness of societal goals are concerned Key success factors in accomplishing the organization's mission are its profitability, and a high-quality level of expertise (See Bruhn 2005, pp. 150-162).

The issue dealt with is how to set up indicators for sustainability that consider the triple-bottom-line-approach and integrate into the management structure. Therefore it is important that the management model will take account of the main characteristics of NGOs.

#### E. Nonprofit Organizations form part of the Service Sector

Nonprofit organizations (NPOs) belong to the service sector as their main products are services. The immaterial and intangible aspects of services entail a difficulty in setting up standardized management processes. Also, the service is produced and consumed simultaneously which assumes that the service itself does not allow neither a storage nor a transport. After all, the production of services requires the integration of the consumer himself, the so-called external factor (see Bruhn 2008, pp. 19-24). So, the service sector requires a focus on the securement and communication of quality. Strategic service marketing is an important factor here, referring to an integrated communication strategy, focusing on a strong brand and image as determining factors for the purchasing decision criteria (see *ibid.*: 25).

These elements of strategic service marketing also apply to non-governmental organizations but it is of importance that nonprofit marketing takes account of the special characteristics nonprofit organizations (NPOs) show: One important characteristic of NPOs is that their management is dominated by societal goals and a strong mission and vision. They determine the corporate strategic management and contribute remarkably to the organization's success. Economic objectives are important parameters in the general framework, but not as essential as the organization's values. Nonprofit organizations are characterized by a focus on quality. Internal and external stakeholders contribute to the organization's success by providing financial, human or material resources. Therefore it is an integral part of the marketing objectives to create confidence with the stakeholders, to build up a positive reputation and to meet the stakeholders' expectations (see Bruhn 2005, 156-173).

The special features of services as well as the particular characteristics of nonprofit organizations affect the strategic planning of marketing. Consequently, it is of importance here to introduce the essential elements of nonprofit marketing now.

#### F. Nonprofit Marketing

The function “corporate strategic planning” is concerned with the determination of the fields a nonprofit organization works in. It comprises the mission of the company, the definition of the relevant market and the determination of the most essential business units. In the NGO context the balance of its vision and mission, a high quality in accomplishment and the guarantee of the economic basis are of significant importance. Also, the consideration of criteria leading to an adequate market segmentation are set up in the mark of corporate strategic planning. On the whole, this entity deals with all strategic issues that are of relevance in the long run (see Bruhn 2005, p. 148 ff.)



Fig. 3: Own illustration in accordance to management processes in Nonprofit-Marketing in accordance to Bruhn 2005, p. 95.

Strategic marketing planning is a subcategory of corporate management and refers to the planning of marketing strategies as to the different business units. Strategic marketing planning is of a more operational level and refers to measures that can also be of short notice. These strategies take account of the organizations business units, the market participants, and the marketing mix (see *ibid.*).

Quality is a crucial competitive factor for companies in the service sector and NGOs in particular. The reasons for the importance of quality are diverse: A rising number of competitors, a decrease of resources, as well as the immateriality of nonprofit products require a successful quality-orientation as a distinguishing factor in a competitive market (see *ibid.*: 229 ff.).

The operational marketing categorizes into the four functions: product, promotion, place and price. This systematization invented by McCarthy (1960) is frequently used in the German research community. In the case of the service sector it is important to extend these four categories by the aspects personnel, physical facilities and processes (Magrath 1986, in *ibid.*: 292). Nonprofit marketing also bases upon the assumption that the organization has to take measures in the field of resource management first before turning to the performance policy and communication measures (see *ibid.*: 95-99).

Finally implementation actions help establish the strategies within the organization. The better the implementation management succeeds in adjusting the corporate strategies to the organizational culture the better the strategies are implemented (see *ibid.*: 422).

Last but not least the controlling of nonprofit marketing includes the analysis and presentation of financial information as well as the planning and coordination of all controlling processes (see *ibid.*: 474).

#### G. Measuring Images

As pointed out before, the organization’s image and reputation are two elements which underline the NPO’s credibility and which are constituent of nonprofit marketing. Both the image and the reputation, also expressed by the brand, are key elements in binding the stakeholders of NGOs. That’s why a methodological framework for corporate sustainability will not only have to analyze management structures with special regard to marketing but also will have to highlight the corporate image as a crucial element of marketing.

There is a number of definitions regarding the terms “attitude” and “image”. Both terms are closely linked and there is a lively discussion in the research community whether they can be treated equally (see Kroeber-Riehl 2008, p. 211).

A key concept for the operationalization of attitudes is the so-called three-components-theory. Attitudes consist of affective, cognitive and conative aspects. The affective component refers to the activating processes including emotions and motivations, whereas the cognitive component is linked to knowledge and learning processes. The conative component highlights the connection between attitude and behavior. All three components add up to a consistent picture of an attitude (see *ibid.*: 216).

Image is defined as “the holistic basis of an attitude and the complex, multi-dimensional structure an attitude is based upon” (Trommsdorff 2004, p.168). An image is formed when “several impressions of an object or a company or a product get a subjective evaluation. Emotional and cognitive aspects finally add up to an image” (Trommsdorff et al. 2008, p.891). One distinguishes images of products, brands and companies (see Foscht/Swoboda 2011, p. 127).

The measuring methods for attitudes group into one-dimensional methods considering the affective component of attitudes only, and the multi-dimensional measurement of several components such as the affective and cognitive dimensions. Due to the definition of images as multi-dimensional structures of attitudes, the multi-dimensional measuring methods for attitudes can be applied to image analyses (see Kroeber-Riehl 2008, p.211).

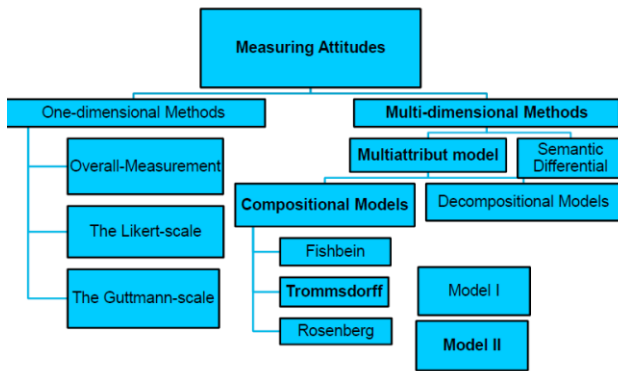


Fig. 4: Own illustration in accordance to Swoboda 2002, p. 197.

Trommsdorff delivers a model which allows the measurement of images in the context of competition (The Trommsdorff II model: Competition-Image-Structure-Analysis). This type of analysis enables the measurement of the current state of the art regarding the essential elements of an image allowing a comparison between the consumer's perception of the corporate image and their perception of the competitor's corporate image. Positioning models measure the key elements of image and help operationalize the aspect "sustainability" in the mark of an image (See Trommsdorff 2008, p. 891 ff.).

The Competition-Image-Structure-Analysis manages to answer the following questions:

- Which image characteristics are responsible for the success of the brand?
- Which are the most important image factors of the competitors?
- How do different image-positionings in the market influence on each other?
- Which of the image dimensions contribute to the market share?

(See *ibid.*: 905).

The Image analysis will take account of the fact that there might be expectations by the stakeholders towards the nonprofit organization with reference to sustainability. The corporate image will position the organization in the stakeholder's perception. A positioning analysis focuses on the expectations from the demand-side and delivers a conclusion on the discrepancy between the realization of sustainability in the management structures and the perception the stakeholder's eye.

#### IV. METHODOLOGY

It needs empirical evidence for a model of corporate sustainable management in the service sector based upon the triple-bottom-line approach of sustainability and a NGO perspective. By means of developing a set of indicators for sustainability in normative, strategic and operational management, corporate sustainable

management (as well as its effectiveness) can be proved empirically.

The research gaps are:

- Model of sustainable strategic and operational corporate management in the service sector
- Empirical evidence of sustainable management models using NGOs in British heritage tourism as example

The major research questions are:

- Which are the success factors for sustainability in corporate strategic and operational management?
- Which are the indicators for sustainability in corporate strategic and operational management?

The research methods will include:

- A qualitative approach by means of conducting in-depth interviews with Director Generals and a quantitative research method, a survey, which will help identify the elements of sustainability in management structures.
- These factors will then be organized in a set by a factor and cluster analysis.

The second part of this conceptual framework will deal with the analysis of sustainability as an image dimension. The Competition-Image-Structure-Analysis will elaborate the image dimensions regarding sustainability in the perception of stakeholders and will position the organization in their competitive environment.

The research gaps are:

- Determining sustainability as an image dimension (sustainability in a corporate image)
- The Trommsdorff "Competition-Image-Structure-Analysis" as a model of positioning transferred to the dimension "sustainability"
- Case-study: British NGOs in heritage and nature-based tourism

The major research questions are:

- What is the corporate image concerning sustainability?
- Which indicators show sustainability in the corporate image of an organization?
- Which are the expectations of the stakeholders towards sustainability?
- Is there a discrepancy between the implementation of sustainability in the management structure and the perception of the stakeholder (in particular in comparison to the competitive field)?

The research methods will be:

- Quantitative measurement of image dimensions by means of rating scales



- The data analysis is suggested by factor and regression analyses or a causal analysis in the context of the Trommsdorff II Model.

## V. DISCUSSION

This paper has presented the framework for a study on corporate sustainable management and an image analysis in the context of sustainability.

Further steps to be taken would include the drawing of the sample as well as the data collection. The British Charity Commission provides a listing of all charities in England and Wales which can serve as a basis for the sampling.

The management approach is based on a broad definition of corporate management. Maybe it can be useful to focus on some management functions only and deal with them in depth. As far as the study on sustainability in marketing management is concerned the concept provided is feasible, but it could also be of interest to deepen the approach by selecting only one major aspect of the strategic marketing management framework. It is of discussion to use other fields of application in the service sector in order to set up this management model and to allow a comparison between different players in the tourism industry. Furthermore it is interesting to compare the differences between sustainability in profit-driven and nonprofit management, and finally, a view on management models in the industrial and consumer goods industry will help round up the discussion.

## VI. CONCLUSION

German tourism research lacks management approaches in the field of sustainability. This paper has managed to identify these research gaps by referring to management models in the context of British non-governmental organization in the heritage sector. To highlight NGOs as player in the sustainable tourism process is a new view in Germany. German management theories had been restricted to industrial and consumer good enterprises so far. Now their elaborations find a new context which points out an institutional distinction between profit-driven companies and nonprofit organizations. Nonprofit organizations show specific characteristics which give an insight into the key elements into their management processes. There is the need to give empirical proof of a management model based upon the triple-bottom-line approach in tourism management and the nonprofit sector. Nonprofits are dependent on marketing as a key function in the sustainable management process. Hence it is of particular significance to highlight the elements brand and image as essential components of nonprofit marketing. In addition to the sustainable management model an image analysis is suggested. The intention is to analyze the category sustainability in the perception of the

stakeholders. These have special expectations towards the NGOs, an aspect that will be measured by means of an competition-image-structure-analysis developed by Trommsdorff. Both elements, the empirical proof of sustainable management structures, and a concluding image analysis allow to judge on the discrepancy between the implementation of sustainability in the organization and the expectations raised by the stakeholders. In order to provide a suitable field of application the data will be collected from British NGOs acting as players in heritage and nature-based tourism.

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# The future of social sciences methods- the qualitative heuristic methodology- going back to the roots of natural sciences- an abstract of an analysis

A. Wolff

Faculty of Business, University of Plymouth, Plymouth, UK/ Hochschule München, Munich, Germany  
(annabelle.wolff@hm.edu)

*Abstract* - The qualitative heuristic method by Gerhard Kleining (1982, 1990/91 1994, 2007) tries to reconnect the social sciences again with the natural sciences by focusing its methodology on the systematic exploration and discovery.

The method emphasizes searching and finding within qualitative data by asking open questions on the text. The text needs to be looked at by as many perspectives as possible and the answers need to be analysed by the above described rules. This is the so called "principle of dialogue". An abstract of an analysis will exemplify the method.

*Keywords* - principle of dialogue, qualitative heuristic method, social sciences methodology, text analysis method

## I. INTRODUCTION

In this paper the qualitative heuristic text analysis method is compared to other social sciences methods and an abstract of an analysis will show how this method can be applied to analyse text documents.

Part of this abstract analysis are parts of the speeches of the German Chancellor Gerhard Schröder at the meeting of the German *Bundestag in 1998 and 2003*, Plenarprotokoll 15/32; Plenarprotokoll 14/3, Berlin) which will take a closer look at the economic and political situation of the time and its influence regarding reforms within Germany.

## II. METHODOLOGY

The qualitative heuristic method by Gerhard Kleining (1982, 1990/91 1994, 2007) tries to reconnect the social sciences again with the natural sciences by focusing its methodology on the systematic exploration and discovery. Kleining (2007: 191) says that the detachment of the social sciences from the natural sciences starting in the second half of the 19th century suggested by Wilhelm Dilthey a German theologian and philosopher had a very negative influence on the scientific value and recognition of social sciences. Dilthey formulated the separation of the natural sciences with the theory and foundation of human sciences and developed the method of hermeneutic.

The heuristic method though omits typical problems that hermeneutic methods have like the interpretive, static and subjective observation of the text.

The four main heuristic rules to follow during the analysis should be:

1. Openness of the researcher
2. Openness towards the research object

3. Maximum structural variation of the perspectives during the data collection
4. Analysis of similarities

The research process will not be linear, but in form of a dialogue. It emphasizes searching and finding within qualitative data by asking open questions on the text. The text needs to be looked at holistically and the answers need to be analysed by the above described rules. This is the so called "principle of dialogue".

General questions that can be asked on the text are:

- Which topics are discussed?
- Which persons/groups are addressed?
- How are these described?
- What are internal and external influences?

A successfully executed analysis tests itself by "internal validity". It is valid when new data and perspectives do not provide any new results. It is reliably when all data can be subsumed under the same category (100% rule). By "testing the limits" the range of validity can be shown.

## III. RESULTS

### A. Comparison of social sciences methods

The following *Table 1(own summary)* will show a comparison of social sciences text analysis methods. Each text analysing method has its specific effectiveness. Both the grounded- theory as well as the heuristic methodology are both very time and work intensive. Furthermore both methods place high demands on the ability of the researcher.

The heuristic method is though the only social science text analysis method right now that tries to omits typical problems that other social sciences methods have: like the interpretive, static and subjective observation of a text. While the Grounded Theory accepts similarities and differences, the heuristic method searches apparent differences in favor to overcome these similarities.

TABLE I  
COMPARISON OF SOCIAL SCIENCES TEXT ANALYSIS METHODS

	Content Analysis	Hermeneutic Text Analysis	Grounded Theory	Heuristic Text Analysis
<b>Type of text</b>	Large amount of text	Concentration on specific texts, text in its entirety	Concentration on specific texts	Concentration on specific texts, internal and external perspectives, analysis of similarities
<b>Goal</b>	To explain, compare and structure texts and to reduce the complexity	To explain and interpret text contents and intension of the author	To generate a new theory through a open interpretation from empirical data	To explore and discover the text with the principle of dialogue
<b>Method</b>	The research question is the selection criterion; data collection (coding) takes place to systematically reduce information; Analysis (statistical evaluation) with a gain in knowledge; interpretation for classification into larger relationships followed by conclusions	Substantive and formal description of the text, formulation of an impression and justification based on text samples, text-immanent and text external facts; description, interpretation and rating influence reciprocally	The permanent comparison is the central principle of the grounded theory analysis. This means that phenomena which manifest themselves in individual text passages are marked with a code (open, axial or selective). Afterwards other passages are searched for which exhibit similar or contrasting phenomena. "W"- questions are asked.	The four main heuristic rules should be the openness of the researcher, the openness towards the research object, the maximum structural variation of the perspectives during the data collection and the analysis of similarities. The research process will not be linear, but in form of a dialogue.
<b>Results</b>	Analysis of large amount of data, reduction of complexity and recognition of structural coherences	To draw conclusions from specific findings which allows a classification of the work	Development of categories and further hypothesis	Various data is examined for similarities to obtain one structural frame, integrates and optimizes scientific results
<b>Advantages</b>	<ul style="list-style-type: none"> <li>• Clear rules and code guideline</li> <li>• Easy and quick performance</li> <li>• intersubjectivity and transparency</li> </ul>	<ul style="list-style-type: none"> <li>• "Sense" of data comes during the analysis</li> <li>• Data record of many people can be analysed together</li> <li>• Hypothesis need not to be formulated in advance</li> </ul>	<ul style="list-style-type: none"> <li>• More universal method by open, theoretical coding of text</li> <li>• Research question and theoretical framework can be adapted in the course of research process</li> </ul>	<ul style="list-style-type: none"> <li>• Open, objective, flexible, widely-varied observation of research object</li> </ul>
<b>Disadvantages</b>	<ul style="list-style-type: none"> <li>• Paraphrasing impedes complexity of text and its contents</li> <li>• established theories prevent discovery of important information</li> <li>• Subjective opinions and interpretations</li> </ul>	<ul style="list-style-type: none"> <li>• Interpretative and often subjective, static observation of text</li> <li>• Pre-formulated hypothesis prevents open, objective observation</li> </ul>	<ul style="list-style-type: none"> <li>• Time intensive</li> <li>• Complicated coding and memo process</li> <li>• High demand of pre- knowledge of researcher</li> </ul>	<ul style="list-style-type: none"> <li>• Time intensive</li> <li>• Very complex method</li> </ul>

It focuses on the systematic exploration of the research object internally and externally in form of a dialogue.

This method of discovering, searching and finding has been neglected for many years in the area of social sciences and therefore scientific results in social sciences are often not valued as much scientific results in natural sciences and funding through the economy, politics is less than for natural sciences.

In regards to the future of social sciences this method might bring back some more reputation and reputation to comply with present and future scientific standards.

### B. An abstract of a text analysis

Clement Attlee already noted in the past that *"human beings need to make important decisions on imperfect knowledge in a limited time"* (Bennett 2013: 21).

Political decision making processes are always difficult to understand for outsiders. There are various factors that influence political decision making: economic, social, personal, electoral, legal, international, party political, and many more.

For the systematic exploration of the Chancellor speeches of Gerhard Schröder the text will be observed in form of a dialogue by asking open but holistic questions like:

- Which topics are discussed?
- Which persons/groups are addressed?
- How are these described?
- What are internal and external influences?
- **And here specifically sub-questions:**
- How long is it to the next significant election?
- How unified is the governing political party?
- Are there powerful interest groups involved?
- What is the current economic situation, and future prospects?
- Are any of the key ministers under particular pressure?
- Who is talking to whom on this issue, and how are their views being led in?
- What is the likely media, parliamentary, and public reaction to the alternative course of action?
- What is going on in European/international politics at the time?

Parts of this abstract analysis are from the government statements of 1998 and 2003. The government statement of 2003, given by Chancellor Schröder, is introduced with the title: *"Mut zum Frieden und Mut zur Veränderung"* (translation: courage for peace and courage for change). Why has he titled his speech in the following way and what has happened since 1998 when Schröder came with the SPD back in power after being 16 years in opposition? Which topics are discussed, what courage/peace/change is he talking about and what is the economic and political development, etc..

In this analysis of the two documents the focus of the open questions has been on the political and economic situation of Germany. The year in which these issues are mentioned in the speeches will be put in brackets like this "(98)".

The statement "courage for peace referred to the war that as going on in Iraq and Germans non-military involvement during these times. Regarding the statements "courage for change" which will be the focus here, the analysis of the text reveals that during the reign of Schröder, Germany as well as other European countries had been under major economic pressure, especially regarding the prospects on the labour market. The underlying goal for Germany was to reduce the unemployment rate. In his speech (1998) Schröder talks about the need "to modernize the state and the economy"(98). This is also something that Schröder still mentions in his 2003 speech by titling his speech with "courage to change" ('03). Germany, as well as other European countries are "fighting with a bad fiscal situation, high amounts of debts and high tax commitments" ('98). This is partly due to the needed political concentration of the conflicts in Kosovo and Afghanistan, and later on also 9/11 and the Iraq war. The national politics were only second ranked because of the international political crisis.

In 2003 the "weakness of economic growth is still a problem". Furthermore Schröder states that the "European house needs to be consolidated economically, socially and politically to eventually get one common currency" ('98). The "basis of Germany and other European countries (like France and Great Britain) is the "industry" ('03) and the "motor of this growth is the middle class" ('03). The goal should be to "keep a level of welfare for all" ('03). There have to be more "investments in research" to further this ('03). Germany has an "important role within Europe". Unemployment needs to drop, jobs need to be preserved and new jobs need to be created ('98). Part of this is the need for "innovation, new companies, new products, new markets, better education and a new tax politic ('98). This led to a close cooperation between the British Prime Minister Tony Blair and Chancellor Gerhard Schröder who published the Schröder/Blair Paper in 1999 and introduced the idea of the "Third Way". The "Third Way" tries to connect ideas of left and right wing politics by combining right-wing economic and left-wing social policies.

There was a need for major reforms, especially "tax reforms, law reforms, pension reforms, social policy reforms, energy reforms, reforms regarding social security contributions and reforms of the education system" ('98). The statement "courage to change" ('03) especially meant the courage to reform. Schröder becomes very concrete by talking about "cutting state benefits, furthering and demanding own responsibility, everybody needs to do something for the state" ('03). There is a need for "active labour politics, a reform of the social systems, more

private provisions (pensions)" to offer "future generations (demographic change issue) a better future" ('03).

In summary one can see very clear similarities between the two texts regarding the economic situation in 1998 and 2003. The state needs to be modernized and reformed economically to further an economic growth.

So what happened politically in the 1990's and what were the outcomes that had to conclude from the economic problems mentioned in the speeches of Chancellor Schröder? Here are some external and internal influences that evolve from the analysis.

In the 1990s the right of centre administration and the opposition kept on arguing about the so called "reform tie-up", while at the same time the economic crisis lead to mass protests against the feared cuts in social services and unemployment kept rising. The outcome of the federal election (1998) was unique in the history of Germany. For the first time parties that are traditionally classified as "left of centre" received more than 50 per cent of the votes. The Social Democrats became the strongest political force for the first time since 1972. This was mainly due to their strength and majority in the Council of Ministers (12 of 16 states were led by the SPD) who were able to block major reforms of the CDU/CSU/FDP and gained even more power because of that. Gerhard Schröder became Chancellor and remained in office until 2005. He led the first red-green coalition at federal level.

During his time in power Schröder had to deal with many political, economic and ecological challenges. His politics dealt with reform and sustainability and it signified a radical change in the development of Germany. The change to the 21<sup>st</sup> century was signified by the beginning of globalization, financial crisis, war and peace issues and an ecological conscience. Schroder's initial goals in his first reigning period were to focus on national politics and the economical reformation of Germany. The crisis in Kosovo, Afghanistan and international terrorism made it necessary to rather act in international politics. Shortly before his second term in power Germany had a big flood catastrophe which eventually helped Schröder to get his focus back on national politics and the financial and fiscal problems within the country (Wolfrum, Edgar 2013: chapter "Aufbruch ins 21. Jahrhundert").

Germany as many other countries were experiencing economic difficulties, high numbers of unemployment and the topic of demographic change within Germany started to cause discussion about the future of the welfare systems. Schröder knew that a lot of people expected a reformation of the economic and social policies from him. He followed the political strategy of Tony Blair and Bill Clinton who were keen to reform their country and boost the economy. It was therefore no surprise when Chancellor Schröder, and Prime Minister Blair published the Blair/Schröder paper in 1999. The paper was supposed to represent the willingness of both politicians to work in similar directions to reform the existing welfare state system (Clasen/Siegel 2007: 4). The strategy of the "Third Way", that was mentioned in this paper, resulted in the

late 1990s and early 2000s transformation of the traditional welfare state into a workfare state ("activating welfare state"). This new arrangement also demanded services in return from its citizens. Schröder's main goals, announced under the slogan 'To admit one's responsibility', were to cut social spending and to encourage more personal responsibility (Butterwegge 2006: 159; 237 et seq.).

Between 2002 and 2005 Schröder took further steps in the 'reformation' of the German welfare state by transforming the Labour market with the Hartz reforms, introducing the "Riester-Rente" (a supplementary private pension insurance), tax reforms, etc. Schröder's goal was to reduce the unemployment rate in Germany from four million to two million within four years. The reforms of the benefit systems Hartz (especially Hartz IV) represented a radical change and reform within the German welfare system. A considerable reduction in short and long term unemployment has led to the assumption that the Hartz reforms are successful. But these statistics are flawed since not all workers, like part-timer are not included in the statistics. Furthermore people that received sickness benefits were transferred into the system of unemployment benefits. This special reform of the unemployment system has affected the character of the German welfare state since then and led to claims of the first signs of retrenchment" (Kemmerling/Bruttel 2006: 109). At the same time this radical reform showed one the one hand the possibilities of change and on the other hand the willingness of Germany to change something within their system. This change in paradigm from a passive welfare state to an activating welfare state meant that Germany still wanted to keep his main welfare ideas, but wanted to modernize it.

The name of the reform, "Agenda 2010" already points out, that reform and modernization takes time. And not all of the planned reforms could be adopted right away. Some had to be revised due to new occurring issues. Therefore the SPD was still unable to reduce unemployment or revive the country's stagnant economy, and it suffered a series of devastating losses in state elections. Why was that so? The perception of a party that political action may be at least as important as the adopted programmes was evident in the phase of red-green coalition, but the policies of this phase lacked a clear social democratic vision which was reflected in inconsistency of the political acts. Thousands of party members left the SPD in protest over cuts in what were considered sacred programmes, such as unemployment benefits and health care, and some ex-SPD members formed an alternative party under former SPD leader Oskar Lafontaine; This led to the establishment of the Labour and Social Justice – The Electoral Alternative (WASG) in 2005 by disappointed Social Democrats and trade unionists. The new party jointly campaigned in 2005 with the eastern-based Party of Democratic Socialism (PDS).

Some other reasons why the SPD lost so many votes were policies like Hartz IV, which became a synonym for poverty and the dismantling of the welfare state. The Hartz reforms resulted in major cutbacks of social welfare benefits which provoked and irritated many voters. Also leadership problems within the party and the new neoliberal approach irritated the voters rather than motivated.

#### IV. DISCUSSION

One can see a very clear difference between the speeches of 1998 and 2003. In the 1998 Schröder talks about his responsibility (the responsibility of the new federal government (red- green coalition) to reform and change the country economically and politically. In 2003 Schröder followed a very clever strategy to share responsibility for the further positive development of the German nation. He demanded that everybody needs to be an active citizen that has the requirement to work hard to keep the German state in a good economic and political balance.

The biggest social reform that took place in Germany were the Hartz reforms. The Hartz reforms were introduced in 2003, but with much controversy within the Party. Thousands of SPD- members left the party afterwards to join a new left- wing Party under Oscar Lafontaine. The foundation and relative success of the new Left Party can be seen as the result of programmatic weakness and policy decision making of the SPD.

Schröder knew that by his "quick" introduction and implementation of the Agenda 2010 during his second term in power that he would probably lose some more voters and members, but he still decided to do so, for the political reform of Germany. On the one hand this signified the beginning of a political crisis for his party, on the other hand it signified, as seen in 2010 (Germany was ranked again very high economically- a so called driving economically and politically force) the slow but steady political and economic recovery of Germany.

#### V. CONCLUSION

The analysis reveals that during the reign of Schröder, Germany, as well as other European countries like Great Britain had been under major economic pressure especially regarding the prospects on the labour market. The underlying goal was to reduce the unemployment rates by reformation and the "courage to change".

In summary the historical analysis reveals that the reform of the benefit system (Hartz reforms) represented the beginning of substantial changes within the German welfare system produced by political key players, such as Gerhard Schröder and other influencing members of the SPD and associated interest groups. All decisions that took place had to be done on imperfect knowledge in a

very limited time. In the end one needs the courage to do politics. That is politics.

The heuristic methodology exposes in detail the main internal and external influences and political decision making processes that led to a change of attitude within the SPD regarding the welfare state and some of its social policies.

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# Mechanochemistry: Tunable molecules for biodegradable material

Michael F. Pill<sup>1,2,3</sup>, Alfred Kersch<sup>1</sup>, Martin K. Beyer<sup>2,4</sup> and Hauke Clausen-Schaumann<sup>1,3</sup>

<sup>1</sup>Munich University of Applied Sciences, Department of Applied Sciences and Mechatronics, Lothstr. 34, 80335 Munich, Germany

<sup>2</sup>Institut für Physikalische Chemie, Christian-Albrechts-Universität zu Kiel, Olshausenstrasse 40, 24098 Kiel, Germany

<sup>3</sup>Center for NanoScience (CeNS), Geschwister-Scholl-Platz 1, 80539 Munich, Germany

<sup>4</sup>Institut für Ionenphysik und Angewandte Physik, Leopold-Franzens-Universität Innsbruck, Technikerstrasse 25, 6020 Innsbruck, Austria

(pill0@hm.edu)

Mechanochemistry is addressing the question how chemical reactions behave, when a force or stress is applied. The controlled degradation of materials is useful for biodegradable materials. Such materials can be used for drug delivery systems, temporary prosthetic devices, or in the packing industry. Besides, the force controlled degradation can be used for the design of force-sensing and self-healing materials.<sup>1</sup> Because all biodegradable materials undergo chemical reactions with water, it is also important to gain knowledge about the behavior of the molecules in aqueous environments. We have investigated one new class of such materials: the tunable hydrolytic, poly(silyl)ester, in aqueous environments.

This silyl ester bond was investigated with single molecule force spectroscopy methods<sup>2</sup> with the atomic force microscope (AFM), see Figure 1.

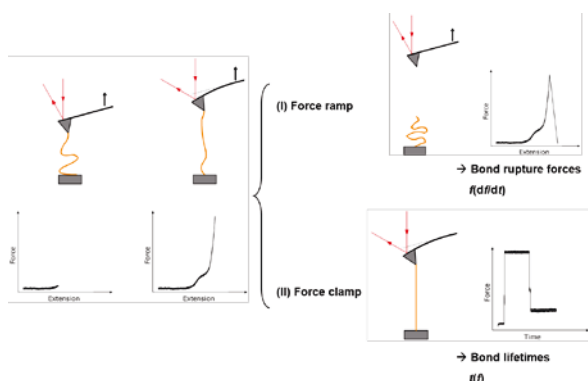


Fig. 1. Single molecule force spectroscopy methods by using the AFM

The silyl-ester bond was formed via a proton catalyzed ester condensation under acidic conditions (pH 2).<sup>3</sup> Dynamic single molecule force spectroscopy,<sup>4</sup> was used to investigate the maximum force which the molecules can hold. At force loading rates of 100 pN/s, a maximum force of 2.5 nN per molecule was observed.<sup>5</sup> Under static load, the kinetic parameters of mechanically activated chemical reactions, such as bond scission and hydrolysis, can be determined. For our system two decay channels were observed.<sup>6</sup> Analysis of the experimental results, with an Arrhenius based kinetic model revealed two distinct reaction channels with nearly the same activation energy but with different Arrhenius pre-exponential factors. This indicates two different chemical reaction, e.g. silyl-ester hydrolysis.

To clearly identify the reaction mechanisms, quantum chemical calculations using density functional theory (DFT) were performed, see Figure 2.

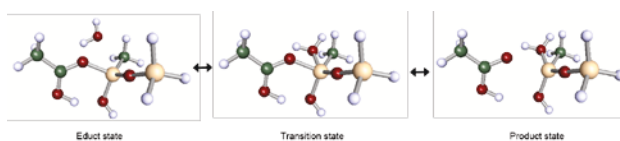


Fig. 2 DFT estimated reaction

It was found that a proton catalyzed hydrolysis of the silyl ester is the preferred reaction. The two distinct chemical reactions which were observed in the experiment, can be explained with different side groups at silyl ester.<sup>7</sup> Furthermore, the maximum forces of the DFT calculations are in the same range as the ones obtained by the dynamic force spectroscopy experiments.

The combination of these two approaches, AFM experiments and quantum chemical reactions, allows determining, explaining and predicting the stability of chemical bonds under mechanical load. It was also shown that the stability of the biodegradable silyl ester bond can be tuned via specific chemical side groups. It is therefore possible to produce stronger or weaker polymeric materials based on silyl ester bonds with different chemical side groups.

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# Psychology Meets Computer Science

## Impact of Social Identity on Pedestrian Simulation

I. von Sivers<sup>1</sup>, A. Templeton<sup>2</sup>, G. Köster<sup>1</sup>, J. Drury<sup>2</sup>

<sup>1</sup>Department of Informatics and Computer Science, University of Applied Sciences, Munich, Germany

<sup>2</sup>School of Psychology, University of Sussex, Brighton, United Kingdom  
(isabella.von\_sivers@hm.edu)

*Abstract* - Modern crowd management relies on simulations to ensure safety by predicting the behaviour of the crowd in certain scenarios. For this, the computer model must use an accurate understanding of crowd behaviour. This entails cooperation between psychologists and computational modellers which is still rare.

One of the most utilised theories of crowd behaviour in social psychology is self-categorisation theory (SCT). SCT predicts that under some conditions individuals come to share a social identity which can lead to helping strangers.

We devise a social model for pedestrian dynamic simulation based on self-categorisation processes: the Social Identity Model Application (SIMA). Typical helping behaviour ensues for persons who share a social identity – assisting injured persons evacuate. We demonstrate the impact of this new model on the behaviour of pedestrians in selected scenarios. We build the SIMA on top of the thoroughly validated Optimal Steps Model for locomotion.

*Keywords* – Self-categorisation, crowds, pedestrian dynamics, Optimal Steps Model

### I. INTRODUCTION

Over recent decades, extensive research has been conducted on pedestrian dynamics to ensure safety at public events. On the one hand, psychologists and sociologists have examined and explained the behaviour of the crowds in emergencies, riots or public events. On the other hand, computer scientists, physicists, mathematicians and engineers have aimed to model the behaviour of pedestrians and simulate scenarios of events and emergencies in advance to give predictions of the movement.

In a recent review of crowd models, it was found that most of the modellers of pedestrian dynamics use outdated psychological assumptions in their simulations ([1] in preparation). Recently, several crowd modellers have acknowledged the importance of introducing modern theories from social psychology to gain adequate simulations of crowd movement. However, most of these newer models only cover the behaviour of small groups, not the collective behaviour of crowds where the entire crowd act together as a unit. One contemporary theory, which is based on extensive research of collective crowd behaviour, is self-categorisation theory (SCT: [2]).

In this paper, we present a new model at the social level for pedestrian dynamic simulation: the Social Identity Model Application (SIMA). This model follows

self-categorisation theory and the resulting behaviour during an emergency evacuation. We model the helping behaviour (returning to injured pedestrians and helping them to evacuate), which is based on reports given by the survivors of the London Bombings of 7th July 2005 in empirical social psychological research [3,4].

Furthermore, we demonstrate our results and argue that in order to more accurately model crowd behaviour in emergencies where the crowd act together, modellers must include collective behaviour based on social identity in to their scenarios.

### II. SELF-CATEGORISATION THEORY

As part of the social identity approach, self-categorisation theory is one of the leading theories of collective behaviour, which has been thoroughly researched across a range of crowd events such as urban riots [5], mass emergency evacuations [3], religious mass gatherings [6], and collective action [7]. Self-categorisation theory suggests that identity is based on people's perception of their own place within a group and the perceived group membership of others, and that this is the cognitive mechanism which makes collective behaviour possible [8].

Self-categorisation theory can explain how unconnected strangers can come together psychologically without prior interpersonal relationships or interpersonal interaction, as it explains how people can shift from having a salient personal identity to having a salient identity as a group member. It also explains the helping behaviour that crowds in emergencies often exhibit; people are motivated to help those who they perceive to be members of their group (see [9]). For example, in the July 7<sup>th</sup> London bombings, survivors became united through a shared social identity due to the common threat of the bombs that they all faced, and helped one another to evacuate. In our model, we implement aspects of self-categorisation theory by focussing on the shared social identity of the survivors of the London bombings in order to examine the effect that helping has upon evacuation time.

### III. SOCIAL IDENTITY MODEL APPLICATION

In pedestrian simulations, most modellers focus on the locomotion of pedestrians. That is, how to navigate and move from one place to another. However, it has been

shown by psychologists that social and collective processes influence the behaviour and movement of pedestrians. It is important to include such aspects in pedestrian simulation. Hence, we introduce a social level on top of the locomotion level. This structure allows us to change the models on the different levels.

On the locomotion level we use the well validated Optimal Steps Model [10,11]. This model controls how a simulated pedestrian moves from one place to another. The Social Identity Model Application (SIMA) controls the self-categorisation and the helping behaviour.

#### A. Self-categorisation in the SIMA

Self-categorisation theory explains how strangers can become united and help fellow ingroup members. We implement aspects of this theory in the SIMA. The SIMA starts with the self-categorisation process initiated by the experience of a common fate which occurs in an evacuation by definition at the beginning of the simulation. Following SCT, not every person in such an emergency will categorise themselves as an ingroup member with the others to the same degree. Hence, we use a parameter to control the percentage of pedestrians sharing the social identity.

#### B. Self-categorisation in the SIMA

In line with self-categorisation theory, we assume that only people with a shared social identity are willing to help strangers. We model typical helping behaviour – returning to injured pedestrians and helping them evacuate. Other kinds of helping can be added to the model in future research.

We introduce a new attribute which marks a pedestrian either being injured or not injured. An injured pedestrian – we model only badly injured pedestrians – needs another helping pedestrian to evacuate. The percentage of injured pedestrians can be set by a parameter at the beginning of the simulation.

Helping behaviour will only be triggered if the pedestrians share a social identity with the other survivors and are not injured themselves. The helping behaviour in our simulation consists of three stages: the search for injured pedestrians, the approach to an injured pedestrian and the assistance to evacuate.

### IV. RESULTS

We show the impact of our new social model in a scenario inspired by the July 7<sup>th</sup> London bombings. A London Underground C69/C77 Circle Line train with six cars is simulated. The pedestrians evacuate to the platform outside the train. We have a total of 192 passengers in the train sitting on the seats. This setting can be seen in Fig. 1.



Fig. 1. Scenario inspired by the London Bombings 2005. In the upper part of the figure, the train is shown. The green bar at the bottom of the figure is the target for all pedestrians.

Fig. 2 shows a screenshots during the simulation. Pairs of helpers and injured people can be observed. This is the behaviour which was reported by survivors and evidenced by photographs taken after the London Bombings.

At the beginning of the simulated evacuation, healthy pedestrians approach injured people. They become pairs and evacuate together. Uninjured pedestrians who are not helping others evacuate on their own. The whole crowd evacuates successfully. However, helpers with injured persons need more time to evacuate. This increases the overall evacuation time when compared to the evacuation time of a crowd of healthy individuals. We find that this rise of the evacuation time is realistic and expected.

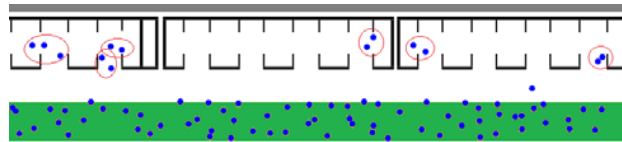


Fig. 2. Screenshot during a simulation with the SIMA. The red circled pairs are helpers with injured pedestrians. They need more time to evacuate but no injured pedestrians are left in the train.

### V. DISCUSSION

A model that only considers the locomotion level of pedestrian dynamics cannot cover the overall behaviour of the crowd. In particular typical helping behaviour cannot be captured. This is unrealistic because badly injured pedestrians in a simulation would simply be left behind. The result would be an infinite evacuation time, or casualties where none were observed. The SIMA, on the other hand, is able to reproduce assisted evacuation of injured persons as reported from real incidents. The evacuation times predicted by the SIMA for incidents with gravely injured persons are longer, and as we find, more realistic, than those predicted by pure locomotion models

### VI. CONCLUSION

In this paper, we introduced a social model for pedestrian dynamics, the SIMA, which includes the social identity approach and specifically self-categorisation theory, the leading theory of crowd psychology, in evacuation simulation. The results show a significant impact on the success of an evacuation and on the predicted evacuation times. This highlights the importance of considering the findings of social psychology in pedestrian evacuation dynamics.

The main purpose of our future work is the combination of theories from social psychology with

models from computer science. One of our next steps will be to extend the SIMA. A more complex model to cover all the reported behaviour in emergencies could be the goal. Different types of helping are conceivable. In addition, according to Drury et al. (in preparation), the perception of helping among ingroup members could lead more people to help others (social influence).

The combination of theories from social psychology and the models from computer science is the main purpose of our future work.

#### ACKNOWLEDGEMENT

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## **PhD-Symposium for Applied Sciences**

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### **Agenda**

#### **Wednesday 14<sup>th</sup> May 2014 - Symposium: Day 1/ KGk.**

*8:30 registration open*

9:00 – 9:30 Welcome Prof. Dr. Michael Kortstock, President MUAS

(R0.056) 9:30 – 11:30 session 1

*11:30– 13:15 lunch break*

13:15 – 14:45 session 2

*14:45 – 15:00 coffee break*

15:00– 16:00 session 3

16:30 – 18:00 *Poster Session 1*

*ca. 18:30 end*

#### **Thursday 15<sup>th</sup> May 2014 - Symposium: Day 2/ PhD Node Plymouth**

*9:30 registration open*

10:00 – 11:00 session 4

11:30 – 12:30 *Poster Session 2*

*12:30 – 13:15 lunch break*

13:15 – 14:45 session 5

*14:45 – 15:00 coffee break*

15:00– 16:30 session 6

*ca. 17:00 end*

Wednesday 14 <sup>th</sup> May 2014	Thursday 15 <sup>th</sup> May 2014
<p><b>Session 1</b></p> <p>9:30 Carina Prein “Structural and Nanomechanical Analysis of Cartilage using Atomic Force Microscopy”</p> <p>10:00 Leonhard Polz, M. Sc. “Investigations on High-Temperature fibre-optic Sensing with Regenerated Fibre Bragg Gratings”</p> <p>10:45 Michael Pill “Mechanochemistry: Tunable molecules for biodegradable material”</p> <p>11:15 Sebastian Walser, M. Sc. “Microelectromechanical microphones”</p> <p><b>Session 2 KGk.</b></p> <p>13:15 Manuel Winkler, M.Eng. „Biological Effects of Light Depending of Indoor Environmental Quality”</p> <p>13:45 Christian Bichler, M.Eng. „Analyse und Optimierung der obertägigen Anlagentechnik tiefegeothermischer Heizwerke“</p> <p>14:15 Paul Mittermeier, M.Eng. „Nachhaltige energetische Modernisierung von Stadtquartieren in Europa“</p> <p><b>Session 3</b></p> <p>15:00 Isabella von Sivers “Psychology Meets Computer Science: Impact of Social Identity on Pedestrian Simulation”</p> <p>15:30 Andreea Denițiu “FastXray: fast tomographic 3D-volume reconstruction”</p>	<p><b>Session 4 PhD Node Plymouth</b></p> <p>10:00 Anna Wulf “Open Strategy – as a new and barely explored strategy tool?”</p> <p>10:30 Abdullah Alothman “The Impact of Saudisation Policy on the Employment of Women in the Saudi Private Sector”</p> <p><b>Session 5</b></p> <p>13:15 Christina Tölkes, Dipl.-Geogr. “Corporate Sustainable Management of NGOs”</p> <p>13:45 David Kühner “Simply asking? – How to evaluate employee environmental behavior in work settings”</p> <p>14:15 Elias Butzmann, Dipl. Geogr. “The sustainable yield of nature-based tourism products in protected areas”</p> <p><b>Session 6</b></p> <p>15:00 Wolf Hiemeyer, “Integrated marketing and sales approach in the B2B industry”</p> <p>15:30 Alexander Pesch “Customer Profitability Analysis and Activity-based Costing in the Hospitality Industry: Data Requirements and other Implementation Challenges.”</p> <p>16:00 Jürgen Steinheber “Diffusion of innovation in emergent and advanced economies: contrasting success factors in Brasil and Germany”</p>

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For further questions please contact: Dr. Katja Mitzscherling ([katja.mitzscherling@hm.edu](mailto:katja.mitzscherling@hm.edu))

In case of emergency contact: Office FK09: +49 89 1265 - 3901

