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Heterogeneous and homogeneous groups in the innovation process

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Abstract: This article discusses the use of heterogeneous and homogeneous groups in the innovation process of companies. We analyze the dilemmas between homogeneous and heterogeneous competences, interests, orientations and professional backgrounds in the development process and underline that there is no universally applicable “one best way” of dealing with these dilemmas. The concept of dilemma provides instead the tools to analyse advantages and weaknesses of heterogeneous groups and to deal with them. This will be illustrated on the basis of interviews with executives of three German and Swiss companies.

KEYWORDS: DILEMMA, INNOVATION PROCESS, HETEROGENEOUS GROUPS, HETEROGENEOUS TEAMS, DIVERSITY, CHANGE

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1. Heterogeneous or homogeneous groups in innovation processes?

In innovation management, a crucial challenge is the task to identify the optimal composition of project groups in innovation processes. One dimension of this composition is the professional and socio-cultural homogeneity of these groups. But there is no definite superior solution for the "optimal" composition of a group. At least, two different positions can be distinguished - one of which promotes homogeneous groups and the other favours heterogeneous groups to create innovations.

Some authors argue that groups with heterogeneous participants facilitate innovations. For example, the "value-in-diversity"-perspective of a human resources discussion called "Managing-Diversity" emphasises that heterogeneous groups perform better than homogeneous groups. The perspective regards adjusted problem solving, more organizational flexibility, enhanced marketing efforts (Cox 1993: p. 27) and a higher level of creativity and innovation (Cox 1993: p. 31).

Kanter (1983) emphasises that in innovative companies more women and non-white people are employed than in other companies. Kanter suggests that the reason for the higher innovation probability is the greater diversity of ideas which she compares with a "marketplace". The diversity of ideas would be necessary to facilitate ideas.

> *"Note that it is not just any team that aids innovation but a tradition of drawing members from a diversity of sources, a variety of areas. Innovating companies seem to deliberately create a 'marketplace of ideas', recognizing that a multiplicity of points of view need to be brought to bear on a problem." (Kanter 1983: p. 167)*

The network perspective describes this in more detail. For Granovetter (1973) and Burt (1992) homogeneous people build clusters. Between these clusters the individuals are heterogeneous. People in clusters share a lot of time together and develop intense emotional contact (Granovetter 1973: p. 1361) with friends, colleagues or family members. Because they often talk about the same topics, information circulates within the cluster and therefore the information is non-redundant and the likelihood of innovation is low. It increases when somebody mediates between these clusters as "bridge" or "knowledge broker" (Burt 1992: p. 30-32). Bridges or knowledge brokers generate connections which are more elusive and irregular. Granovetter emphasises "the strength of weak ties" (1973) as a source of new and relevant information. As a result, heterogeneous groups are more effective in creating

innovations because they avoid non-redundant information and allow access to information of other clusters.

Some German authors focus also on heterogeneity (Wiesenthal 1995, Gläser et al. 2004, Shinn/Joerges 2004, Hoering/Kühl/Schulze-Fielitz 2001, Aretz/Hansen 2002). In the context of organizational learning, Wiesenthal (1995) supports the position that heterogeneous groups enhance innovations. Wiesenthal differs between conventional and unconventional learning[1]. Conventional learning occurs when the actual performance differs from the target value and must be adjusted. Unconventional learning occurs when new goals are sought for. In practice, conventional learning sticks to the organizational cognitive frame with only organizational members, whereas with unconventional learning influences beyond the organization are used by including other actors[2]. The inclusion of other actors who do not possess the organizational cognitive frame or the organizational paradigm[3] creates heterogeneous groups. Hence, Wiesenthal (1995) applies the concept of reducing paradigms in heterogeneous groups for creating innovations.

Gläser et al. (2004) consider heterogeneous groups as a joint-venture of different sources in the dimensions of knowledge, language and interests. (Gläser et al. 2004: p. 7). The term heterogeneity takes into account combination of all cognitive, institutional and cultural heterogeneities. This should represent a new modus of knowledge production (Gläser et al. 2004: p. 10). All these scholars emphasise that heterogeneous groups facilitate innovation.

In contrast to that, other authors have stressed that homogeneous groups facilitate innovations. Powell (1990) points out that even homogeneous groups[4] spread information to create conditions which generate innovations.

> *"One of the key advantages of network arrangements is their ability to disseminate and interpret new information. Thus, to the extent that competition is based on such fac-*

[1] The distinction is similar to March (1991) who distinguishes between exploitative and explorative learning and to Argyris/Schoen (1978) who distinguish between single-loop and double-loop-learning.

[2] For example, Wiesenthal suggests introducing a quasi-membership to people who wants to add something without being too deeply involved; he submits to invite professions which are connected to another cognitive frame and he suggests changing the top-management continually to implement a new cognitive frame top-down.

[3] The ideas of paradigms and changing paradigms are strongly related to the concept of Thomas Kuhn (1962) in case of scientific revolutions.

[4] I.e., Powell (1990) deals with the expression „arrangements of networks" but this can be interpreted in terms of homogeneous groups: „Networks should be most common in work settings in which participants have some kind of common background – be it ethnic, geographic, ideological or professional." (Powell 1990: p. 326)

> *tors as the ability to innovate and translate ideas into products quickly, network forms of organization are more likely to proliferate […].” (Powell 1990: p. 325-326)*

To support the power of homogeneous groups, Powell takes into account the higher level of trust and solidarity[5] in networks compared to other groups.

> *“The more homogeneous the group, the greater the trust, hence the easier it is to sustain network-like arrangements.” (Powell 1990: p. 326)*

As trust enhances, networks do well in reacting in time on new ideas and implement them. Networks stabilize unsettled environments and reveal implicit knowledge, which is necessary for innovation (Powell 1990: p. 322).

Similar to this notion, some authors of the discussion about “Managing Diversity” deals also with disadvantages of heterogeneous groups. However, disadvantages of heterogeneous groups correspond to advantages of homogeneous groups. Many studies reveal that cooperation is a difficult issue in heterogeneous groups (Watson/Kulmar/Michaelson 1993, Ancona/Caldwell 1992, O’Reilly/Williams/Barsade 1998, Brewer 1996). For example, the probability of conflicts destabilising groups increases with demographic heterogeneity. Consequently, rivalry increases and communication is aggravated (Ancona/Caldwell 1992: p. 323). O’Reilly/Williams/Barsade (1998: p. 187) support that conflicts are not productive at all and always have a negative effect on the innovation process[6].

The two perspectives which prefer homogeneous or heterogeneous groups to facilitate innovations are diametrically opposed. To summarize the first perspective, heterogeneous overtake homogeneous groups due to their greater diversity of ideas which are non-redundant and heterogeneous groups open the border to ideas localized out of the cognitive frame. The second perspective states that homogeneous groups are predominant in creating innovations because of more distinct abilities to implement innovation, avoid conflicts and create trust. Both positions are verisimilar and empirically proved. A precise decision whether one or the other is true cannot be found. Symptomatically, Stumpf/Thomas (2000) headline their article “How to Cope with the Diversity of Diversity Research on Group Effec

[5] With reference to Emile Durkheim (1964), it is better spoken of mechanical solidarity in contrast to organic solidarity. Mechanical solidarity refers to social cohesion based upon the likeness and similarities among individuals in a society, whereas organic solidarity describes the dependency of individuals on each other in more advanced societies.

[6] Brewer (1996) found reasons for the utmost probability of conflicts in heterogeneous groups. The variety of identities in heterogeneous groups can lead to discrimination and loss of trust (Brewer 1996: p. 51) and further to egoism and the needs of security (Brewer 1996: p. 54f.).

tiveness". To present a way out of this diversity, advantages and disadvantages stand side by side (e.g. Triandis 1994) or complex models with intervening variables are being developed (Ancona/Caldwell 1992). Clear-cut, unidimensional solutions are generally dissatisfying. This is not the way we prefer, because "one-best ways" only occur in exceptions, as Kühl states (1998: 305). Rather, we suggest the concept of innovation dilemmas.

2. The concept of dilemmas in organizations

This chapter will present the concept of dilemmas as an existing theoretical approach which deals with the contradictions between heterogeneous and homogeneous groups and ways to cope with this dilemma.

2.1. Innovation dilemmas between stability and change

This section examines the term "dilemma" and present similar existing approaches of innovation dilemmas.

The social psychologist Karl Weick established the concept of dilemmas in relation to behaviour in organizations. He emphasises that it is not only possible to gather advantages of all options but to choose one option and simultaneously accept the disadvantages of this option at the same time.

> *"Organizations often confront dilemmas […]. The important point about the two horns in a dilemma is that those horns are distinct, cannot be merged or compromised, and whenever one horn is resolved the other one remains to haut the organization." (Weick 1969: p. 174)*

Hence, Weick favours not only one option but takes both options into account to the same extent (Weick 1969: p. 26).

Stefan Kühl considers the concept of dilemmas as antipole to rational thinking in the tradition of Max Weber, Frederick Taylor and Henri Fayol (Kühl 2002: p. 251). Referring to Luhmann, he postulates to "dethrone the term of purpose" (Luhmann 1973: p. 86). Kühl argues that in dilemmas, equal reasons are in favour of two options. It is necessary to choose one, but the other seems to be just as well attractive (Kühl 2002: p. 257f.). Discrepancies, ambiguity and inconsistence cannot be seen as problems and cannot be removed because

they reflect the nature of organizations and these are not trivial machines (Kühl 1998: p. 306).

From the perspective of innovation theory, innovation was often described as contradictory, ambivalent process (e.g. Schumpeter 1934, Zaltman et al. 1973, Lullies/Bollinger/Weltz 1993, March 1991, Rammert 1988, Heidenreich 2004 and Christensen 1997). Schumpeter, who was often regarded as founder of innovation theory, had defined on the one hand development in our sense of innovation as “the carrying out of new combinations” (Schumpeter 1934: p. 66). As consequence, he postulates that innovation explores out of existing things. On the other hand, he identifies innovation as “gale of creative destruction”, which "incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one" (Schumpeter 1942: p. 83). This statement leads to the opinion that innovation is determined by a total change. These two statements of innovation as exploration of existing things and total change demonstrate the ambivalence of innovations though the ambivalence is not very distinct yet. However, recent studies often highlight the existence of the innovation process as a contradictory unity of opposing principles, orientations and dynamics (e.g. Heidenreich 2004: p. 367).

Especially Rammert deals with innovation dilemmas. He distinguishes between the research and development division and the rest of the company based on economic rules. The first represents logic of change, complexity and diversity. The second represents control, calculation and focussing (Rammert 1988: p. 20; p. 33). In order to survive, it’s necessary to include these two conflicting objectives. When the first is overemphasised, a risk of utilisation occurs. When the second is overemphasised, an innovation restraint occurs (Rammert 1988: p. 209).

Also Christensen (1997) examines “the innovator’s dilemma”. His dilemma deals with well-managed companies. They listen to their clients and invest in new technologies but still lose their market dominance (Christensen 1997: p. IX) because of so called “disruptive innovation”. A “disruptive technology” is defined as a low-performance, less expensive technology which enters a heated-up scene where the established technology is outpacing people's ability to adapt it. In general, the incumbents cannot adjust a new technology because the capabilities are specialized, resources are allocated in the existing technology and it is too risky to adopt a blanket technology for large scale companies. Finally, the managers of established firms stuck in their thinking and do not get into the potential benefit from innovative

technologies (Christensen 1997: p. 207ff.). Taking the example of the computer disk drive industry, he illustrates how an existing trajectory of technological development was cut and the incumbents lost their dominance.

Put in more broad terms, Rammert (1988) and Christensen (1997) confirm a dilemma of stability and change in the innovation process. Rammert reveals a dilemma of organizational units and Christensen of incumbents and newcomers. But these dilemmas do not exactly apply to our case of heterogeneous and homogeneous groups. A more precise description was already afforded by Zaltman et al. (1973). They introduce the innovation dilemma between groups with high complexity (in terms of heterogeneous groups) and groups with low complexity (in terms of homogeneous groups). In the perspective of Zaltman et al. (1973), generating ideas is as well necessary as implementing ideas. Since heterogeneous groups generate ideas best and homogeneous groups implement ideas best, a dilemma can be detected.

> *"It is important to note the innovation dilemma involved: […] The greater complexity (e.g. number of occupational specialities, their professionalism and differentiated task structure) of the organization provides the opportunity to bring more-varied kinds of information to bear on decision situations. […] However, high complexity, because of potential conflicts and the difficulties in reaching consensus as what innovations to implement can make implementation difficult." (Zaltman et al. 1973: p. 159f)*

To illustrate that generation and implementation of ideas are necessary for the innovation process to the same extent, the dilemma between heterogeneous and homogeneous groups of Zaltman et al. (1973), should be kept in mind.

To summarise this section, dilemmas take into account two alternatives to the same extent because there does not exist a universally applicable way. Regarding the approaches of innovation dilemma, a dilemma between stability and change has been often described. In some sense, Zaltman et al. (1973) deal especially with a dilemma between heterogeneous and homogeneous groups. The authors refer to the necessity to generate and implement an idea to the same extent to create innovations.

2.2. Different ways to deal with the dilemma

However, stating a dilemma is not our only objective. Rather we also want to present ways to avoid or handle[7] innovation dilemmas which take place in real innovation processes. Thus on the one hand we are able to prove the different possibilities to deal with the dilemma and on the other hand to give practical advices. Four different possibilities can be distinguished.

Firstly, it is obviously possible to find a balance between heterogeneous and homogeneous groups. The initial motive to find this compromise is to bring together all advantages of both heterogeneous and homogeneous groups. If neither heterogeneous nor homogeneous groups possess all features needed to create innovations, a compromise between heterogeneous and homogeneous groups may be the solution. However, there is no reason why only the advantages prevail in such compromise. It can not be excluded that only the disadvantages overtake the advantages.

Consequently, it is crucial to find other ways to cope with the mutually interfering goals. Relating to this, Heidenreich (2004) distinguished between a spatial, social, material and temporal dimension of the dilemma in the context of regional networks.

> *"There is no universally applicable set of innovation-conducive institutions or a magic formula for regional competitiveness but only the ability to handle the contradictions and conflicting goals of regional innovation processes. In order to develop this thesis, we will now discuss four dilemmas of regionally concentrated innovation processes. These dilemmas refer to the spatial, social, material, and temporal dimension of these processes; they specify the initially mentioned tension between innovations and institutionalisation, or, put in more broadly terms, the dilemma between opening and closure." (Heidenreich 2004: p. 368)*

[7] We want to stress that "ways to deal or cope with the dilemma" cannot be described as "solution" because this contradicts the idea of dilemmas.

These dimensions can be interpreted as further proposals to cope with the dilemma. [8]. The compromise between heterogeneous and homogeneous groups corresponds with the material dimension to deal with the dilemma. Secondly, the temporal dimension consists of the distinction between a heterogeneous group in the early stage and a homogeneous group in the late stage of the innovation process (Zaltman et al. 1973). Thirdly, concerning the social way to deal with the dilemma, it is suggested to hire team members who care about the diversity of ideas and team members who focus on implementing innovations. This can be achieved by setting objectives and different systems of incentives (analogous to Ortmann et al. 1990). Coming to the spatial dimension to cope with the dilemma, it is possible to separate several development locations from one production locations. All these dimensions have in common that one part relates to stability and the other to change. Even though dilemmas cannot be solved in this way, it helps to find ways to include the conflicting goals.

3. Own approach and hypotheses

To illustrate the theory of dilemmas developed beforehand, we conducted interviews with team executives in the large-scale companies Siemens Com, IBM and BrainStore. BrainStore is a Swiss company specialized in innovation. Basically, we want to know if innovation managers are aware of group composition themes and are aware that long-established units with similar participants do normally not facilitate innovations.

H 1. Executives in charge for innovations deal with the questions of heterogeneous and homogeneous groups and are aware of the advantages of heterogeneous groups.

With respect to the theoretical approach it is evident that innovation is an ambivalent process between stability and change. On the one hand, a greater diversity of non-redundant ideas and the reduction of paradigms enhance innovation. On the other hand, it is necessary to implement them, to avoid conflicts and to create trust in the innovation team. We agree that this dilemma impacts on the question of group composition. Neither heterogeneous nor

[8] We would prefer to distinguish between four “ways to deal with the dilemma” rather than four different dilemmas, because the dilemma between stability and change stays the same and only the ways to cope with the dilemma differ.

homogeneous groups could fulfil the diversity and implementation of ideas to the same extent. This conflict embodies the concept of dilemmas.

H 2. Executives in companies detect advantages as well as disadvantages of heterogeneous groups and therefore confirm the dilemma in the innovation process.

However, to state a dilemma is not our only objective. Furthermore, we want to find ways to cope with innovation dilemmas in real innovation processes. To begin with, it is necessary to find a balance between heterogeneous and homogeneous groups. But the compromise will vary depending on the company.

H 3. The compromises between heterogeneous and homogeneous groups will vary, depending on different types of innovation.

We postulated as well that the compromise does not solve the dilemma because the disadvantages could prevail, too. Consequently, other ways to deal with the dilemma should be considered. As mentioned above, the compromise between heterogeneous and homogeneous groups corresponds to the material dimension to deal with the dilemma. We have discussed other possibilities to deal with the dilemma but for reasons of restricted resources, we will focus on the temporal dimension.

H 4. Executives responsible for innovation processes also differentiate the degree of heterogeneity depending on the innovation stage. They start with a more heterogeneous group and finish with a more homogeneous one.

Hence, a heterogeneous group will serve best at the beginning of the innovation process, because they can be expected to invent most successfully new ideas. In contrast, when innovations have to be implemented, homogeneous groups are preferred because they usually agree on how things should be done without permanent conflicts.

4. Innovation dilemmas in companies

This section contains our empirical findings gained in interviews with innovation managers of two German global enterprises and one Swiss company.

4.1. Innovations through a diversity of perspectives and proximity to the target group

In this chapter we want to show how innovation managers deal with heterogeneous groups and how they explain the advantages.

All interview partners initially used heterogeneous groups as a source of innovation. Staff members of IBM Böblingen stress the diversity of their project group members, at Siemens workshops with university-professors are conducted and at BrainStore consumers, sellers and teenager in its innovation process are brought together. All interviewed executives were convinced of the positive effect of heterogeneous groups on the innovation result. Therefore, they emphasise not only the higher diversity of ideas in heterogeneous groups, but also the importance of a feedback of the target group before the product-launch.

Employees of IBM Böblingen speak about heterogeneity in the sense of diversity which is used as a new management-keyword. Its project teams are composed of employees from various nations, of both genders and of staff with varying educational levels. Furthermore, the company also drew on joint ventures with other companies and on collaborations with other units. One respondent from IBM Böblingen comments on the obvious positive effect of heterogeneous groups.

> *"A heterogeneous group consists of a pot of different ideas. And this pot will obviously create more innovations than a homogeneous one." (Interview IBM; translated)*

Another interesting example is the complete business concept of the company BrainStore. BrainStore offers the possibility to create innovation by inviting various people without professional background in the creative sector. They conduct workshops and creative games to create ideas which will result in innovations. They claim to "produce" innovations like an innovation "factory". One of the Chief Executive Officers (CEO), whom we interviewed, is convinced that innovation requires an open-minded perspective. This is not possible within inflexible, rigid company departments. These homogeneous groups usually exhibit similar mind sets, and do not consider path breaking ideas (Schnetzler 2004: p. 30, 53)[9]. Their reflections turn around existing ideas and correspond to the culture of the company[10]. In contrast,

[9] Nadja Schnetzer, one of the two CEOs of BrainStore who we also interviewed, also published a book with her experience on the theme.

[10] This sounds like elements of the system theory with self-referential systems are entered the economic thinking. If it is a self-description or only a transfer by an academic trained person has to be left open.

people with different backgrounds, different potential consumers, members of the company and teenager have to be brought together to enhance really innovative products and services supported by a moderated process (Schnetzler 2004: p. 30). BrainStore offers innovation workshops with such heterogeneous groups. We had the occasion to participate in such an innovation workshop searching a new way to market a medical product. The group consisted of forty people: medicine students, patients, employees, marketing staff and approximately twenty teenagers. To present another example, the service of a plane was to be improved by BrainStore. The teenagers in a workshop came up with the idea that all passengers should have access to the cockpit view. Out of this unrealistic idea, an innovation process was completed. Television screens which show the view of the pilot were installed in front of each seat (Schnetzler 2004: p. 85). This concept to assemble a heterogeneous group to create innovations seems to be successful. In 2005, BrainStore did a revenue of 3.5 Mio Euro with clients like BMW, Siemens, General Motors, British Telecom and Microsoft.

Another successful example of creating innovations through heterogeneous groups is Siemens Com with its network “Campus”. This network consists of engineers and managers of Siemens Com and university-professors for communication science and informatics. The professors are expected to introduce new perspectives beyond the specific Siemens culture. For instance, the network developed a product which installed a telephone system in a company automatically. Normally, it is necessary to employ an expensive administrator to implement a telephone system. The idea of the new product is to connect phones with each other and the product operates them, selects telephone numbers and makes an administrator redundant. At the computer fair “CeBIT” 2006, the product won an innovation award (Siemens AG 2006). For knowledge and innovation sociologists, the invention of this product is of high interest. Not the reduction of costs was crucial to invent the new product but introduction of the “peer-to-peer”-thinking. “Peer-to-peer”, which is known from the internet music platforms, can be seen as another knowledge field in comparison to the telecommunication world. For three sessions, the responsible manager wondered what peer-to-peer-technology has to do with his business. Only when one of the professors explained that “peer-to-peer” exists without authority, he came to the idea of the new product which implements phones automatically. Hence, the product of telephone systems was created by dealing with a totally different topic. Furthermore, the involvement of professors was crucial because they differ immensely from the Siemens employees in their way of thinking.

The project manager of Campus explains why nobody got the idea to reduce costs easily. Normally, the communication professionals think in terms of a hierarchically structured standard[11] where a central administration delegates to subunits. In this paradigm people cannot imagine system products without administration. Only the discussion about "peer-to-peer", taken from a different knowledge field, enabled the creation of a telephone system product without administration. The heterogeneous group has questioned the conventional paradigm.

In contrast, the respondents mention another explanation why long established units do normally not facilitate innovation which refers to the proximity to the target group. The innovation mangers tend to develop products which do not meet the demands. Heterogeneous groups point to the perspective of the target group and thus reduce the risk of failure.

The CEO of BrainStore illustrates the usefulness of consumers to the innovation process. In one case, the packing of a medical product should be improved. The CEO insisted to include ambulance personal because they have a consumer's perspective. Indeed, they gave the crucial impulse to improve the packaging. The ambulance personal emphasised the everyday problem that they cannot read the dose and name of the product if they cut the package in pieces. Package designer or industrial package specialist would never have had such an idea. Consequently, it is effective to include persons with new perspectives. In particular, teenagers were considered as crucial to get new ideas. The CEO claims that teenagers are open-minded, efficient, curious and not bound to existing paradigms.

In this chapter, we examined if innovation manager are aware of the advantages of heterogeneous groups. Indeed, all interviewed innovation manager have dealt with the question of heterogeneous groups. They try to achieve heterogeneity by involving university professors or building diverse project groups. One company even specialised in creating ideas, bringing together people from various backgrounds. Furthermore, we revealed that developers and inventors are bound to established paradigms. To promote innovations, these paradigms have to be opened up. Finally, there is evidence that heterogeneous groups can provide a feedback from the target group in advance and reduce risk to launch a product.

[11] The standard is called "Private Branch Exchange".

4.2. Limits of heterogeneity

In our second hypotheses, we postulated that heterogeneity can not be increased up to a certain degree without getting negative effects. Executives responsible for innovation processes also face problems with heterogeneous groups. Consequently, we expected limits of heterogeneity.

The interviewed experts encountered various disadvantages of heterogeneous groups. One innovation manager argues that in a group of five persons ten options are generated. In heterogeneous groups, it is difficult to get to the point, which causes high costs and long processes. In fact, the CEO of BrainStore is aware that their way to create an innovation is an expensive one.

> *"Our method, which includes different people to create innovations, is only one way. The advantage is to get broad, supported ideas which are close to the target group. But of course, critics stress that it is expensive and complicated. If you want innovations 'quick and dirty', our place is not the right one." (Interview BrainStore; translated)*

Furthermore, communication in heterogeneous groups is difficult and could lead to conflicts and failure. Particularly, the case of international groups with various languages could complicate effective communication, as one innovation manger at Siemens Com states. Communication is also complicated when some team members are not familiar with the issue. For example, a housewife presumably would not be able to contribute to technical problems. Yet talking about usability, housewives can really contribute useful knowledge. Hence, the usefulness of a person to create ideas depends on the subject or domain, as the interview partner at Siemens Com explains.

The CEO of BrainStore reports on a case when the heterogeneity of an innovation group was too broad. In some cases heterogeneity causes interpersonal problems which could avoid any productive communication. For examples, traditional thinking staffs were brought together with fashionable teenagers. The workshop failed.

> *"Once, we had a group from a company which is led by orthodox Jews. These people had very conservative values and wore the traditional religious clothes. And, as always, we invited teenagers. But in this case, the cultural differences were too huge. The managers were bothered by the clothes of the teenagers. They wore tore jeans and generally had a provocative appearance. They were not too uncommon in my opinion, but were not similar to the children of the orthodox Jews. There was no real communication in the workshop. Finally, the mangers rated the results bad." (Interview BrainStore; translated)*

On the one hand, a group can be too heterogeneous. However, on the other hand a group may also be too homogeneous to create innovations. For example, the CEO of BrainStore conducted an innovation workshop with young employees of a software firm and teenagers. The CEO reports that in this case the degree of homogeneity was too strong. Both groups could not learn much from each other as they were too similar and did not leave the "comfort zone". There was no tension between them and therefore the results were not innovative.

Broadly speaking, according the interview partner of BrainStore a too high and also a too low degree of heterogeneity may occur. In conclusion, the CEO of BrainStore speaks about a certain "tension" which has to develop between the participants.

> *"We mentioned that the differences between the participants may be too strong or too weak. It is necessary that the people are able to converse with each other. The chemistry between them has to be good. Yet, a certain tension must be felt." (Interview BrainStore; translated)*

An innovation manager at Siemens Com also spoke about "tension" to express that the discussion must be open and focused at the same time. The professors of the university ensure the openness of the group whereas the innovation manger tries to focus the ideas to exploit them. Hence, one has to find a balance between openness and closure.

> *"If you are too focused on innovation, you will not see the point. The difficulty is to create openness within the subject. If you only deal with existing ideas, innovations will not be created. I observed that Siemens employees normally try to focus the discussion. The professors in contrast want to spread their ideas. This field of tension creates ideas." (Interview Siemens Com; translated)*

To sum up, a group can be both, too heterogeneous and too homogeneous to create innovation. On the one hand, a group may fail because of too strong differences. In this case communication is complicated, e.g. for interpersonal difficulties. On the other hand, a group can be too homogeneous if participants only confirm each other in their paradigms. Repeatedly, the term "tension" is used to stress the conflicting goals in innovation processes. Hence, there is a lot of evidence that a dilemma occurs.

4.3. Different compromises between heterogeneity and homogeneity to deal with the innovation dilemma

In our third hypothesis, we assumed that the compromise between heterogeneous and homogeneous groups varies depending on the conditions of the innovation process. The diverging kinds of compromise between heterogeneous and homogeneous groups will be discussed in this chapter.

While no one of our interview partners asked for further explanations on the term “heterogeneous groups” the usage of the term “heterogeneity” differed considerably among the experts.

As already described in chapter 4.1, IBM Hardware development has often benefited from the heterogeneity of its project teams that were composed of employees from various nations, of both genders and of staff with varying educational levels. However, all employees share some kind of technical education. This is illustrated by an interview partner from IBM who always has in mind technical academic disciplines such as informatics or electrical engineering when he discusses the concept of diverse academic backgrounds. At IBM Hardware, heterogeneous groups still share a certain technical education. We want to abstract this sort of heterogeneous group as “skills-based”. To create innovation, IBM draws on the technical skills of their employees.

In contrast, BrainStore runs projects which bring together consumers, experts of other relevant fields and teenagers. Such groups are regarded as useful because they introduce a new perspective into paradigmatically “closed” companies. As shown in chapter 4.1, it was ambulance personal who gave the crucial impulse to improve the packaging of a medicine product rather than packaging experts. We want to label this BrainStore innovation strategy as “influencing factors”, because the company wants to integrate knowledge sources which will influence the success of the product.

Siemens Com is located between the poles of “skills-based” and “influencing factors”. On the one hand, the idea of “Campus” network is similar to IBM strategy. The network consists of technical Siemens Com engineers and university professors in telecommunications. Hence, both IBM and Siemens Com share a technical education. On the other hand, our interview partner considers the integration of psychologists, communication scientists and organizational consultants into Campus in order to benefit from their diverse academic perspectives. Additionally, the head of a Siemens Com Think Tank plans to invite professionals

of the creative sector and consumers to an innovation workshop. Furthermore, he studied psychology. This is surprising for a head of a think tank which develops technical products and gives us a hint of the importance of consumer behaviour to the innovation process at Siemens.

We suggest explaining the difference between “skills-based” and “influence factors” referring to the distinction of March (1991). He distinguishes between exploration and exploitation.

> *“Exploration includes things captured by terms such as search, variation, risk taking […] discovery. Exploitation includes things as refinement, choice, […] selection, implementation” (March 1991: p. 71)*

Put in more broad terms, exploration can be defined as the investigation of new objectives whereas exploitation improves established routines. Hence, while exploitation refers to innovation on an existing trajectory; exploration paves a new trajectory (compare Dosi 1981). This distinction describes the differences between the IBM Hardware and Siemens Com concepts of heterogeneity. IBM Hardware does exploitation, because the chip development is more or less focused on performance improvement. In contrast, BrainStore and Siemens Com search an objective to invent an automatic telephone system or new airplane designs. In both cases, various sources of knowledge are combined. Nevertheless, both examples can be described as innovations (see Schumpeter 1934: p. 66).

In this chapter, we revealed diverging understandings of “heterogeneity”. IBM Hardware conceives heterogeneity as “skills-based” and brings together persons with an exclusively technical education, whereas the BrainStore concept of heterogeneity refers to “influence factors”. Furthermore, we analysed the reasons for these diverging understandings. While IBM Hardware does exploitative innovation and Siemens Com does explorative innovation aiming at radical new technologies. If innovation is focused on exploring new paths, it is necessary to increase the degree of heterogeneity and to include “influencing factors”.

4.4. Dealing with the innovation dilemma: Changing groups at different stages

In this chapter, we will discuss another option to deal with the dilemma. We do not only want to look for a compromise between homogeneous and heterogeneous groups but also take into account a temporal dimension in the innovation process. In hypothesis four, we have suggested that the degree of heterogeneity is decreasing gradually during the innovation process.

Empirical evidence suggests that there is a relation between time and heterogeneity decrease. In our three case studies, heterogeneous teams turned into homogeneous groups. Furthermore, three forms of heterogeneity decreases can be distinguished. Siemens Com forms varying teams at every innovation stage, IBM uses more homogeneous groups and BrainStore initially works with a large group and later on with a small part of it.

Firstly at Siemens Com, an innovation manager explained his vision of an ideal innovation process. Firstly, managers define 'innovation fields' such as "security". Secondly, a very heterogeneous group, e.g. consumers of diverging national origins, brainstorms ideas for the innovation process. In a third step, these ideas are evaluated by experienced experts who lack groundbreaking ideas. Finally, a team of Siemens engineers develops prototypes, and product managers produce the product. Thus, teams at Siemens Com become increasingly homogeneous during the innovation process and especially different teams are used in different stages.

IBM pursues a different approach based on changes of locations. Not varying units (e.g. the marketing unit set the goals), nor professions (e.g. the business managers prescribed it), or countries (e.g. goals were defined in the US) but varying locations have an impact on the innovation process. During the interview, IBM employees spoke about "Hamburg" or "Austin" (Texas, US) where the goals are set. This construction of the reality relates to the discussion of regional networks (e.g. Cooke/Heidenreich/Braczyk 2004). We suggest that the innovation process benefits from a particular institutional set consisting of the "exploitative" location that is embedded in the "explorative" (March 1991, see chapter 4.3) location. In these locations, the same teams are working at the projects. In the long run, groups are becoming more and more homogenous, as team members get to know each other (Granovetter 1973; Gläser et al. 2004: p.12).

At BrainStore, a third strategy can be observed. This company brings together consumers, teenagers, experts, moderators and client staff. In the following stage, only the experts, moderators and employees evaluate the created ideas. At the final selection stage, only the board of managers and moderators are present. Hence, the group is gradually minimized.

To conclude, our case studies revealed that groups are gradually becoming more homogeneous in the innovation process. We distinguished three strategies: changing teams depending on the innovation stage, homogeneous tendencies in one location and stepwise minimization of the original group.

5. Conclusion

This article analysed the use of heterogeneous and homogeneous groups in the innovation process of companies. In our theoretical assumptions, we claimed that recent studies revealed two contrary positions. Some scholars argue for heterogeneous groups expecting a greater diversity of ideas which are non-redundant and go beyond individual frames of reference. In contrast, other authors claim that homogeneous groups are crucial for the creation of innovations. They expect that homogenous groups help to avoid conflicts and create trust. As none of the theories appeared appropriate, we have suggested the concept of dilemmas.

Dilemmas take into account two alternatives to the same extent. It is necessary to choose one, but the other one seems to be just as well attractive. Many scholars claim that there is an innovation dilemma between stability and change. In particular, Zaltman et al. (1973) pointed out a dilemma between heterogeneous and homogeneous groups. Following the authors it is necessary to do both generating an idea and implementing an innovation in the existing environment.

We agree that there is a dilemma between stability and change which has to be taken into account when it comes to group composition. Furthermore, several dimensions of dealing with the dilemma can be distinguished: a material, spatial, social and temporal dimen-

sion[12]. In the material dimension, compromise between heterogeneous and homogeneous groups has to be found. In the temporal dimension, the degree of heterogeneity during the innovation process is changing.

To examine the theoretical assumptions on innovation dilemmas, we conducted interviews with global players. We chose Siemens Com, the German development location of IBM and BrainStore.

All in all, our findings confirm that companies are aware of the advantages of heterogeneous groups and use them to improve their innovation process. The interviewees reported on a network of university professors, various project groups, and a business concept involving consumers, experts and teenagers.

There is a lot of evidence that professions are shaped by underlying paradigms that must be questioned to create innovations. Heterogeneous groups including people from outside the company are an effective means to dissolve paradigms. Another advantage is the feedback of the target group before innovations are launched.

Furthermore, we pointed to certain disadvantages of heterogeneous groups. Empirical evidence suggests that the more heterogeneous a group, the greater is the risk to cause conflicts or to miss the project target. One innovation manager reported on an example of an innovation project with participants with mutual aversions. This hindered communication. However, groups may also be too homogeneous resulting in the mutual reconfirmation of underlying paradigms.

When advantages and disadvantages are juxtaposed, there is a lot of evidence for the existence of dilemmas. Some interview partners see the necessity of a certain “tension” between the members of innovation groups.

Moreover, we revealed diverging concepts of the term heterogeneity. We distinguished “skills-based” heterogeneity in which only persons with technical education are brought together from “influence factors” in which, for example, consumers are included. However, a compromise between heterogeneous and homogeneous groups is not the overall solution.

An additional option to deal with the dilemma is to alter the degree of heterogeneity in the course of the innovation process. While a heterogeneous group could reveal new ideas initially, a homogeneous group could focus on building a prototype and launch the

[12] For reasons of restricted resources, we focused on the material and temporal dimension.

product in a late phase of the innovation process. Three forms were examined. Firstly, the initial group is followed by a totally different group. Secondly, homogeneous tendencies are occurring in one location. Thirdly, the original group becomes gradually minimized.

To conclude, it makes sense to analyze the innovation process in terms of dilemmas rather than suggest ‘one best ways’. In contrast to Margaret Thatcher’s saying “there is no alternative”, organizational sociologist in the context of dilemmas could draw the attention to the advantages as well as the disadvantages of every option. The usefulness of thinking in dilemmas has been confirmed by different ways to deal with it. It is not only possible to find a compromise between heterogeneous and homogeneous groups but also to take into account other options - for example a temporal one - to deal with the innovation dilemma.

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