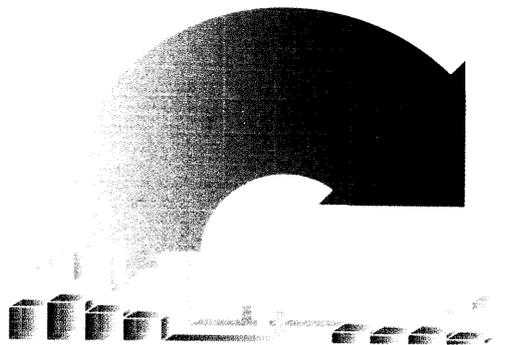


Environmentally-Friendly Product Development



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The deviation between the actual impact and predicted impact is partly due to lacking homogeneity in the design of the motors and partly due to uncertainties resulting from the attribution of processes to growth properties. But all in all, the presented approach is an efficient way to infer the environmental impacts from a known product of one size to similar different sized products and thus enables the product developer to take environmental decisions even at the conceptual phase when little is known yet about product properties.

5.6 Interdisciplinary Teamwork in Product Development

5.6.1 Task-Related Diversity as Main Characteristic of Interdisciplinary Teams

Modern product development is characterised by a number of challenges like increasing product complexity and decreasing product life cycles and development times. In order to deal with these demands, product development is more and more done by interdisciplinary teams: Within the development of environmentally friendly products, for example, experts from different fields like marketing, product development and environmental assessment are working together.

The main characteristic of interdisciplinary teams is their composition of experts with different disciplinary backgrounds. In team research, differences within a team are generally called as “diversity” (Jackson et al. 1995; Rosenstiel et al. 2004). Due to the fact that members of a team can differ from each other in numerous ways, diversity in teams is described as a multidimensional construct (Rosenstiel et al. 2004). Jackson (1996), for example, classifies the contents of diversity in teams in two dimensions: Readily detected attributes vs. underlying attributes on the one hand and task related attributes vs. relations-oriented attributes on the other hand (see Table 5.6).

Table 5.6. Attributes of diversity in teams (examples), adapted from Jackson (1996)

	Task related attributes	Relations-oriented attributes
Readily detected attributes	Department/unit membership	Sex
	Organisational tenure	Age
	Formal credential and titles	Nationality
	Education level	Ethnicity
	Disciplinary background	Religion
Underlying attributes	Knowledge and expertise	Socio-economic status
	Skills	Attitudes
	Physical abilities	Values
	Task experience	Personality

Readily detected attributes and underlying attributes are usually seen as connected (“trait-approach”, McGrath et al. 1995): The diverse composition of interdisciplinary teams for example is normally seen as connected with diversity in knowledge, expertise and task-experience.

5.6.2 Benefits of Task-Related Diversity

With respect to the performance of a team, an interdisciplinary composition is often seen as beneficial. Especially in the case of complex tasks it is expected that such teams perform better than disciplinary ones. The main reason for this expectation is the general assumption, that diversity – especially when it is task-related – fosters the performance of a team by placing a wide base of knowledge and experience at the team’s disposal (see e.g. Webber and Donahue 2001). Within the research of the CRC 392, this assumption has been tested by an empirical study (Felsing et al. 2004b) in which 36 two-person teams of different task-related diversity had to solve tasks of varying complexity within a simulated complex work environment, called CAMS (Cabin Air Management System, Sauer et al. 2000). The task-related diversity of the participants was created by different trainings with respect to system management strategies and task experience. It was expected that teams with high task-related diversity perform better than teams with low diversity especially in the case of complex tasks. Indeed, results partly showed a superiority of the diverse teams over homogeneous ones - however, a general superiority could not be found (Felsing et al. 2004b). One possible explanation for this finding may be that within the diverse teams, the vice-versa knowledge about the task-related competences and experiences of each team member (“transactive memory”,

Wegner 1986) was too small to use the teams' diversity in an optimal way. A post-experimental questioning supported this assumption. Furthermore, the time during which teams were working together was perhaps not long enough to build up and benefit from such a transactive memory (Felsing et al. 2004b). Finally, one should differentiate more accurately between the performance potential of a team and its actual performance, like Steiner (1972) did. As diverse teams may naturally have a higher performance potential than homogeneous teams, they must not benefit automatically from it, but have to be supported by special measures, like the one described below in section 5.6.4.

5.6.3 Drawbacks of Task-Related Diversity

Diversity in teams can be seen as a "double-edged sword" (Webber and Donahue 2001) because it is not only associated with a higher potential to solve (complex) tasks but also with some drawbacks or costs like, for example, negative affective reactions or conflicts (for overview see Milliken and Martins 1996 or Williams and O'Reilly 1998). To that effect, interdisciplinary teams pass as teams with a high susceptibility for "process losses" (Steiner 1972) like communication problems and conflicts (Felsing and Kopp 2003). Indeed, empirical research in this field is fairly rare. Therefore, within CRC 392 a study was carried out to examine the consequences of task-related diversity for team processes in interdisciplinary teams. For this purpose, 110 students were questioned, which were working for about three months in disciplinary and interdisciplinary project teams at the TU Darmstadt¹⁷. The subjects of this questioning were the following variables: perceived task-related diversity, conflicts, communication problems, cohesion, individual well-being of the team members and integration activities. Conflicts and well-being were measured with the standardised scales "FAKT"¹⁸ respectively "STAI"¹⁹, the other variables were gathered by self-developed instruments. All scales showed satisfactory reliabilities²⁰.

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¹⁸"Fragebogen zu arbeitsbezogenen Konflikten in Teams"/"questionnaire for workrelated conflicts in teams", Windel et al. 1999.

¹⁹"State and Trait Anxiety Inventory", Laux et al. 1981.

²⁰Cronbach's $\alpha > .7$.

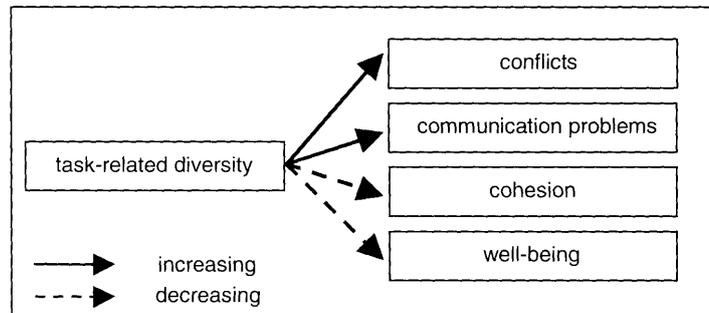


Fig. 5.30. Postulated consequences of task-related diversity in teams

It was predicted, that interdisciplinary teams are characterised through more task-related diversity and reported problems (conflicts, communications problems and detracted well-being and cohesion), than disciplinary teams. Furthermore, it was expected that the more task-related diversity is perceived by a member of a interdisciplinary or disciplinary team, the more problems should be reported from it (Fig. 5.30).

Finally, it was assumed that less problems will be reported by a team member if within the team integration activities and exchange processes took place with respect to disciplinary knowledge, experiences, goals and disciplinary speeches (Fig. 5.31).

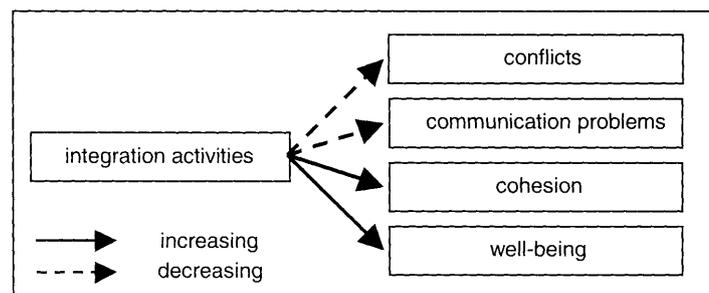


Fig. 5.31. Postulated effects of integration activities

The results of the study supported the models in Fig. 5.30 and Fig. 5.31: All obtained correlations were in the postulated direction, and became - with the exception of the relationship between integration activities and communication problems - all significant, too.

5.6.4 Interventions

The studies summed up in the previous sections, revealed two main results: Firstly, task-related diversity can be beneficial with respect to team performance. Secondly, task-related diversity can make team processes more difficult by fostering process losses like communication problems and conflicts. Furthermore, both studies show that it may be helpful to support diverse teams by purposeful trainings or team development measures to reduce their process losses and increase the benefit of their high performance potential. For this purpose, within CRC 392, a mixture of a training and team development measure was developed to support interdisciplinary project teams. The concept of this measure is mainly attached to theoretical approaches of Clark ("common ground", 1996) and Wegner ("transactive memory", 1986). It consists of four modules (see Table 5.7).

Table 5.7. Contents and objectives of a mixed training and team development measure for interdisciplinary project teams

Module	Contents and Objectives
1. Development of consciousness	- Consciousness for different disciplinary perspectives on the teams task - Tolerance of other perspectives and opinions.
2. Training of communication competencies	- Comprehensible sending of messages - Active listening and feedback giving
3. Building up a common ground	- Common apprehension of the teams task and objectives
4. Building up a transactive memory	- Vice-versa knowledge about the task-related competences and experiences of each team member

First module. The first module aims to actuate a development of consciousness with respect to task-related diversity in interdisciplinary teams. In this module the participants should learn to recognise and tolerate different disciplinary perspectives in interdisciplinary teamwork.

Second module. Within the second module, the communicative competences of the participants are trained especially with respect to comprehensible sending of messages, active listening and feedback giving. The participants have to learn to send messages which are adapted to the knowledge and perspectives of members of other disciplines than their own. Furthermore, they should develop the ability to give other team

members a constructive feedback about that what they understood from their messages.

Third module. The subject of the third module is building up a “common ground” (Clark 1996) about the team’s tasks and objectives. At the end of this process a common apprehension of the team’s tasks and objectives should be reached as a base for the further cooperation within the team.

Fourth module. In the fourth and last module, the aim is to establish a vice-versa knowledge about the task-related competences and experiences of each team member (“transactive memory”, Wegner 1986). Such a transactive memory is seen as important for the efficient allocation of tasks within a team (Brauner 2001). Within interdisciplinary teams it is often weak distinct. Therefore, it is established within the fourth module by vice-versa introductions of members of different disciplines about the task-related knowledge and expertise which is available in the single disciplines.

A short version of the described training and team development measure was used the first time to support an interdisciplinary project team of the Center of Interdisciplinary Technical Research in Darmstadt. Team members were asked about their assessment of the measure directly after its accomplishment and once again three month later. The overall mixed results showed a partly support for the chosen approach.