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Towards a Conceptual Model of Team-Based Innovation: Enablers and Obstacles of Innovation Productivity

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Abstract

The paper presents findings of a case study conducted in a highly innovative sector division of an international corporation. Results are based on semi-structured interviews, employed with key players (n = 36) of the innovation process. Objective of the interviews was the identification of central enabling and inhibiting factors of team-based innovation. Qualitative and quantitative findings of the interviews are incorporated as input and context factors of a conceptual model of innovation team performance that will be object to further empirical investigation by the research team.

Keywords
Team-based innovation, innovation productivity, obstacles and enablers, case study

1. Introduction
Innovation, the ability to develop new products or services, is the fundamental source of corporate value creation (Reichwald and Piller 2009). But contemporary organizations need more than innovative products, they must operate effective innovation processes, from idea generation to market launch, in order to maximize innovation productivity (Aschoff et al. 2009). At the majority of companies, innovation activities are however not subject to systematic management (Verloop 2013) causing a great amount of unexploited productivity potential.

Exploiting innovation productivity concerns every innovating organization independent of type, degree and impulse of innovation (Nonn 2009). The trend towards customized innovations shows that companies increasingly offer innovative services (e.g. engineering solutions) tailored to specific customer demands. The complexity of these requests forces organizations to set up cross functional innovation teams that are able to respond to the heterogeneity of requirements. The innovation team and its effective work design, subsequently turn into central elements of productive innovation management. Despite the recognized importance of innovation and the vast amount of research addressing it, little attention has been given to innovation productivity on team level. Various models have specified impact factors of general innovation productivity (e.g. Sammerl 2009; Tidd and Bessant 2011). These, to a large extend generic models however neglect specific conditions of team-based innovation productivity.

The research at hand aims to contribute to recent attempts of innovation research towards the construction of team-based models for the prediction of innovation performance (e.g. Hülseger et al. 2009, Ries et al. 2012; Somech and Drach-Zahavy 2013) by analyzing central impact factors from the micro perspective. The findings of the case study represent the first step towards the conceptualization of a systematic model that will be subject to future empirical investigation.

2. Case Study
The research is based on a qualitative case study including semi structured interviews with key players spanning the core phases of the innovation process. Objective of the interviews was the identification of critical factors that determine team-based innovation productivity within the organization. The corporation targeted for the research, a leading supplier on the home living and construction market, operates in 64 countries with more than 190,000 employees. The core business of the 175 subsidiaries in Central Europe is

to develop, produce and market high-tech building-material. The interviews were conducted in the German division of the corporation that produces high-end material for applications of the automotive industry. As technology leader of the corporate group, the success of the sector division highly depends on the creation of superior product and service innovations.

2.1 Participants

Participants (*n* = 36) of various departments, hierarchy levels and age groups were interviewed. Table 1 displays participant information in more detail. Participant selection had taken place by the operations manager of the sector division and was achieved on the basis of job-related experience and knowledge of innovation-related activities (e.g. company and division tenure, quantity of previous innovation projects).

Table 1: Information of interviewed participants

Participant	**Age** (yr) 16-30 (*n* = 9) 31-50 (*n* = 22) 51-69 (*n* = 5)	**Department**	**Management** M = Manager (*n* = 9) NM = No Manager (*n* = 27)
1	31-50	Construction	NM
2	50-69	Manufacturing	NM
3	31-50	Process Technology	NM
4	31-50	Process Technology	NM
5	31-50	R&D	NM
6	50-69	Process Technology	M
7	31-50	R&D	M
8	16-30	Maintenance	NM
9	31-50	Manufacturing	NM
10	16-30	Construction	NM
11	31-50	R&D	NM
12	16-30	Application Engineering	NM
13	31-50	Marketing	NM
14	31-50	Manufacturing	M
15	16-30	Tool Technology	NM
16	16-30	Tool Technology	NM
17	31-50	QEHS	M
18	16-30	R&D	NM
19	31-50	Application Engineering	NM
20	31-50	Manufacturing	NM
21	50-69	R&D	M
22	31-50	Manufacturing	NM
23	31-50	Customer Service	NM
24	31-50	Marketing	M
25	31-50	Maintenance	NM
26	50-69	QEHS	NM
27	31-50	R&D	NM
28	31-50	Test Laboratory	NM
29	50-69	QEHS	NM
30	31-50	Customer Service	M
31	31-50	Manufacturing	NM
32	16-30	Customer Service	NM
33	16-30	Test Laboratory	M
34	31-50	QEHS	M
35	31-50	Logistics	NM
36	16-30	Logistics	NM

2.2 Data collection and analysis

Data was collected via face-to-face interviews, which were scheduled to a conference room in the head office of the division. Within three weeks all interviews were taken; each with durations between 30 and 45 minutes. The data of each interview was captured by audio records and was complemented by observation notes of the visiting researcher. A semi-structured manual guided interview discussions and contained the topics illustrated in Table 2.

Table 2: Categories of the interview manual

No.	***Category***
1	*Introduction/Explanations*
2	*Comprehension of innovation at the division*
3	*Enablers and Obstacles of innovation projects*
4	*Innovation Culture*
5	*Innovation Leadership*
6	*Strengths and weaknesses of sector division*

Data analysis was conducted twofold. Based on audio records, the qualitative data was evaluated by content analysis, following the approach of Mayring (2000). The approach can be applied to model building and comprises the systematic reduction of data, including the stages displayed in Table 3.

Table 3: Content analysis

No	***Stage of analysis***
1	*Transformation of audio recordings into written transcripts*
2	*Iterative examination of written transcripts*
3	*Development of coding frames*
4	*Allocation according to coding frames*
5	*Quantifiable segments*

Complementary to the qualitative interview data, quantitative data was gathered by a conglomeration of existing survey items of innovation culture and innovation leadership.

2.3 Results

2.3.1 Qualitative Data

The segmentation of the qualitative data resulted in eight critical factors, impacting the success of previous innovation projects at the sector division. Depending on their occurrence, critical factors turn into enabling or inhibiting effects of team innovation. The quantified segments are summarized in Table 4.

Table 4: Obstacles and enablers of innovation projects

	Obstacle	***Critical Factor***	***Enabler***
Input factors	*Insufficient provision of time*	***Workload*** *(n = 23)*	*Provision of time for creativity*
	No access to financial resources	***Financial resources*** *(n = 19)*	*Access to innovation budgets*
	Bureaucracy	***Autonomy*** *(n = 23)*	*Responsibility of project execution*
	No dedication to change	***Leadership support*** *(n = 18)*	*High priority of innovation projects*
Context factors	*No involvement in innovation related decisions*	***Participation*** *(n = 19)*	*Integration of employees' competencies*
	Project team members only of R&D and top management	***Team constellation*** *(n = 17)*	*Composition across departments and functions*
	Patriarchal structure	***Hierarchy*** *(n = 17)*	*Fluid hierarchies*
	Risk aversion and lack of motivation	***Attitudes*** *(n = 18)*	*Willingness to take risk, motivation to change status quo*

The reason of failed innovation projects most often reported, is the lack of time for innovative thinking. The insufficient provision of time causes the main thread to the initiation of innovations. Innovation success further is inhibited due to limited access to financial resources. Innovation team members claim, that no budgets are provided, which are crucial to develop, test and experiment innovative ideas. High degrees of bureaucracy inhibit employees from making innovation-related decisions on their own. Emotional and cognitive support as well as perceived dedication to change of the responsible leader is experienced to advocate the success of innovation teams. Frustration due to absent opportunities to participate leads to decreased motivation of the development of ideas for future innovation projects. Moreover, frustration is caused when decisions about new innovation projects are made without inclusion of departments that are affected by subsequent changes. Positive experiences are reported on short communication and information distances, enabled via fluid hierarchy structures. Inherent attitudes e.g. dedication to change and willingness to take risks turn into engines of innovation team success.

2.3.2 Quantitative Data

The findings of quantitative survey data confirm and extend the qualitative data results previously described. Participants had to rank importance and status quo of innovation culture and innovation leadership items on a 6-Point Likert Scale. The mean and corresponding standard deviations of the actual and desired values are displayed in Figures 1 and 2.

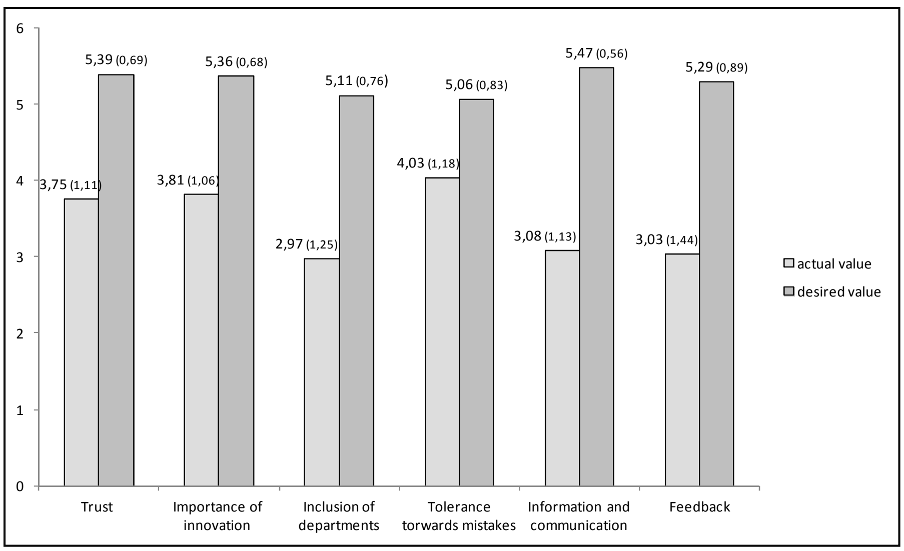

Figure 1: Survey results of innovation culture

As most important aspect of innovation culture, participants ranked information and communication behavior ($\mu = 5.47$; sd = .56), trust in employees ($\mu = 5.39$; sd = 0.69), the importance/priority of innovation ($\mu = 5.36$; sd = 0.68) and feedback on innovation ideas ($\mu = 5.29$; sd = 0.89). With mean values higher than five, the inclusion of all affected departments ($\mu = 5.11$; sd = 0.76) and the attitude to tolerate mistakes ($\mu = 5.06$; sd 0.83) were further assessed as essential to an innovation enhancing corporate culture. The most significant mismatch between actual and desired state of innovation culture, concerns the information and communication behavior (actual value = 3.03; desired value 5.47), which lends support to qualitative data and the argument of building flat hierarchies with fluid information exchange across departments and hierarchy levels. Significant discrepancies further concern feedback on innovation ideas (actual value = 3.03; desired value 5.29) and the inclusion of different departments (actual value = 2.97; desired value 5.11). These mismatches show the dissatisfaction of employees with opportunities to participate and thus confirm the critical factor *participation* previously identified in qualitative results.

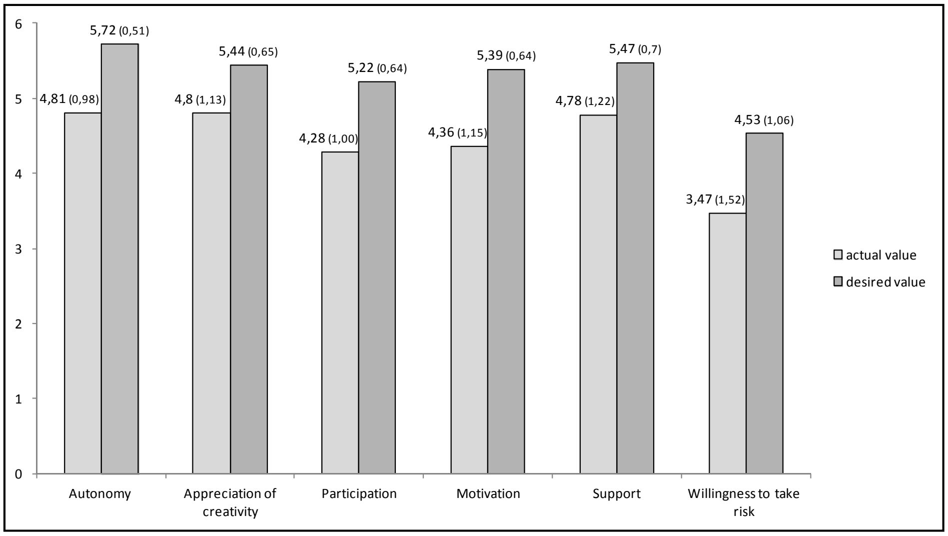

Figure 2: Survey results of innovation leadership

As most relevant aspect of innovation leadership behavior, participants rated *autonomy* in decision making processes, which supports previously elaborated survey results of innovation culture as well as qualitative results of section 2.3.1. Compared the constructs of innovation culture, the mean values of innovation leadership (figure 2) indicate relatively high standard deviations e.g. the willingness to take risk (1.52; 1.06), which shows that values of innovation leadership behavior greatly differ among the assessed leaders.

Compared to items of innovation culture, the mismatch between desired and actual values of innovation leadership behavior is rather small e.g. the desired support ($\mu = 5.47$; sd = 0.70) and the actual support ($\mu = 4.78$; sd = 1.22) of leaders or the actual ($\mu = 4.8$; sd = 1.13) and desired ($\mu = 5.44$; sd = 0.65) appreciation of creativity. The biggest mismatch between desired and actual status quo is displayed by the items of autonomy (actual value = 4.81; sd = 0.98 / desired value 5.72; sd = 0.51), participation (actual value = 4.28; sd = 1.00/ desired value 5.22; sd = 0.64), the motivation to be creative (actual value = 4.36; sd = 1.15/ desired value 5.39; sd = 0.64) and the willingness to take a risk (actual value = 3.47; sd = 1.52 /desired value 4.53 sd = 1.06).

Contrary to the assessment of innovation culture, the assessment of the status quo was evaluated rather positive. Since the interviewed participants had to evaluate their direct supervisors, results could be biased due to the participant's uncertainty of anonymity.

2.3.1 Conceptual Model

The identified impact factors of the success of team-based innovation were incorporated as input and context factors into the conceptual model, depicted in figure 3. In addition to the results of the case study, the conceptual model was build upon recent findings of innovation research concerning success factors of team based innovation.

In the model, team member characteristics and context factors are examined simultaneously. The model is based on the work of Högl (1998) and suggests an integrative perspective for the elaboration of team innovation. The central argument is that team innovation is influenced by work design and the composition of the team, facilitated by the context that may inhibit or support innovative accomplishments.

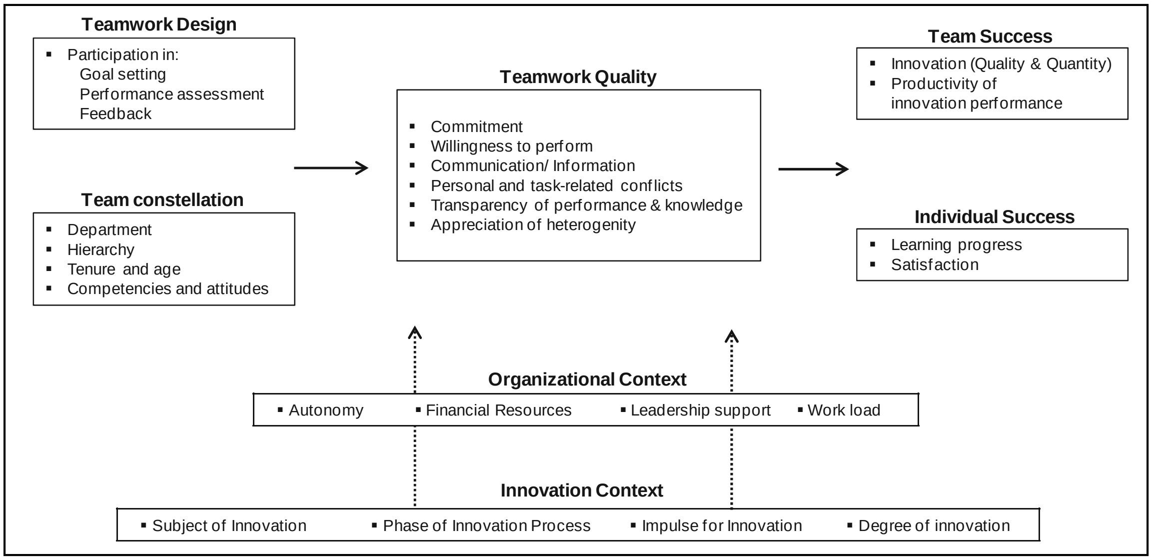

Figure 3: Conceptual map – impact factors of team-based innovation

The model is composed of five potential impact dimensions on the success of team-based innovation. 1) the input dimension, including work design and constellation of the innovation team, 2) the process dimension, constituted of team quality that compasses the development of the innovation team 3) the organizational context dimension – representing the accumulated case study results, dimension 4) the innovation context describes different impulses, subjects and degrees of innovation as well as the separation of distinct phases of the innovation process. Based on dimension 5) it shall be tested whether critical success factors of team innovations vary among particular innovation contexts. The framework of the conceptual model will guide future research and hypothesis building for a subset of variables on predicting the success of innovation teams. Future studies will be used to validate and improve the quality of the model.

4. Implications and future research

Practical implications of this research are expected to support innovation managers to understand relevant impact factors and dedicate more concern to performance improvement of innovation team processes. Moreover, the conceptual model provides the innovation research community with a reference framework and comprehensive perspective for proceeding and assessing the cause and degree of successful team innovation. Future studies of the research team will focus on the constellation and work design of heterogeneous innovation teams.

Further studies will be executed with the objective to elaborate on the effects of participation, goal setting and feedback by applying the psychological team evaluation method ProMES (Productivity Measurement and Enhancement System) developed by Pritchard (1993, 2002). The team approach will be applied to several innovation teams in order to evaluate whether the significant increases in productivity can be replicated in the context of innovation. In addition, different innovation contexts will be examined to see whether the effects of input variables e.g. team constellation differ between distinct phases of the innovation process and between different types of innovation e.g. product, service and process innovations. Finally, the case study findings will complement current research on the enhancement of a model, built to assess the productivity of knowledge-intensive services (Petz et al. 2013, Rannacher et al. 2012).

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References

Aschhoff, B., Doherr, T., Köhler, C., Peters, B., Rammer, C., Schubert, T., and Schwiebacher, F., Innovationsverhalten der deutschen Wirtschaft: Indikatorenbericht zur Innovationserhebung, ZEW, Mannheim, 2009.

Högl, M., *Teamarbeit in innovativen Projekten: Einflussgrößen und Wirkungen.* Dissertation Universität Karlsruhe. Gabler Verlag, DUV, Wiesbaden. 1998.

Hülsheger, U.R.; Salgado, J.F.; Anderson, N. Team-level predictors of innovation at work: comprehensive meta-analysis spanning three decades of research. *Journal of Applied Psychology*, vol. 94, No. 5, 1128-1145. 2009.

Mayring, P., *Qualitative Inhaltanalyse: Grundlagen und Techniken*. 9th Edition, Beltz, Weinheim, 2007.

Nonn *Analyse und Steigerung der Innovationsproduktivität –ein kompetenzbasierter und systemdynamischer Ansatz.* Dissertation Rheinisch-Westfälische Technische Hochschule Aachen. 2009

Petz, A.; Duckwitz, S.; Schmalz, C.; Mütze-Niewöhner, S.; Schlick, C.M.: Development and Evaluation of a Novel Service Productivity Model. *Proceedings of the 5th CIRP International Conference on Industrial Product-Service Systems* pp. 383-394, Bochum 2013.

Pritchard, R.D.; Kleinbeck, U.; Schmidt, K-H.) *Das Managementsystem PPM: Durch Mitarbeiterbeteiligung zu höherer Produktivität. Beck Verlag,* München, 1993.

Pritchard, R.D., Holling, H., Lammers, F., and Clark, B., *Improving organizational performance with the productivity measurement and enhancement system: An international collaboration,* 1st Edition, Nova Science Publishers, New York, 2002.

Rannacher, A., Stranzenbach, R., Sturm, F., and Mütze-Niewöhner, S., A system dynamics model of the evaluation of the productivity of knowledge-intensive services, *Scientific Research*, in press, 2013.

Reichwald, R., and Piller, F., *Interaktive Wertschöpfung: Open Innovation, Individualisierung und neue Formen der Arbeitsteilung,* 2nd Edition, Gabler, Wiesbaden, 2009.

Ries, B.C., Diestel, S., Wegge, J. and Schmidt, K.H., Die Rolle von Alterssalienz und Konflikten in Teams als Mediatoren in der Beziehung zwischen Altersheterogenität und Gruppeneffektivität. *Zeitschrift für Arbeits- und Organisationspsychologie* vol.54, pp. 117-130. 2010

Sammerl, N., *Innovationsfähigkeit und nachhaltiger Wettbewerbsvorteil: Messung, Determinanten, Wirkungen.* Dissertation. Universität Witten/Herdecke. Gabler Verlag, DUV, Wiesbaden. 2009

Somech, A., and Drach-Zahavy, A., Translating team creativity to innovation implementation: The role of team composition and climate for innovation, *Journal of Management,* vol. 39, no. 3, pp. 684-708, 2011.

Tidd, J. and Bessant, J. *Managing Innovation: integrating technological, market and organizational change*. John Wiley and Sons Ltd., West Sussex,

Verloop, J., *Success in innovation: Improving the odds by understanding the factors for unsuccess,* Elsevier, Massachusetts, 2013.

Biography

Theresa Myskovszky von Myrow received her Master of Science (M.Sc.) degree in International Business from the University Maastricht, the Netherlands in 2010. Since two years she is research assistant at the Institute of Industrial Engineering and Ergonomics at the RWTH Aachen University. Her research interests include innovation, human resource and age management with a particular focus on the development of productive R&D teams.