Role Models for Radical Innovations in Times of Open Innovation

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In this paper, we study the influence of innovator roles in highly innovative ventures. In order to obtain a differentiated picture we take into account the degree of innovativeness as a moderating variable. To test our hypotheses we use a sample of 146 highly innovative new product development projects. We choose a rigorous sampling design and apply state-of-the-art measures for the degree of innovativeness. Furthermore, we apply multi-trait-multi-method methodology (MTMM) to enhance the validity of our study. The results show that innovator roles have a strong influence on innovation success but these influences are positively and negatively moderated by innovativeness. The moderating influences depend on the type of innovativeness. Remarkably, with increasing technological innovativeness innovator roles which create inter-organizational links with the outside world appear to be more important than intra-organizational linker roles, and support from high-ranked organizational members turns out to have a significant *negative* effect on project success with higher degrees of technological innovativeness. Possible explanations for these findings are discussed and consequences for innovation research and innovation management are shown.

Introduction

Innovator roles have a long tradition in the innovation management literature. The research stream on *champions* (Schon, 1963; Chakrabarti, 1974; Rothwell et al., 1974; Maidique, 1980; Howell & Higgins, 1990a,b; Markham, Green & Basu, 1991; Shane, 1994; Markham, 1998, 2000; Markham & Griffin, 1998; Tabak & Barr, 1999; Sicotte & Langley, 2000; Howell & Shea, 2001; Markham & Aiman-Smith, 2001; Roure, 2001; Howell, Shea & Higgins, 2005) and *gatekeepers* (Allen, 1970, 1977; Aldrich & Herker, 1977; Tushman, 1977; Tushman & Katz, 1980; Tushman & Nadler, 1986; Domsch, Gerpott & Gerpott, 1989) documents that these roles are very critical for the success of innovations. Research in German-speaking countries has over the last 30 years developed four additional innovator roles which show a significant positive influence on innovation success (Klümper, 1969; Witte, 1973, 1977; Dumont du Voitel, 1976; Kaluza, 1979; Gemünden, 1981, 1985, 1994, 2003; Hauschildt & Chakrabarti, 1989; Gierschner, 1991; Pulczynski, 1991; Gemünden & Walter, 1996, 1998; Vitt, 1998; Walter, 1998; Ernst, Leptien & Vitt, 2000; Ernst & Vitt, 2000; Hauschildt & Schewe, 2000; Walter & Gemünden, 2000; Folkerts, 2001; Hauschildt & Kirchmann, 2001; Folkerts & Hauschildt, 2002; Scholl, Hoffmann & Gierschner, 2004; Gemünden, Hölzle & Lettl, 2006; Gemünden et al., 2006; Herrmann, Befurt & Tomczak, 2006; Papies, 2006; Rost, 2006; Rost, Hölzle & Gemünden, 2007; Schmidthals, 2007). These roles are called the expert, power, process, and relationship promoter. Another research stream has emphasized project management as crucial for the success of innovative projects. In particular, the characteristics of the project leader are assumed to strongly influence the success of innovative projects (Murphy, Baker & Fisher, 1974; Might & Fisher, 1985; Pinto, 1986; Baker, Murphy & Fisher, 1988; Gemünden, 1990; Gemünden & Lechler, 1997; Lechler, 1997; Cooke-Davies, 2002; Elkins & Keller, 2004; Prabhakar, 2005). There is strong evidence that the competence of the project leader has a significant positive influence on the success of innovative projects. However, all these research streams have not yet taken into account the degree of innovativeness of projects. There are some claims that innovator

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roles are particularly important in the early stages of innovation projects and for highly innovative ventures (Hauschildt, 1999; Howell & Shea, 2001), but this has neither been elaborated theoretically nor tested empirically.

Theoretical Foundation

Innovator Roles

The management of innovation requires persons who commit themselves with enthusiasm and self-motivation to the new product or process idea. These persons may or may not have been officially assigned to the innovation process. They do, however, show a high personal involvement in the innovative project and foster and nurture the project often in addition to their official organizational position. The description of this behaviour led to the development of the champion role and the role of the gatekeeper. The champion concept has for a long time been a mono-personal concept where the success or failure of the innovation process is attributed to one single person: '. . . the champion must be a man willing to put himself on the line for an idea of doubtful success. He is willing to fail. But he is capable of using any and every means . . . in order to succeed' (Schon, 1963, p. 84). Although many studies have analysed championship behaviour, Markham comes to the conclusion that the influence of champions on the success of the innovation process is not granted (Markham, 1998, p. 500). This may be explained by his very special definition of the champion which he uses in his studies, and by conceptual and methodological problems in previous research (Howell & Shea, 2001). However, recent research from Howell, Shea and Higgins (2005) does show a significant positive influence. In their excellent study, they clarified and validated the concept. They showed that, according to US managers, championship behaviour is characterized by (1) enthusiasm and confidence, (2) persistence, and (3) the capability to bring the right people together, and that this behaviour significantly increases the success of new product development projects.

The technological gatekeeper was brought into the R&D management literature by Tom Allen and his research team. The technological gatekeeper is mainly active in the research and development area. Gatekeepers establish an information and communication exchange network, filter the information needed, assemble information from internal and external sources, and provide it to their organization and its workgroups (e.g., Allen, 1970; Tushman & Katz, 1980; and the German replication study from Domsch, Gerpott & Gerpott, 1989). Although the influence of networking and the importance of knowledge import has become widely recognized in the era of 'open innovation', there has been no systematic follow-up study which considers the changes in communication by the use of the Internet.

Researchers in German-speaking countries see the innovation process as no longer driven by only one but rather four persons who should work together. First, the *power promoter* who has the necessary hierarchical power to drive the project, to provide needed resources, and to help to overcome any obstacles that might arise during the course of the project. Second, the *expert promoter* who has the specific technical knowledge for the innovation process. Third, the *process promoter* who derives his influence from organizational know-how and intra-organizational networks. He makes the connection between the power and the expert promoter and has the necessary diplomatic skills to bring together the people necessary for the innovation process. And last but not least, the *relationship promoter* who has strong personal ties not only inside but especially outside the organization, i.e., to customers, suppliers and research partners. The relationship promoter shows some parallels to the technological gatekeeper, but whereas Allen and his team have concentrated on the knowledge import, Walter and Gemünden (2000) have stressed the external exploitation of knowledge via technology licensing, technology transfer, and technology-intensive B2B relationships. Thus the German research has stressed the export of knowledge.

In the German approach promoters are defined by the type of barriers they help to overcome, the type of power bases on which their influence is grounded, and the type of characteristic value-creating functions they fulfil by their specific type of behaviour. Thus, the power promoter helps to overcome barriers of will, mainly by his legal power and his access to resources, the expert promoter helps to overcome barriers of ability by his expert knowledge, the process promoter helps to overcome bureaucratic and internal administrative barriers by means of his internal organizational networks, and the relationship promoter helps to overcome barriers of not-knowing external partners, and not being able or willing to communicate with them, by means of his external, inter-organizational networks.

The project manager is an institutionalized role model to foster innovative projects. In contrast to the other roles, a core assumption of this role is a formally assigned responsibility

for an innovative task, and this usually includes leading a team which is formally assigned to an innovative project and its project manager. Leading a project not only comprises leadership of a team, it also includes planning and controlling, as well as cooperation with various stakeholders, particularly project sponsors, project clients and project suppliers.

Many organizations aim to increase the professional level of their project management by enhancing the competencies of project managers. Examples of such efforts are career track models for project management and the certification and qualification of project managers (Hauschildt, Keim & Medcof, 2000). If project management competence matters, than the leaders of innovative projects should have more experience in leading projects and a higher competence. For our sample of radical innovations, we found that in the firms who showed higher growth and profitability figures, the leaders of innovative projects did indeed have a higher level of experience in leading projects. We therefore use a project manager's leadership experience in previous projects as a characteristic of his professional project leadership qualification.

Project Innovativeness

Recent state-of-the-art reviews show that innovativeness is best understood as a multidimensional phenomenon (Green, Gavin & Aiman-Smith, 1995; Avlonitis, Papastathopoulous & Gounaris, 2001; Danneels & Kleinschmidt, 2001; Hauschildt & Schlaak, 2001; Garcia & Calantone, 2002; Salomo, 2003) relating to market, technology, organizational change and environmental alterations.

The innovation is radical for the market if the innovation satisfies former unsatisfied needs for the first time. There is a quantum leap in customer benefits. A completely new market may be created (market potential dimension). The new product may require considerable changes in customer behaviour as well as substantial financial investments from the customers. This may lead to resistance on the part of the customer (market barrier dimension). The innovation can be called radical in the technological dimension if the knowledge about the product architecture or its components significantly differs from existing knowledge. Existing knowledge may become obsolete to some degree. The innovation often relies on completely new technological principles, new architectures or new materials. Innovativeness on the organizational dimension relates to the internal change of the innovating organization. Changes may be required in strategy, structure, processes, competencies, incentive systems or culture. In addition to these dimensions, we suggest a fifth dimension relating to environmental alterations, such as the required establishment of a new infrastructure (e.g., hydrogen filling stations), regulatory changes or changes of value systems.

Hypotheses

Innovator Roles and Project Success

In order to reconcile and integrate the research streams from the United States and the German-speaking countries, we assume that the champion largely parallels the process promoter identified in the German literature. The player of this role is usually not the project manager, but a mid-level or upper-mid-level executive who sets up the project and supports it by persistently linking it with other upper-mid-level or top-level stakeholders. In contrast to the US literature, we see the champion as only one out of several innovator roles, and try to isolate the relative importance of this role instead of seeing it as the one and only important role.

We further see two different kinds of inter-organizational boundary roles: the technology-related relationship promoter who parallels the technological gatekeeper, and a market-related relationship promoter who concentrates on the exploitation of know-how.

In contrast to the gatekeeper literature, we see the task as not only importing knowledge, but also of mobilizing technological resources outside the own organization in order to develop new products or services. Thus, the technology-related relationship promoter also knows external technology partners that engage in cooperative projects, and has good personal relationships with them. He knows how to define, establish and run cooperative R&D projects, how to create and secure trust, and how to get third-party money for such projects, particularly from public research institutions (Gemünden et al., 2006).

We thus analyse the influence of six innovator roles: expert promoters, power promoters, process promoters (champions), technology-related relationship promoters (an extension of technological gatekeepers), market-related relationship promoters, and project managers. The literature on champions, gatekeepers, promoters, and project managers usually posits a positive influence on the success of innovative projects. We therefore test the following hypothesis:

Hypothesis 1: *Success of highly innovative new product development projects increases*

with increasing influence of: (a) expert promoters, (b) power promoters, (c) process promoters (champions), (d) technology-related relationship promoters (technological gatekeepers), (e) market-related relationship promoters, and with (f) increasing leadership experience of project manager from previous projects.

The Moderating Role of Project Innovativeness

A core assumption of innovation management is that innovative tasks need to be managed in a different way from routine tasks. Were this assumption not true, there would be no need to make a distinction between management and innovation management. However, this basic assumption has not been challenged so far. There have been some investigations that have conceptualized and measured the construct 'innovativeness' (Green, Gavin & Aiman-Smith, 1995; Danneels & Kleinschmidt, 2001; Hauschildt & Schlaak, 2001; Garcia & Calantone, 2002), and there also exist some empirical studies that analyse interaction effects of success factors and innovativeness (Olson, Walker & Ruekert, 1995; Högl, Parboteeah & Gemünden, 2003). However, even in these studies radical innovations are underrepresented. This is not the case in our research project, where we took great care to ensure a sample with many highly innovative projects and which covers a broad range of innovativeness. This sample design allowed us to adequately test moderating, direct and indirect effects of innovativeness on project success.

In general, with increasing innovativeness, ambiguity and uncertainty increase and more complex learning processes are needed. Processes for discovering, diffusing and incorporating new knowledge require longer and closer cooperation between the partners involved. Therefore, these projects require special organizational attention and support. Looking at the innovation process, we find a multitude of barriers that hinder the successful progress of innovation throughout the organization. The barriers of incompetence, ignorance, unwillingness and administrative rules tie up time, money and people, resources that are needed for the successful execution of the innovation process. This holds especially true for radical innovations, which challenge the organization in every way possible. We believe that radical innovations cannot become successful without the special backing of highly committed people within the firm. Consequently, the positive effect of innovator roles is expected to be higher for radical innovations than for their incremental counterparts (Lee & Na, 1994). Therefore we formulate the following hypothesis:

Hypothesis 2: *The positive impact of (a) expert promoters, (b) power promoters, (c) process promoters (champions), (d) technology-related relationship promoters (technological gatekeepers), (e) market-related relationship promoters, and (f) project manager's leadership experience, increases with increasing project innovativeness.*

Empirical Analysis

Sample

In order to answer our research questions, it is important to ensure that innovation projects with very high degrees of innovativeness are included in our sample. Previous quantitative research has relied mainly on mailed questionnaires to a large number of companies asking each company to provide specific information with respect to a recently completed new product development (NPD) project. Following such a procedure will more than likely result in a sample of incremental to moderate innovation projects, yet few radical innovations. While radical innovations are generally supposed to be critical for a firm's long-term competitiveness, they are accompanied by high uncertainty on both the technological and the market dimensions (Leifer et al., 2000). Therefore, project termination is more likely and terminated projects are usually excluded in standard data collection procedures. Altogether, this may result in respondents being rather reluctant to disclose information about radical innovations to interested researchers.

In order to avoid these sampling problems we took a stepwise approach. First, we asked over 20 experts from different technological fields to point out different specific technological areas of strong research and advanced development activity with great potential for radical innovations. A total of 45 promising technological areas were identified (e.g., 3D imaging technology or nanotechnology). The same experts were then asked to identify companies that are very active in pursuing technological development. We then contacted these firms and asked them to participate in our study with their most radical NPD projects in their respective technological areas (e.g., flight simulator with 3D vision). Additionally, we contacted companies that had won prizes for their NPD projects. In total, 276 German companies were contacted of which 104 agreed to participate in the survey with one ongoing or recently market-launched innovation project.

The 104 interviews in 2001 were based on a questionnaire and an additional interview manual providing basic definitions for the central constructs of the study. The questionnaire had been successfully pre-tested with several R&D and marketing managers from selected companies. Using structured interviews for collecting the data allows us (a) to address respondents' concerns about confidentiality which is especially important for data on radical innovations, (b) to create a common understanding of the central constructs of the study, and (c) to reduce potential halo effects as past project phases were identified with correct dates and the specific situation of each phase was discussed intensively with each respondent.

In order to increase variance of the construct innovativeness, we gathered an additional 42 cases using questionnaires. The same questions and the same type of key informants were used. All selected companies were winners of innovation prizes. We focused on the following five industries: automotive (18%), mechanical engineering (26%), electronics (28%), software (18%) and biotech (10%) – the majority operating in a B2B environment. The sample included companies of all sizes: 38% generate revenues of more than 500 million Euro, 35% less than 50 million Euro, and the rest somewhere in between.

Measures

Innovator Roles

Data on characteristics of promoters were collected by assessments of the key informants. The rating scales for the measurement of innovator roles range from 1 to 7. The innovator roles and project management characteristics were measured by the indicators shown in Table 1.

Project Innovativeness

Project managers were asked to assess each aspect of product innovativeness as it was experienced *ex ante*. Project innovativeness was measured with the following dimensions and items: technology dimension (measured by new technological principle, quantum leap in performance, squeezing out of existing technology), market dimension I: market potential, market driver (creates totally new customer benefit, attracting many new customers, unique competitive advantages), market dimension II: market barrier (change in customer attitude and behaviour required, high learning expenditures for clients, parts of the value chain are not needed any more (e.g., B2B marketplace will replace traditional distributor)), organizational dimension (reorientation of corporate strategy, new

Table 1. Operationalization of Innovator Roles and Project Management

Characteristic	**Operationalization**
Power promoter	*'The key person supports the project above-average from a higher hierarchical level.'*
	Hierarchical rank of the key person
Expert promoter	*'The key person promotes the project by his/her high technological know-how.'*
Process promoter	*'The key person knows the organizational processes and campaigns above-average for the smooth progress of the project.'*
	'The key person acts as a link between decision makers and experts.'
Technology-related relationship promoter	*'The key person has good relationships with important external cooperation partners.'*
	'The key person supports the search for external cooperation partners, information exchange with cooperation partners and the collaboration with cooperation partners.'
Market-related relationship promoter	*'The key person promotes the project by his/her market-related know-how.'*
Leadership experience of the project leader	*Experience in leading previous projects*

organizational structure, new qualifications for employees, major change of organizational culture), and environmental dimension (creation of a new infrastructure, altered regulation in order to implement innovation, critical debate of innovation in society).

The values of the five innovativeness measures are taken as the arithmetic mean of the respective items. The five innovativeness measures correlate only moderately: discriminant validity according to the Fornell–Larcker criterion is fulfilled. This means project innovativeness is a multi-dimensional construct. Therefore, it makes sense to analyse the moderator effects of each innovativeness dimension separately.

In our multi-trait-multi-method analysis, the domain of responsibility of the two kinds of informants (market versus technology) was used as the method factor, and the five innovativeness constructs were used as traits.

Table 2 confirms the validity of our measurement: two-thirds of the variance of the items are explained by the traits, only 12% are explained by the informant's domain of responsibility and knowledge background. Some 20% are unexplained error variance. The informant bias is therefore only a moderate one. A *t*-test for paired samples of the raw items did not show any significant differences at the 5% level between the marketing and technology respondent. It should be noted that the significance of this measurement test is higher than previous tests that we have conducted as we used not only the answers of one informant from the first data collection wave, but of two informants from both data collection waves, i.e., more than 400 cases were used.

Project Success

Respondents were asked to evaluate project performance in relation to their specific goals on seven-point Likert scales. Project success measures were the traditional triple constraints of time, budget and quality. For each criterion, success is calculated as the mean score of the up to three stage assessments. In addition, meeting target cost of the new product was used as a success measure. All these measures have usually been actively controlled in the analysed projects; this means that the informants can give reliable and valid assessments.

Data Analysis Methodology

Given the relatively high number of main effects and interaction effects, and considering the six innovator roles, the five innovativeness dimensions, and the four measures of success, a highly complex multivariate test design is evident. In order to reduce complexity, and to avoid overfitting of the data, we first tested simpler models, and looked at the characteristics of the scales. We found that the interaction effects differed strongly between the different dimensions of innovativeness, so that using only one second-order construct for innovativeness would not fit. Instead, it appeared necessary to treat the different dimensions of innovativeness as distinctive influences, with each having its own moderating effect.

We decided to leave out environmental innovativeness from our analyses, because it had a highly skewed distribution. In a minority of the cases, this kind of innovativeness matters very strongly, but in the majority it does not matter at all. Market barriers did not show any main or interaction effects significant at the 5% level. Therefore we also omitted this variable from our analysis.

Empirical Results

Main Effects

Table 3 shows the results. Each column lists the results of one multiple regression, using time, quality, budget, and target cost as dependent variables. Only significant (bold, $p < 0.05$) and weakly significant (italics, $p < 0.10$) standardized estimated partial regression coefficients are shown.

It is evident that the main effects of innovativeness are not significant, with the exception of a negative effect of organizational innovativeness on budget and target cost. Research in innovation management shows that especially radically new designs need to prove their suitability in practice before being accepted on the market (Lynn, Morone & Paulson, 1996; Veryzer, 1998). Only then can product process improvements be established which enable the firm to lower the costs in order to bring the product to the mass market. Therefore, it is not necessarily surprising that a high degree of innovativeness correlates negatively with budget and target costs, particularly for unexpected cost of organizational changes.

Regarding the main effects of the innovator roles, we can see that, with the exception of the power promoter, all other innovator roles show significant positive influences and no significant negative influences. The expert promoter improves time and quality, the process promoter (champion) budget and target cost. Thus they are both very complementary. The technology-related relationship promoter increases quality and budget by fostering

Table 2. MTMM Analysis of the Innovativeness Measures

	Traits					Methods		Variance decomposition		
	T	**T2**	**T**	**T4**	**T5**	**Techno.**	**Marketing**	**Trait**	**Method**	**Error**
Technology										
T1: Technology	0.838					.263		0.702	0.069	0.229
T2: Market Drivers		0.583				0.701		0.340	0.491	0.169
T3: Market Barriers			0.852			0.258		0.726	0.067	0.207
T4: Organization Change				0.731		0.091		0.535	0.008	0.457
T5: Environment Change					0.959	–0.030		0.919	0.001	0.080
Marketing										
T1: Technology	0.770						–0.111	0.593	0.012	0.395
T2: Market Drivers		0.999					–0.043	0.998	0.002	0.000
T3: Market Barriers			0.705				–0.709	0.497	0.503	0.000
T4: Organization Change				0.840			–0.277	0.706	0.077	0.217
T5: Environment Change					0.865		–0.107	0.748	0.012	0.240
Chi^2 28.98 df 16 RMSEA 0.057 GFI 0.97 AGFI 0.92							**Mean**	**0.676**	**0.124**	**0.199**

Table 3. Results of the Regression Analyses

	Time	Quality	Budget	Target cost
Main effects – Innovativeness				
Technological dimension				
Market potential dimension				
Organizational dimension			**–0.22**	*–0.18*
Main effects – Role characteristics				
Expert promoter	**0.40**	**0.44**		
Power promoter				
Process promoter			**0.22**	**0.29**
Technology-related relationship promoter	**0.25**	*0.18*	**0.25**	
Market-related relationship promoter				
Project leader experience	**0.36**	**0.24**	**0.35**	
Interaction effects – Technological innovativeness				
Expert promoter	**–0.23**		**–0.24**	
Power promoter	**–0.30**		**–0.26**	
Process promoter	**–0.31**	**–0.23**	**–0.25**	
Technology-related relationship promoter			*0.17*	
Market-related relationship promoter	*0.20*	**0.24**		
Project leader experience	*0.19*		**0.29**	
Interaction effects – Market potential innovativeness				
Expert promoter	**0.35**		**0.20**	
Power promoter				
Process promoter				
Technology-related relationship promoter			**–0.33**	
Market-related relationship promoter				
Project leader experience				
Interaction effects – Organizational innovativeness				
Expert promoter				**–0.31**
Power promoter				
Process promoter				**0.31**
Technology-related relationship promoter	*0.18*	**0.28**		
Market-related relationship promoter	**–0.27**	**–0.26**		
Project leader experience	*–0.16*			
Explained variance (corrected measure)	*24.8%*	*14.8%*	*34.8%*	*14.9%*

cooperations with technology suppliers, and the market-related promoter improves time performance by bringing in market-related time pressures. Finally, the experienced project leader acts as expected, and helps to fulfil the three traditional project success criteria of time, quality and budget. The unexpected result that the power promoter has no significant influence deserves some comment. The projects in our sample were often strategically important, therefore at least one power promoter was found in 72% of the cases, and in 35% of the cases two or more power promoters were supporting the project. The Likert-scale to assess power-promotion '*The key person supports the project above-average from a higher hierarchical level*' goes from 1 to 7. In 51% of the projects the value '7' was chosen, in 21% '6' was chosen, i.e., there was a high amount of power promotion in most of the projects, thus there was no barrier of not wanting the innovation. In contrast to the many studies on normally innovative projects, we found that additional resources did not significantly correlate with any of our four success measures. To summarize: innovator roles have important main effects for improving the success of radical innovations. Only the power promoter showed no significant main effect, because lack of resources was not a critical success factor (see also Gemünden, Salomo & Krieger, 2005).

Interaction Effects

What are the moderating effects of innovativeness? Increasing technological innovativeness shows positive and negative interaction effects. The troika of expert, power and process promoter performs significantly poorer when technological innovativeness increases. This is quite surprising, because this troika has been advocated very often, and has been seen as the core part of the promoter models. Our findings cast doubts on this core model. We observe that the two externally oriented types of relationship promoters, and the experienced project leader, increase their positive impacts with increasing technological innovativeness. It is very likely that in cases of high technological innovativeness, a lot of new knowledge is created outside the organization, e.g., in universities and research institutions, or among competitors, suppliers and customers, so that the traditional internal troika cannot cope with these dynamics. Project managers, experienced in leading R&D projects, will nowadays also cope with cooperation partners, so that they can also handle the external sources of innovative uncertainty much better.

Market potential innovativeness also shows positive and negative interaction effects, but these are much less significant. Higher degrees of expertise as reflected by the expert promoter allow exploiting the higher market potential significantly better within time and budget. However, if this expertise does not come from within the firm, but has to be acquired from outside by means of a technological relationship promoter, it will significantly lead to budget overruns with increasing market potential.

Organizational innovativeness also shows positive and negative interaction effects, but in this case the negative interaction effects cannot be attributed to the internal innovator roles, and the positive ones to the externally oriented roles. Rather, other explanations are needed. Organizational innovation means that the organization needs to build up new competences. It has to change its processes, structures and/or its culture and value system. The negative interaction with the expert promoter indicates that relying on existing competences does not help, but will increase the problem of meeting target costs. By finding new technological partners, and fostering cooperation with them, technology-related promoters may bring in required new competences and thus save time and improve the quality of the new product. Process promoters, recognizing the value of new competences, and the need for organizational change and integration of externals, may also help to overcome the competence gap. They may bring together the right people and support organizational change by means of their internal networks. Market-related champions stress the market opportunity, but they underestimate the problems of organizational change, and therefore show negative interaction effects. The experienced project leader may cope with his project demands, but the more a change of his permanent organization is required, the more helpless he becomes, and finally his activities show negative interaction effects.

How do the innovator roles perform in the light of these findings? It can be seen that the expert promoter, who is often seen as the core actor, because technological expertise is a basic requirement of many innovations, particularly if the term 'technology' includes social technologies as well, does not always perform very well in cases of radical innovation. Where does this surprising result come from? The explanation is the source of expertise. If it comes mainly from inside the organization, based on research done in the firm's own laboratories, or on a new combination of already well understood technologies, then the expert promoter is a clear success factor, particularly if only market potential innovativeness is high. However, when radically new technologies develop outside the organization, traditional core competences may become core rigidities. The experts of the past may prefer to stay on their traditional technological trajectories, instead of recognizing the value of new technologies, based on new technological principles, new architectures or new materials.

Eberhard Witte's second promoter in his two power centre theory, the hierarchical power holder, does not show any significant main effect, but two significantly negative interaction effects with technological innovativeness. In cases of radical technological change, power promoters appear to underestimate the technological uncertainty, which may lead to tremendous time and budget overruns. Prominent examples are Concorde, the A380, or the billing system Toll Collect for trucks using German motorways. Such negative evidence is not a completely new phenomenon, having already been found in the same data that Witte analysed, only in that case there was only a power promoter but no expert promoter (Gemünden, 1981). Gemünden and Lechler (1996) showed that power promoters set up projects which lacked strategic fit, they bypassed controlling procedures, and prevented the termination of projects which should have been terminated. On the product portfolio level, Ernst (2001) showed an inverted U-shaped relationship between top-management support and profitability,

because in cases of too many resources the additional projects do not cover the cost of capital. Scholl, Hoffmann and Gierschner (2004) document further defects of power promoters which result from demotivation, if some individuals are treated preferentially and get support while others do not. The often used naïve statement that top-management support is a 'success factor' thus needs to be qualified.

Process promoters – who resemble champions in the US literature – have significant positive main influences on budget and target cost. However, with increasing technological innovativeness, they show significant negative interaction effects for time, quality and budget. These negative interaction effects with technological innovativeness are partly compensated by the fact that, in cases of increasing organizational innovativeness, process promoters appear to lower target cost, probably by bringing together people from different departments, better integrating externals, and by fostering required changes in structures and processes. Thus, the effect of process promoters depends very much on the kind of innovativeness and on their ability to open the organization to externally created innovations.

Technology-related relationship promoters, who are an extension of technological gatekeepers, show a very positive performance picture. First, they positively and directly affect quality and budget. Second, the positive influence on budget increases with increasing technological innovativeness. Third, there is a positive interaction effect for time and quality with increasing organizational innovativeness. There is only one negative interaction effect for budget with market potential innovativeness.

Market-related relationship promoters also show a very positive balanced scorecard, which is based on significant positive main effect for time, and positive interaction effects with technological innovativeness for time and quality. However, on the negative side, increasing organizational innovativeness shows negative interactions for time and quality.

Discussion and Conclusion

Our study shows that innovator roles do have a positive influence on innovation success, thus supporting our first general hypothesis. However, this positive influence does not increase with all dimensions of innovativeness, and also not for all kinds of innovator roles. Rather, we see a much differentiated picture which cannot be easily explained. Thus our second general hypothesis is not confirmed, but needs to be revised.

It appears to be that the more internal models of promoter cooperation, i.e., Schon's Champion, Witte's tandem structure of expert and power promoter, and Hauschildt and Chakrabarti's troika of expert, process and power promoter, do not fit all kinds of innovations. In the era of open innovation, technology and market-related relationship promoters are needed as boundary spanners for importing external knowledge resources, and cooperating technology partners, and for importing customer demands, and exploiting values created by innovating customers. Otherwise not-invented-here syndromes and group-think phenomena within the traditional troika may support sticking to the wrong innovation, which may be even worse than non-innovation.

Furthermore, in the area of professionalized project and innovation management, formally assigned project leaders, and professionalization of innovator roles, professionalization of cross-functional teamwork, and a good innovation system also play a very important role. This has been overlooked in the champion, gatekeeper and promoter literature.

Although our findings need to be confirmed by other studies, and by follow-ups which consider the long-term effects of radical innovations, we may already conclude that the profile of the innovativeness dimensions matters. This means that decision-makers and researchers in innovation management must take a closer look at which types of requirements are posed by an innovative problem. Although it is desirable to create new customer value, which can be defended easily without changing the own knowledge base, it will often be necessary to invent and develop new technologies, to do this together with partners in strategic alliances, or to insource new technologies from outside. In cases of radical innovation, it is more likely that the innovators also have to master organizational and societal change, and changes in competition. How much change is required should be taken into account more thoroughly, higher market potential and value creation does not always imply higher barriers and more difficulties. It is a genuine task of finding the intelligent combinations. The aim of innovation management is not to create heroes, who finally prevail against all odds or ruin their organization. The aim is to find out which are the most valuable options, taking into account potential risks, and find ways to realize these options. In times of worldwide open innovation arenas this requires open innovators.

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