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Leadership and cooperation as success factors in innovative R&D projects on electronic platforms

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Abstract

Purpose – This study examines 56 R&D projects, in each of which several organizations cooperate via an electronic system platform. The aim was to examine the relationships among leadership, cooperation, and project success (product improvements).

Design/methodology/approach – The paper investigates to what degree the relative importance of different aspects of leadership and cooperation in R&D projects on electronic platforms differs depending upon situational conditions.

Findings – Given a low level of electronic system and process integration, the frequency of personal contacts makes a significant contribution to explaining success variance. The quality of communication (team trust) is particularly important in the case of a high degree of electronic linkage. Enhancement of team spirit is more conductive to success in larger groups. Ensuring frequent personal contacts and clarifying goals, tasks, and responsibilities, respectively, contributes significantly to explaining success variance in large projects (but not in small ones). In projects with a great degree of task novelty (exploration), trustful communication becomes particularly important.

Research limitations/implications – The sample was rather small, as is the population of interorganizational cooperative projects that was studied. Further research is needed in regard to the moderator effects that is posited.

Practical implications – Knowing what is important in a particular project configuration makes it possible to take informed action with respect to the success criterion.

Originality/value – The paper shows how, in the context of R&D projects on electronic platforms, the relative importance of different aspects of leadership and cooperation depends on the specific project characteristics.

Keywords Digital communication systems, Research and development, Team working, Contingency planning

Paper type Research paper

Increasingly, products are being developed in a collaboration of different companies that cooperate with one another via electronic platforms (Weisenfeld *et al.*, 2001). In such projects, it is assumed that the project and team success is fostered by the technological aid of an electronic platform. Thus, far, there are no studies that examine what type of leadership may help in bringing to fruition the assumed technological advantages of such a technologically aided cooperation. Moreover, it is unclear how leadership of teams that cooperate via electronic platforms should take into consideration the size of the projects or teams and the degree of newness of the

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products that are to be developed. The objective of our study is to examine these questions, which are of considerable importance for practitioners.

Conceptual background and hypotheses

Cooperation and leadership aspects in R&D projects that are potentially critical for success

A systematic analysis of the pertinent literature (Anderson and West, 1994; Kim and Lee, 2003; Gerwin, 2004) leads one to expect that the following aspects of leadership and cooperation should be of importance in regard to products developed on an electronic system platform by cooperating organizations: goal clarity/goal mutuality, decision autonomy, team trust, team spirit, open vertical communication, quality of information flow, and frequency of personal contacts. Each of these variables, designated as independent variables in our study, will be considered in turn below. From a contingency approach perspective, three project characteristics are considered as situational aspects (context): the degree of electronic linkage of the cooperating organizations, the number of permanent project members (project size) as well as the newness of the problem the teams are working on. These variables will be discussed below, after the leadership and cooperation variables.

Goal clarity and goal mutuality. R&D processes are marked by a high degree of task complexity. Moreover, if several organizations cooperate by sharing the workload, there also results a high degree of task interdependence. Task complexity and task interdependence demand a clear and mutual goal orientation (Keller, 1992; Bruce *et al.*, 1995; Wageman, 2001; Sternberg *et al.*, 2004). On the basis of clear and, above all, mutually shared project goals, responsibilities, partial tasks, and intermediate goals (milestones) must be defined clearly and timely (Bonner *et al.*, 2002).

Decision autonomy. Within innovative projects it is vital that the project members are able to autonomously make decisions regarding the adequacy of their actions (Wageman, 2001; Bonner *et al.*, 2002), in the sense of a decentralized self-regulation (Thamhain, 2003; Kirkman *et al.*, 2004). This is an essential condition for learning (Mikkola, 2003) and for the development of intrinsic motivation, which is critical for innovations (Amabile, 1996).

Team trust. The suggestion of unusual ideas, the treading of new paths, and even the relaying of information makes a person vulnerable. Since, this requires trust, team trust is therefore an important predictor of team innovativeness (Edmondson, 1999; Ingham and Mothe, 1998; Zaheer *et al.*, 1998). If project members from different organizations work together, efforts towards an open project climate are relevant for success (Simons *et al.*, 1999; Farr and Fisher, 1992; Kim and Lee, 2003).

Team spirit. Team spirit engenders, among other things, an allocation of the workload that is perceived as fair, as well as a parallel result interdependence (Wageman, 2001). By thus creating a win-win situation, this serves to establish a well-functioning unit comprising project members from different organizations with different cultures, all of whom share a common social identity (Tajfel, 1981),.

Open vertical communication. The possibility for critical dialogical upward communication is important in order to prevent the impression that essential new ideas are doomed to fail from the start because superiors would object to their implementation. Open vertical communication is the medium through which the knowledge capital of the team members can be activated (Gebert *et al.*, 2003).

Quality of information flow. The rapid and timely exchange of all important and relevant information within a project team consisting of members from different organizations is a crucial coordination mechanism (Gerwin, 2004). For this reason, the quality of information flow between the persons and subsystems involved is a critical success factor in R&D projects (Kim and Lee, 2003).

Frequency of personal contacts. When project members from different organizations must cooperate, diversity within the groups increases. In view of the risks of diversity (Jackson *et al.*, 2003), it is vital to establish communication bridges. If a shared goal orientation exists, such bridges may be built through personal and informal contacts that occur on a fairly regular basis (McKnight *et al.*, 1998).

Situation dependency

The above mentioned aspects of leadership and cooperation are variables that are potentially relevant for success in interorganizational R&D projects on integrated system platforms. The aim of our study was to examine which of these aspects are *de facto* critical for success and to what degree. We posit that this depends upon the three context characteristics described below.

Degree of electronic process and system integration of the cooperating organizations. The degree of system and process integration of an electronic development platform can be measured by:

- the degree of integration of project processes into the platform;
- the number of systems of the involved organizations that are connected to the platform; and
- the number of processes and modules (= partial units of a project) that are developed and worked on via this platform.

If the degree of electronic linkage in the interorganizational R&D project is low, then the degree of transparency regarding the developmental stage of all partial processes mediated via information technology is also lower. In order to secure coordination within the project, interactional mechanisms are thus necessary for compensation (more frequent personal contacts, informal meetings). In the case of high electronic integration, coordination is based on information technology, thus reducing the need for compensatory personal coordination contacts (Boutellier *et al.*, 1998).

Moreover, personal contacts foster trust (McKnight *et al.*, 1998). In the assumption that a high degree of electronic integration between cooperating organizations is only agreed upon and installed when a high level of trust has been established between the participating firms, frequent personal contacts as a trust-building medium are less critical for success when the level of system integration is high than when the level of electronic integration is low. Hence,

H1a. When the degree of electronic linkage between the cooperating organizations is low, the frequency of personal contacts is positively related to project success; given a high level of electronic linkage, this relationship is not expected.

A high level of development-related transparency on the basis of a corresponding electronic process and system integration leads to an abundance of information with innovative potential. Innovations can be interpreted as new combinations of extant

information and knowledge bases (Gebert *et al.*, 2003). If this technologically mediated potential is to be realized fully, a complementary interactive mechanism is necessary, namely open, trustful communication: only a dialogical discussion that critically examines contradictory positions activates and utilizes the technologically developed potential for new combinations (Simons *et al.*, 1999). From this follows,

H1b. Given a high level of electronic linkage in interorganizational cooperation, open and trustful communication (team spirit) is positively connected with project success. This relationship is not expected when the level of electronic linkage between the cooperating organizations is low.

The number of permanent members in the project. In smaller project groups, as compared to larger groups, the chance is much greater that each team member comes into contact with everyone else. This explains that projects with a smaller number of project members reach a high level of group cohesion more quickly than do larger projects (Wageman, 2001). In contrast, larger interorganizational groups require more precise efforts to unite the project members in order to establish a sense of belonging for these members from different organizations. Thus,

H2a. In projects involving several organizations with a greater number of project members, there is a positive relationship between activities aimed at enhancing team spirit on the one hand and team success on the other. This relationship is less pronounced in projects with a smaller number of project members.

Interorganizational projects with a greater number of members require more coordination efforts (Gerwin, 2004; Ingham and Mothe, 1998). Possible coordination mechanisms include mutually shared goals and task models as well as clear delineations of responsibilities. Larger projects, in particular, require a clear organizational structure. Moreover, projects with many team members require continuous coordinating adjustments via informal meetings or other means. Hence,

H2b. In interorganizational projects with a greater number of project members, project success is positively connected with efforts to establish goal clarity, goal mutuality, and a clear project structure, as well as with the frequency of informal contacts. These relationships are not expected in projects with a smaller number of project members.

A comprehensive decentralization of decision powers within the project team and its members is connected with the advantages listed above, but also with diffuse forces and unplanned negative secondary effects (Sheremata, 2002; Gebert *et al.*, 2004; Atuahene-Gima, 2003). These risks exist especially in projects with a larger number of project members (and interacting organizations), since a rising number of participating persons or parties increases the plurality of interests. Thus, in extreme cases, decentralization may lead to self-obstruction (Sheremata, 2002). In smaller R&D projects this risk is reduced so that the various advantages of decentralized self-regulation (motivation, courage to tread new paths, learning, flexibility, etc.) become more salient. From this follows,

H2c. In projects with a small number of participating organizations and project members, project success is positively connected with the project teams' level of decision autonomy.

Degree of newness of the task. Theoretically, if the task involves a highly novel project – i.e. if it is not just about applying existing knowledge and entails fundamentally new approaches or re-orientations (Sternberg *et al.*, 2004) – it tends to be more of an exploration and less of an exploitation (Benner and Tushman, 2003). Exploration requires a high degree of trust within the team: the different project members must be assured that their new ideas will not be instrumentalized by others for personal reasons and that they can exchange task-oriented information without having to fear tactical ploys. Moreover, mistakes and detours should not be interpreted as weaknesses. Since, processes of exploration imply a higher risk for all involved (Benner and Tushman, 2003), a high level of trust is necessary for project success. This is much less the case in processes of exploitation, i.e. product developments whose goal is merely the improvement and refinement of existing knowledge. Thus,

H3a. In projects with a high degree of task novelty, project success is positively connected with team trust. This relationship is not expected in projects with a low degree of task-novelty.

Method

Sample

The above hypothesis were tested on $N = 56$ German R&D project teams. These project teams are special in that, on average, four organizations that are independent of one another by law cooperate on an electronic system platform in the context of new product development. The average number of permanent project members was 12 persons, and the average duration of the projects was 24 months. The degree of newness of the task was rated on a scale from 1 to 7, with an average of 5.3.

The projects are spread as follows over various industrial sectors:

- electronics/semiconductor technology: 44 percent;
- biotechnology/pharmaceutical/chemical: 25 percent;
- large scale technology (space ship technology, airplane technology, military technology): 18 percent.
- automobile technology: 13 percent.

In searching for organizations that cooperate to some degree with other, independent organizations on an electronic platform, the first author relied on her personal contacts. Further sources of information were pertinent journals, the web sites of German organizations, and the internet. $N = 450$ organizations were contacted by e-mail, $N = 115$ of which were excluded because their electronically aided R&D cooperation with other organizations was not yet fully operational. Of the remaining $N = 335$ organizations, $N = 91$ declined to participate due to time pressures and data privacy concerns, $N = 34$ declined without specifying reasons, and $N = 157$ never responded despite repeated requests. It is not known to us whether there are systematic differences between those project teams that declined to participate and those examined in our study.

Questionnaire and measurement

A standardized questionnaire was used. This questionnaire was filled out by the project leader responsible for the shared project as well as by the R&D leaders of one of the cooperation partners or some other functionally responsible person in a leadership position.

The scales and questions for measuring the pertinent aspects of leadership and cooperation, R&D success, and project characteristics, respectively, are shown in Table I.

Results

We conducted a regression analysis with "product improvement" as the dependent variable. The results are shown in Table II.

Degree of electronic linkage between the cooperating organizations

The *H1a* and *H1b* are confirmed. Given a low level of electronic system and process integration, the frequency of personal contacts makes a significant contribution to explaining success variance (this does not hold when the level of integration is high). It must be noted, however, that the overall model (*F*-value) merely shows a tendency towards significance, so that the significance of the aspect "frequency of contacts" is to be evaluated with caution.

However, not just the frequency of contacts, but also the quality of communication (team trust) significantly contributes to explaining success variance when there is a high degree of electronic linkage (this is not so when the degree of linkage is low).

Number of project members

The *H2a*, *H2b*, and *H2c* are also confirmed. Enhancement of team spirit significantly contributes to explaining success variance in large (but not in small) project groups. This result is all the more understandable if one considers that (in accord with expectations) in this study the number of project members is significantly positively correlated with the number of organizations that cooperate via an electronic platform ($r = 0.43$; $p = < 0.01$).

Ensuring frequent personal contacts and clarifying goals, tasks, and responsibilities, respectively, contributes significantly in large projects (but not in small ones) to explaining success variance. In large projects, the combination of the leadership and cooperation factors we have measured explains 79.4 percent of the success variance.

In accord with our hypotheses, decision autonomy contributes significantly to project success in small projects (but not in large projects).

Degree of newness of the task

H3a is likewise confirmed. In projects with a great degree of task novelty (exploration), trustful communication in the sense of risk absorption significantly contributes to explaining project success. In projects with low levels of newness, this relationship is less pronounced.

	Items[a]	α
Characteristics of leadership and cooperation		
Goal clarity/goal mutuality	Our R&D project has clearly defined rules and agreements	0.78
	We are all working towards the same ends	
	The R&D project organization is clearly defined	
	Our R&D project goals are preselected and given to us in a precisely defined way	
	Our R&D project consists of several partial projects and partial tasks	
	We have a shared understanding of the contents of our work in the project	
Decision autonomy	In our R&D project, we have high degrees of freedom	0.75
	In our R&D project, we can really accomplish things	
	We have the power to make decisions	
	We can influence the R&D project structure	
	We can manage and organize our projects according to our own judgments	
Team trust	In our R&D project, we work together trustfully	0.81
	We can show weaknesses without fearing negative consequences	
	Within our R&D team, we sometimes relay information that could be used against us	
	We have an open project climate	
Team spirit	In our project, we follow the rules of fair play	0.78
	Project successes are shared fairly among all	
	We celebrate project successes together	
	In our R&D project, team achievements are also rewarded as such	
Open, vertical communication	In our R&D project, we communicate openly about critical issues	0.84
	We can introduce completely new ideas into our R&D project	
	At any time, we can turn to the next higher organizational level if we have critical questions	
	The upper management supports us even in critical project phases	
	We can openly communicate upwards within the project hierarchy	
Quality of information flow	In our R&D project team, we quickly pass on and share information	0.71
	In our R&D project team, we receive all important information on time	
Frequency of personal contacts	At least once per month, our project team meets in person	0.67
	In our R&D project, we have many personal and informal meetings	
Project characteristics (context)		
Degree of integration	Degree of electronic process and system integration; number of processes worked on collectively via electronic platforms	

Table I.
Measurement

(*continued*)

	Items[a]	α
Number of persons in the project	What was the total number of persons from all organizations who worked on the project on a regular basis, not just sporadically?	
Degree of newness	Our R&D project explores new territory with many new insights	
Success criterion		
Product improvement	We have developed new products in our R&D project	0.71
	We were able to gain access to new market segments thanks to our R&D project	
	We have improved our competetive position through our R&D project	
	By incorporating an electronic B2B platform, we have improved the quality of our R&D	

Note: [a]The Likert-Scale for evaluating the items ranges from 1 to 7

Table I.

Discussion

Our study was limited in so far as the project success was not measured via objective data. With respect to this dependent variable, we were only able to obtain subjective evaluations by the respective leader of each project team. Moreover, the relationships we examine are moderator effects that could ideally be tested via interaction analyses. Owing to the relatively small sample size, however, the interaction effects we found in hierarchical regression analysis failed to reach the level of statistical significance. Ideally, such interaction analyses should be conducted with larger samples. Therefore, we report here the comparisons between the results of the regression analyses conducted for two partial samples separated by the median (Table II).

The results shown in Table II confirm the central thesis that evaluations of the relevance of aspects of leadership and cooperation may lead astray when one fails to consider context aspects, in our case the project characteristics. If one looks only at those β-weights that result for the different leadership and cooperation aspects without considering context variables, the impression may arise that mainly the frequency of personal contacts is critical for success. As the contingency approach analysis in the following columns of Table II shows, however, this is not so.

The action-oriented, pragmatic yield of the contingency approach perspective is that an awareness of the context variables enables more fine-tuned efforts in leadership and cooperation (Balachandra and Friar, 1997). One does not do everything that is possible, but focuses on that which is essential given the respective project configuration (those factors with high significant β-weights).

The example of the context variable "number of members in a project" strikingly illustrates the gains attainable by this perspective. While 41.5 percent of the success variance are explainable independently of context, the percentage of explained variance rises to 79.4 in the case of larger projects when considering the specific leadership and cooperation aspects that are important in the respective projects. If one knows what is important in the respective project configurations, it becomes possible to take informed action with regard to the success criterion.

Table II.
Regression analysis of product improvement on leadership/cooperation factors

Predictors		Without context β	Context: Degree eIntegration low β	Context: Degree eIntegration high β	Context: Number of persons involved low β	Context: Number of persons involved high β	Context: Newness low β	Context: Newness high β
Leadership and cooperation								
Goal clarity/goal mutuality		0.15	0.06	0.36	−0.25	0.63*	0.27	−0.10
Decision autonomy		0.26	0.31	0.37	0.79*	−0.13	0.48	0.07
Team trust		0.09	−0.09	0.50*	0.32	−0.06	−0.27	0.55*
Team spirit		0.08	0.49	−0.12	0.07	0.57**	0.05	0.07
Open vertical communication		−0.02	0.12	−0.37	−0.11	0.10	0.06	−0.14
Quality of information flow		0.05	−0.22	0.00	−0.04	−0.36	−0.06	−0.01
Frequency of contacts		0.30*	0.51*	−0.09	0.01	0.65**	0.35	0.25
	R	0.644	0.648	0.812	0.814	0.891	0.718	0.643
	R^2	0.415	0.420	0.660	0.662	0.794	0.516	0.413
	N	56	24	32	19[a]	21[a]	23	33
	F	4.865	1.656	6.655	3.080	7.137	2.282	2.515
	p	< 0.0001	< 0.191	< 0.0001	< 0.047	< 0.001	< 0.085	< 0.042

Notes: R – multiple correlation coefficient; R^2 – share of explained variance; β – standardized regression coefficient; $^*p < 0.05$; $^{**}p < 0.01$;
[a]Total number = 56; the reduced number $N = 19 + 21 = 40$ results from the fact that only 40 of 56 organizations have responded to questions pertaining to the number of persons involved in the project

For practical purposes and with regard to project size, this means that, in the case of many organizations or persons cooperating via an electronic platform, the following coordinating and cohesion-enhancing mechanisms are critical for success:

- goal clarity/goal mutuality;
- team spirit; and
- frequency of personal (!) contacts.

By contrast, if only a few persons cooperate via an electronic platform, it becomes important to grant high levels of decision autonomy to this small team. While this measure might not foster success in larger teams, it does so in smaller groups, possibly by evoking a positive atmosphere of entrepreneurship. This further underscores the practical importance of the findings reported in Table II.

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