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TOWARDS A SITUATIONAL APPROACH IN MANAGING COLLABORATIVE RESEARCH PROJECTS IN IT/IS – FINDING THE RIGHT CONTINGENCY FACTORS

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Abstract

Organisations that engage in research activities with industry and academic partners face many challenges in the effective management of such collaborative projects. These projects have different facets which even change over time. Examples are explorative and creative phases in which innovative research ideas and results are investigated, followed by concrete development tasks that aim at validating and prototyping these ideas. Different project management approaches are required to address each situation adequately. Building on organisational contingency theory, we argue that the project management (PM) approach needs to consider specific contingency factors characterising different context situations of a project. We analyse relevant characteristics by means of a structured literature review and summarise our findings in a morphological framework. We distinguish resource-related, outcome-related and process-related contingency factors which can be used to develop PM contingency profiles for collaborative research projects. The profiles describe a certain project situation together with the most suited management style. Application scenarios are given to illustrate the impact of our results for project managers in a collaborative research project.

Keywords: Situational Project Management, Contingency Factors, Collaborative Research Project

1 INTRODUCTION

Today, research in Information Systems and Information Technology (IS/IT) is often conducted collaboratively by industry and academic partners who share a common research interest and may have acquired additional funding through public funding bodies (Inganäs, Hacklin, & Marxt, 2009). Projects as a means to organise these activities have become increasingly widespread. Project management (PM) has emerged to offer commonly applied knowledge, skills, tools and techniques to meet project requirements (Kerzner, 2006; Office of Government Commerce, 2005; Project Management Institute, 2004). Yet, these projects face many new and un-addressed challenges since they are generally associated with high uncertainty and risks, individually oriented project personnel, heterogeneous project partners which are located at different locations, and significant pressure in terms of creativity and innovativeness (Erno-Kjohede, 2000; Inganäs et al., 2009; vom Brocke & Lippe, 2010a). In addition, certain project characteristics change during the life-cycle and thus hinder the application of a uniform project management approach from start to end. For example, a recent study on creativity in IT research projects has shown that each project passes through more or less creative and structured periods and that the perceived usefulness of creative results changes depending on the project phase (vom Brocke & Lippe, 2010b). New creative thoughts are produced during the preparation phase and certain tasks of the execution phase and a corresponding management style has to facilitate sufficient time to think and explore. Other phases require a more stringent management approach that ensures the timely production of results through documentation and implementation and that channels creativity away from these phases (vom Brocke & Lippe, 2010b).

As a consequence, project management for collaborative research projects has to develop from a static approach which is uniformly applied throughout the project life-cycle to the use of varying techniques depending on the occurrence of certain project situations (e.g. such as the need for creative freedom). The PM community has recognised that an explicitly tailored management style provides a crucial factor for project success and that the adaptation to certain project characteristics is a central task at the start of each project (Dvir, Shenhar, & Alkaher, 2003; Payne & Turner, 1999; Shenhar, 2001; Shenhar & Dvir, 2007). However, there is still a lack of flexibility when it comes to changes within the life-cycle of a project. As these changes can be frequently observed in collaborative research projects, there is a clear need for a situational project management approach. Ideally, a project manager would be able to judge a certain situation or task that occurs during the project life-cycle and be directed to a suitable project management approach which fits the specific circumstances. Within this paper we take a first step in this direction by *providing a framework to analyse each project situation within collaborative research projects in the area of IS/IT (research objective)*.

We follow the idea of organisational contingency theory (Donaldson, 2001) and transfer this to project management (section 3.1). Accordingly project management is most effective if the management approach fits certain internal and external contingencies. To derive these contingencies we then conduct a literature analysis of the constituent characteristics of collaborative research projects (section 3.2). The resulting contingencies are mapped into a morphological framework (section 3.3) which can be used to derive contingency profiles. These profiles characterise a certain situation within the project and suggest a fitting management approach. The main contribution of this work is the identification of suitable contingency factors and related values. The concrete definition of a set of contingency profiles and their validation will be subject to future research. However, we also outline the usage of the profiles in three different application scenarios and show the benefit for the project manager (section 4).

2 BACKGROUND

2.1 The Management of IT/IS Research Projects

IS/IT research projects form a temporary organisation to build, extend or apply new artefacts (information systems or technologies) under a pre-defined research objective and with constraints on costs and time (Project Management Institute, 2004; vom Brocke & Lippe, 2009). A clear distinction of research vis-a-vis software development projects is necessary although these are often referred to as a common project type (R&D projects). Development projects are profit-driven, usually end in market-ready products and have well working methods, while research projects are characterised by their problem-solving nature and unknown outcome/working methods at project start (Turner & Cochrane, 1993; vom Brocke & Lippe, 2010a). Research projects as dealt with in this paper can also contain development or coding tasks, however these serve as a proof-of-concept for the developed research results and are not directly aimed at the customer. In the context of this paper we particularly investigate public-funded collaborative research projects, where the work is jointly executed in a consortium of project partners from industry and academia (Inganäs et al., 2009) and co-financed by public funding bodies.

With the increased amount of projects and funding as well as the involvement of industrial partners also raises the need for a more professional management for this project type. Yet, research projects have rarely been considered in project management literature as opposed to the more traditional fields of construction, engineering and software development (Pinto, Cleland, & Slevin, 2002; Procca, 2008). Only few authors directly focus on their management. Erno-Kjølhed and Clarke elaborate on the large discrepancy between the nature of researchers and the strict formal processes and tasks required for professional project management and conclude that academic behaviour needs to be driven differently from the human resource management of other project types (Clarke, 2002; Erno-Kjølhed, 2000). In addition, Erno-Kjølhed assessed existing planning and scheduling techniques against certain requirements of research projects (Erno-Kjølhed, 2000). To be used successfully, these techniques need to be applied more flexibly than originally intended. Brown deals with the question whether research can be “project managed” and formulates some ground rules for the fruitful application of project management to research organisations (Brown, 1999). Inganäs et al. identified collaborative research projects as a specific model of science-industry transfer and propose the use of dynamic milestones as a suitable method for scope management (Inganäs et al., 2009). In summary, all authors argue that research projects show particular features which complicate the application of existing, widely spread PM practices and that their management is thus a crucial, yet often neglected task.

2.2 The Need for Project Type Specific Management Approaches

Project management has experienced a paradigm shift from the early assumption that “a project is a project” and can be handled via a uniform management approach, to a wide recognition of the variation of methods according to project type and contextual factors (Dvir et al., 2003; Payne & Turner, 1999; Shenhar, 2001). This is supported by various studies on the relationship of project management style and project characteristics which show that the perceived usefulness of common standards vs. tailored approaches is dependent on certain project attributes, such as the application area, size, and maturity of the executing organisation (Besner & Hobbs, 2008; Bubshait & Selen, 1992; Payne & Turner, 1999). Larger projects in mature organisations and projects with well defined tasks and deadlines make greater use of standard PM methods whereas the need for modifications and extensions rises for unconventional project types. A logical consequence for each project is to conduct an upfront analysis of the project type before deciding on the PM approach (Shenhar, 2001). This will identify possible constituent characteristics that require and thus justify the additional effort of adapting and extending existing standards and methods. Missing however is an approach which is not

limited to the project start, but that considers each changing project and adapts the management style accordingly.

2.3 Existing Classification and Contingency Frameworks

Various classification and contingency frameworks have been developed with the goal to categorise existing projects, determine similarities as well as differences and to suggest corresponding management styles. A general overview of existing frameworks is given by Crawford, Hobbs & Turner and Sauser, Reilly & Shenhar and Howell, Windahl & Seidel (Crawford, Hobbs, & Turner, 2006; Howell, Windahl, & Seidel, 2010; Sauser, Reilly, & Shenhar, 2009). Not all frameworks allow for the classification of collaborative research projects. The following table gives an overview of the frameworks that are relevant and summarises their characterisation as a project type:

Authors / Year	Description of classification approach	Classification of collaborative research projects
(Turner & Cochrane, 1993)	2x2 matrix that classifies projects according to the level of goal and methods definition.	Type 4: Neither method nor goals are defined.
(Shenhar & Dvir, 2007)	Multidimensional framework that classifies projects based on novelty, technology, complexity and pace (NTCP framework).	Pace: regular Technology: super high-tech to high-tech Complexity and novelty: largely dependent on concrete project
(Crawford & Pollak, 2004)	Differentiate projects based on 7 dimensions related to hard and soft factors.	Generally on the soft side
(Inganäs et al., 2009).	Different types of research projects into sponsored, contract and collaboration projects	Collaborative research projects as independent project type

Table 1. *Project classification frameworks to classify collaborative research projects*

The project classification supports the initial step towards a tailored PM method by grouping projects based on certain characteristics. However, several shortcomings can be identified with respect to our final goal: the development of a situational project management approach based on changing project characteristics:

First, largely absent are subsequent studies on the relationship of project characteristics and suitable project management approaches and techniques (Bubshait & Selen, 1992). No concrete guidelines are given on how to proceed in finding a suitable method once the project type has been determined.

Second, only a minor percentage of the contingency frameworks derive usable management recommendations for the identified project categories. The given management recommendations for each framework are conversely on a high level. They concentrate on giving broad directions on how to manage each project type and to develop an appropriate management approach. As such, they miss the link to the concrete implementation and application of existing project management standards.

Third, most frameworks do not consider changes during the life-cycle of a project. Turner and Cochrane recommend as a suitable management approach to slowly turn projects into a more predictable type for which conventional PM methods can be applied (Turner & Cochrane, 1993). However, this suggestion aims at detailing the project objectives and working methods as opposed to adapting the management style to the characteristics and environment of the project.

3 FRAMEWORK TO DEFINE PROJECT MANAGEMENT CONTINGENCY PROFILES

Within this section, we will step by step develop our framework for the identification of project management contingency profiles:

1. Building on contingency theory: As an underlying theory we are using the contingency theory of organisational design which is described in the next section along with a conversion of concepts to project management.
2. Analysis of relevant project characteristics: Significant for a situational management of collaborative are those characteristics that change in value during the project and require adaptations to the applied management style. These are derived in a second step based on a literature review.
3. Development of morphological framework that distinguishes resource-related, outcome-related and process-related factors: As a last step, we combine the results into a framework which can then be used to analyse each project situation within collaborative research projects.
4. Future research: the development of concrete contingency profiles from this framework which combine the characterisation of a certain situation with a corresponding management style is subject to future research. Further steps are outlined in the conclusion.

3.1 Building on Contingency Theory of Organisational Design

Our idea of situational management is based on the assumptions (1) that certain project characteristics change over time and (2) that we have an optimal condition if applied project management methods “continuously fit” these changing project conditions. Similar dependencies with a focus on general management have been outlined by the contingency theory of organisational design (Burns & Stalker, 1961; Perrow, 1967). The general concept of contingency theories has proven to be a major framework to optimise certain organisational design parameters (e.g. efficiency, strategy, leadership / management style) (Lawrence, 1993). It is based on the assumption that there is no universal optimal way to manage certain systems or situations, and what is effective in some situations may not be successful in others. Instead, the optimal course of action is contingent upon certain internal and external factors and if the influence of these are known, an organisation is able to adapt its design and thus to increase its performance (Donaldson, 2001). Misfit of contingencies and design will have a negative impact and thus organisations seek to reach and continuously attain fit by changing the organisational variable.

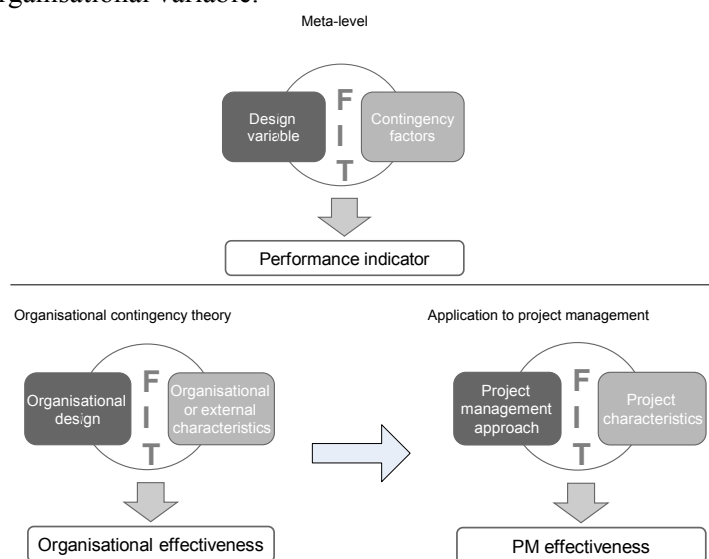


Figure 1. Contingency theory of organisations applied to project management

Figure 1 depicts the basic idea of organisational contingency theory on the bottom left: the relationship between an organisational design or structural variable (e.g. an organisational structure) and its organisational effectiveness (e.g. profitability) is determined by certain internal and external characteristics (e.g. environment, size, etc.) (Donaldson, 2001). On a meta-level, the relationship can be described as follows: the optimal value of the design variable, which is measured based on a certain performance indicator, is dependent on certain contingency factors. Applied to project management (see figure 1 on the bottom right), we can then identify the following main artefacts:

- The *project management approach*, which can be compared to the organisational design variable and
- *characteristics specific to collaborative research projects* that form the contingency factors.

The *project management approach*, more precisely the project management methodology or method, is either a formal mature set of processes or an informal technique that aids the project management team (Project Management Institute, 2004). They can be generally categorised into plan-driven, problem-structuring and emergent models (Howell et al., 2010). Plan-driven methods are based on an up-front identification of project goals and steps into a project plan and the management of this plan and its deviations. Most existing standards fall into this category. The modelling of cause-effect relationships, for example through hypergame or metagame analysis and the soft system models are summarised by the problem-structuring models (Howell et al., 2010). Emergent or agile methods address the issue of ill-defined goals and provide a highly iterative process to define and reach results. A prominent example is the SCRUM methodology. In general all categories of project management approaches are usable within collaborative research projects; however extensions and modifications are necessary based on the concrete project situation.

As contingency factors serve those *project characteristics* that change during the life-cycle of a project and hence determine the adaptations to the management approach. Their identification and combination into a morphological framework is the key contribution of this paper and is described in the next section.

3.2 Identification of Relevant Project Characteristics

The identification of relevant project characteristics is based on a literature review (vom Brocke et al., 2009). The review commenced by searching key journals (International Journal of Project Management and Project Management Journal) and databases (Ebsco Business Source Premier, Science Direct) for keywords related to the management of research projects, existing classification or contingency frameworks and the larger field of public-private partnerships and academic-industry relations and knowledge transfer. The total of results were filtered by excluding papers that

- did not directly include research projects as a specific project type (mostly relevant for contingency frameworks),
- focussed mainly on development projects (even if they were called R&D or product innovation projects),
- provided project type characteristics on a level, where they can be used for a general classification, however undoubtedly no changes during the project life-cycle are expected (e.g. the involvement of academic partners in the project, a general uncertainty of projects results, etc.), or
- were bound to a particular domain and results were not transferrable to IS/IT.

The remaining papers were analysed concerning the provided characteristics. For each article the specific characteristics of collaborative research projects were noted down and, if possible, transformed into resulting contingency factors. The transformation was based on three necessities:

- The characteristic had the prospect to change during the project duration.

- Possible occurrences or ranges were described. These were directly taken from each literature reference and not changed or complemented.
- They have a direct influence on the project management approach. In case of doubt, there were initially added and removed in later steps if they did not provide any additional content.

For example, Brockhoff focuses on the degree of novelty to distinguish different project types and classifies them according to subjective and objective novelty into “routine”, “learning”, “genius/swindler” or “innovation” projects (Brockhoff, 2006). Each research activity is usually accompanied by routine tasks (e.g. tasks related to project reporting) and also the assessment of the existing state-of-the-art (learning) is a central task to ensure novelty and executed prior to each artefact or theory development (Creswell, 2009). Thus a resulting contingency factor within a collaborative research project would be the degree of novelty with the following range: routine, innovation and learning. The results of this literature review are summarised in the table below.

Author	Identified characteristics	Resulting contingency factors
(Atkinson, Crawford, & Ward, 2006), (Crawford & Pollak, 2004)	Different aspects of uncertainty	Success measures : qualitative, mixed, quantitative Number of solution options: refinement of single solution, exploration of alternatives
(Brockhoff, 2006)	Degree of novelty	Degree of novelty: routine, innovation and learning
(Brown, 1999)	Degree of uncertainty, risk profile, degree of novelty, degree of re-use, complexity of process, inter-disciplinary involvement, dominance of scientific input, dominance of managerial input, executive role of project leader	Class of research: Experimental, pilot, demonstration and production
(Erno-Kjohede, 2000)	Predictability of output (on task level), divergence of partners	Predictability of output: high, medium, low Divergence of partners: no values provided, see (vom Brocke & Lippe, 2009)
(Inganäs et al., 2009)	Partner motives, process of knowledge transfer, interaction context and knowledge context	Direction of knowledge transfer: one-way and bi-directional
(vom Brocke & Lippe, 2009)	Project set up, nature of research work, nature of research personnel, nature of public funding	Divergence of partners: academic with similar research interest, academic with complementing research interest, industry – academic, purely industry Involved stakeholders: project internal (project personnel), partner internal (includes e.g. management level at partner organisation), Funding body, scientific community, end users Resource: Admin, researcher or project lead
(vom Brocke & Lippe, 2010a)	Problem-solving nature, unknown outcome, novelty of results, combination of tasks of different	Step in problem-solving process: solution definition, solution generation, solution validation

	predictability, high percentage of testing activities, variations in measurement of success, qualitative success measures	and testing, solution documentation and presentation Predictability of task: administrative/routine, technical (decomposable), complex research step (black box)
(vom Brocke & Lippe, 2010b)	Creative press, product, person and process (specific focus on technology research projects)	Creativity – process: generation of project vision and objectives, definition of research tasks, sense-making, creation of research results

Table 2. Analysis of project characteristics

The identified contingency factors each provide values to characterise a certain situation. This can be for example a project phase, a dedicated task or also the management of specific stakeholders.

3.3 Morphological Framework to Derive Project Management Contingency Profiles

Based on the above identified characteristics, we derive a formal framework to characterise a certain project situation. Thereby we proceed as follows: the characteristics were noted down on cards. As a first step redundancies were identified and the corresponding cards were put aside. The remaining cards were sorted into groups by means of a brainstorming exercise. We derived the following groups as a result: resource-, outcome-, and process-related factors. The following figure depicts the resulting morphological box.

Contingency Factor	Range								
Resource related									
Involved stakeholders	Project internal		Partner internal		Funding body		Scientific community		End users
Divergence of partners	Academic with similar research interests		Academic with complementing research interest		Industry-academic		Purely industry		
Resources involved	Admin		Researcher		Project lead		Management		
Outcome related									
Degree of novelty	Routine			Innovation			Learning		
Predictability	High			Medium			Low		
Number of solution options	Refinement of single solution				Exploration of alternatives				
Success measures	Qualitative			Quantitative			Mixed		
Process related									
Direction of knowledge transfer	One-way			Bi-directional			No transfer		
Predictability of task	Administrative / routine			Technical (decomposable)			Complex research step (black box)		
Duration / re-occurrence	Limited and once			Limited and re-occurring			Continuously throughout the project		
Task	Admin	Generation of project vision	Definition of research tasks	Sense-making		Generation of research results			
					Knowledge acquisition	Generation	Testing	Documentation	

Figure 2. Morphological box of project contingency factors and their occurrences

Each category can be further explained as follows:

- Resource related characteristics: these focus on the involved project personnel, the heterogeneity of the partners and the stakeholders which need to be directly considered in this situation. Concerning the involved stakeholders, these can be purely project internal (project

staff), involve further, partner internal people (such as local management), and include externals, such as the funding body, the academic community or end users. Also partners of different backgrounds can work jointly on tasks, which is expressed by the divergence of partners. The last characteristic is aimed at the role of the involved human resources. These can be admin personnel, researchers (which includes everyone involved in research task, thus also students, PhDs, developers) and the project lead.

- Outcome related characteristics: these summarise all factors that relate to the concrete output of a task our situation which needs to be managed.
- Process related characteristics: these describe the underlying working method and divide these into among a scale of creative to routine tasks. The main purpose of these factors is to classify certain situations or activities into some which are hardly predictable and some which can be planned and/or are routine or admin tasks. Knowing which are the “more risky” phases of a project is an important first step for an appropriate risk management.

An additional characteristic which, is not directly specific to collaborative research projects but has a strong influence on the project management approach is the duration or re-occurrence of a certain situation. It can be limited to a certain period in time and only occur once (e.g. contractual negotiations at the beginning of a project), it can be limited and be re-occurring (e.g. formal reporting) or it can run continuously throughout the project. It has thus been included as a last contingency factor.

A concrete project situation can now be modelled by selecting 0-n occurrences for each contingency factor and project management contingency profiles can be defined by mapping these occurrences to a specific management method. The figure below depicts an example for two different contingency profiles.

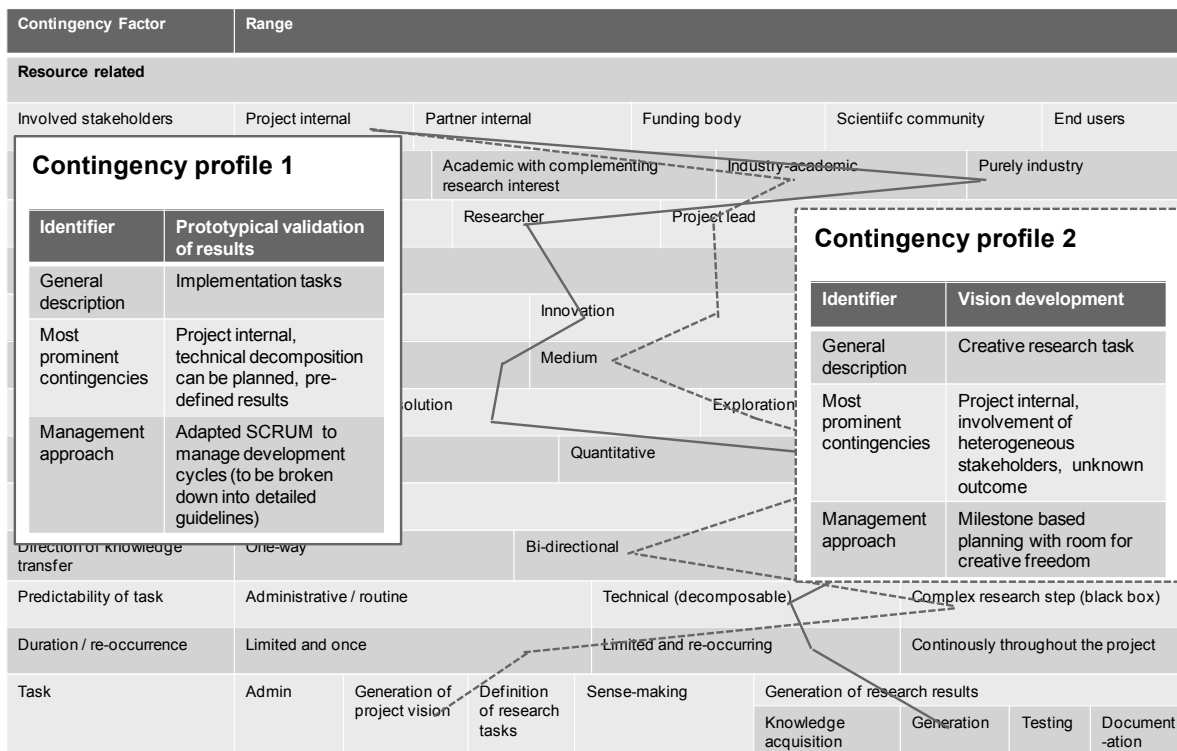


Figure 3. Examples for contingency profile

One example is the shown by the straight line. This depicts a prototype implementation, which is executed by only one partner and less creative and less uncertain in nature. The concrete results are mostly clear and it is important that the work is appropriately managed and coordinated to achieve those pre-defined result within a given time frame and allocated resources. A suitable management approach would be SCRUM as it is used in many development projects.

The dotted line shows the high creative task of defining the project vision and objectives at the start of the project. This situation is characterised by the involvement of all project partners and thus partners of different backgrounds and research interests have to work together. The outcome is defined in terms of the format (a research proposal covering different topics) and often also the general research direction. In general this task is a complex step, which usually is done in various iterations, involving a bi-direction knowledge transfer between project partners. Thus a suitable management approach would be a milestone based planning to allow for the required flexibility within this activity. Only the documentation at the end can be planned in more detailed and thus coordinated through a work-breakdown-structure.

4 APPLICATION SCENARIOS

In this section we show the explanatory power by analysing how the identified factors can be applied in real life examples. Three application scenarios are identified that focus on

- the definition of common PM contingency profiles (best practices),
- the usage within a specific project, and
- company or organisational wide use.

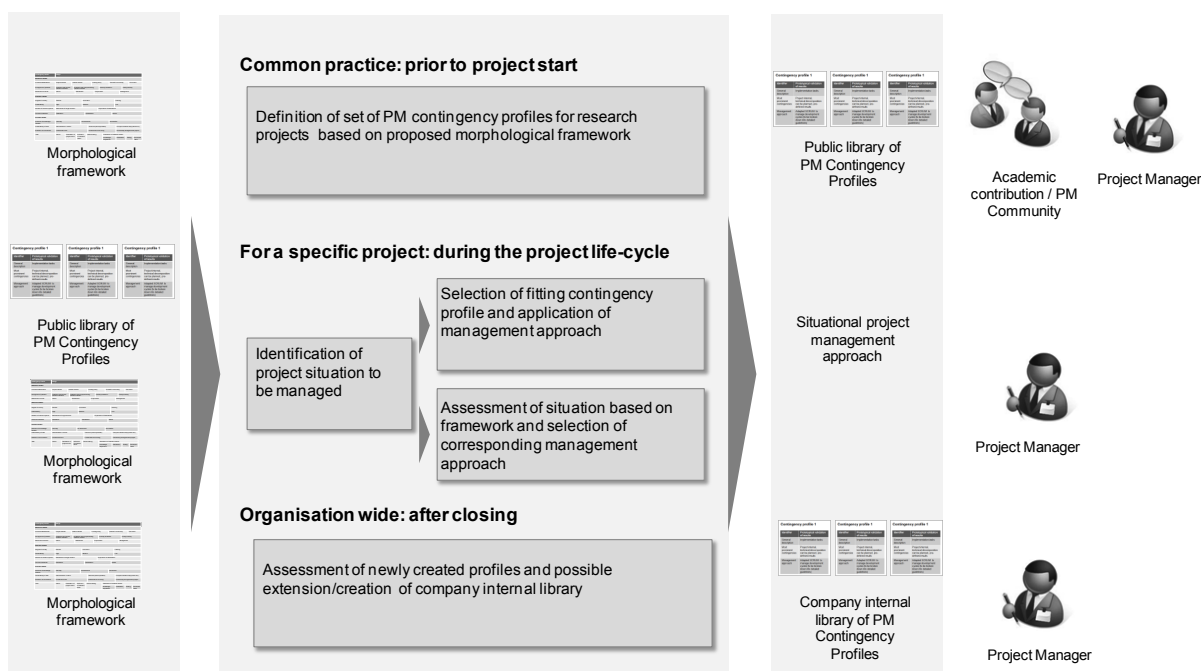


Figure 4. Application scenario for morphological framework and PM Contingency Profiles

Definition of common practice for collaborative research projects: Not each combination of occurrences within the framework reflects a realistic scenario and can be mapped to a management approach. Also, some combinations are likely to happen more often than others. Thus, a logical step is the identification of a set of major contingency profiles including corresponding management approaches which regularly re-occur in collaborative research project. This can be done through an evaluation of existing projects as well as through interviews with project management experts. The results can feed into a library or set of best practices which is commonly available and maintained through academic contribution, the PM community or even single project managers.

Management of specific collaborative research project: Within the life-cycle of a concrete project, the framework as well as the future library of profiles significantly improve the effectiveness of a project

manager when it comes to a flexible application of management styles. Every time a specific management situation is encountered, there are two options: (1) there is an existing profile including a recommended management approach in the library which fits the circumstances. This can then directly be used without the additional effort of deciding and implementing an appropriate management style and the risk of eventually making wrong choices. (2) there is no fitting profile in the library which fits the circumstances. In this case, the project manager can assess the situation by using the proposed framework and then manually select a management style. Here the main benefit lies in the formalisation of characteristics into resource-related, outcome-related and process-related factors which allow for a guided judgment of the situation.

Development of an organisation wide profile library: If an organisation is recurrently involved in the management of research projects, it can be beneficial to develop a company internal library of PM contingency profiles which takes into account company specific requirements. These can be frequently updated by each project manager as part of the closing activities.

5 CONCLUSION AND OUTLOOK

Collaborative research projects are widely spread in IS/IT research. The management of these projects differs from conventional project management in various aspects. One major challenge is to deal with continuous changes of certain project characteristics during the life-cycle of a project. Following the idea of contingency management, according to which the optimal way to manage a situation is dependent on certain internal and external factors, we provided a framework to characterise specific situations in collaborative research projects according to project management requirements. Grounded in literature, we provided a list of eleven project characteristics that (a) are of importance for situational management and (b) require changing methods depending on their values. The resulting box of contingency factors and occurrences can be used to define contingency profiles that map a project situation to a management approach in a formalised way. We presented application scenarios demonstrating how the factors can be used for situational management of collaborative IT/IS research projects. Future research can build on the developed contingency factors. In addition to refining and extending the identified factors, research can concentrate on the definition and validation of contingency profiles with a specific consideration of their occurrence in different stages classic project phases.

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