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Project management of life-science research projects: project characteristics, challenges and training needs

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Thirty-four project managers of life-science research projects were interviewed to investigate the characteristics of their projects, the challenges they faced and their training requirements. A set of ten discriminating parameters were identified based on four project categories: contract research, development, discovery and call-based projects – projects set up to address research questions defined in a call for proposals. The major challenges these project managers are faced with relate to project members, leadership without authority and a lack of commitment from the respective organization. Two-thirds of the project managers indicated that they would be interested in receiving additional training, mostly on people-oriented, soft skills. The training programs that are currently on offer, however, do not meet their needs.

Introduction

The life-science sector comprises all organizations that operate in the fields of biotechnology, pharmaceuticals, biomedical technologies, life system technologies, neutraceuticals, food processing, environmental technology and medical devices. These organizations include academic organizations such as universities and hospitals, industries such as small-to-medium sized enterprises (SMEs) and global companies, and governmental bodies. All these organizations are involved in various stages of research, such as discovery and development, technology transfer and commercialization (see http://www.infoport.ca/life/bins/content_page.asp?-cid=4364 for a full definition of the life-science sector).

Traditionally, academic groups focused on basic research. More recently, however, academic research has shifted from a truly fundamental to a more applied approach [1]. Furthermore, translational medicine fosters the integration of various disciplines within and across organizations. It is considered to be the solution to the problem of decreasing numbers of new drugs to market amid spiralling costs [2]. Public–private partnerships stimulate collaborations between academic and industrial organizations [3]. A greater emphasis on project management is required, most notably in academia, because project management is key to the success of these collaborative partnerships across and within all organizations [2,4].

Research objectives and hypotheses

Life-science research projects are expected to represent complex projects – because of a lack of clarity regarding 'how' and 'what' is to be achieved – which in turn implicates large surplus value upon success [5]. In addition, complexity is introduced by the large numbers of partners involved when multiple disciplines interact throughout all stages of drug discovery and development [6]. The number of partners is further increased by the establishment of public–private partnerships where expertise from academic and industrial organizations is combined. Furthermore, life-science projects (in particular discovery phase projects) are faced with the challenges of increased uncertainty and elevated risk [7].

Two types of projects can be identified, call-based and non-call-based projects. In call-based projects (e.g. EU and technological top institute

1359-6446/06/$ - see front matter doi:10.1016/j.drudis.2010.11.015

projects) the EU or institute defines the project scope including the area of research and the overall aim. Subsequently, consortia are invited to submit proposals addressing this aim through a so-called 'call for proposals'. A more detailed description of the EU procedure is described by Urstad and colleagues [8]. By contrast, not n-call-based projects are typically initiated by organizations themselves in response to a customer need or a request from within the company. These projects could concern discovery, development and contract research. In view of the large number of interactions and the dynamics, call-based projects are expected to be more complex than non-call-based projects.

On the basis of the above considerations, the objectives were to identify: (i) the characteristics of life-science research projects; (ii) the challenges that life-science research project managers face; and (iii) the training needs of these life-science research project managers.

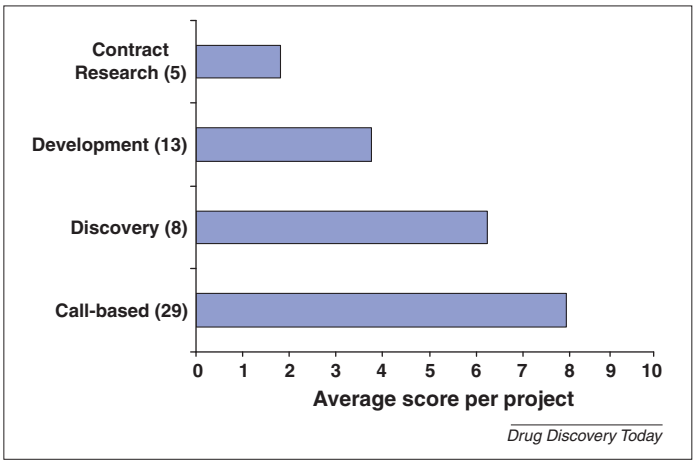

FIGURE 1

Average score of each project category based on summation of the score of the non-equally distributed parameters. The number of projects within each project category is indicated in brackets, whereby the call-based project category consisted of twelve EU, seven TI Pharma (top institute Pharma), five CTMM (center for translational molecular medicines), three TIFN (top institute food and nutrition) and two BMM (biomedical materials) projects.

Research methods

To meet these objectives, 34 project managers of life-science research projects were interviewed. The selection and characteristics of the interviewees and the questionnaire are provided as Supplementary Data I and II, respectively. The size of the test group permits statistical analysis of the data which has been carried out using the software package SPSS (statistical package for the social sciences), version 17. Three different non-parametric tests were performed because the data turned out to be unusually distributed [9]. These tests were carried out on the total score obtained by summation of the individual score on a set of parameters thought to be indicative of project complexity. The first non-parametric test that was applied was the Kruskal–Wallis test. This non-parametric test was used to analyze whether three or more groups differ. When the Kruskal–Wallis test indicated differences among the groups, supplementary Mann–Whitney's *U* tests were performed to detect which groups differed from each other. Finally, the Chi-square test was used to identify which parameters were unequally distributed among groups. Several group compositions were analyzed to identify parameters that showed an equal distribution among these groups. These parameters were subsequently omitted, and the remaining parameters were summed. Finally, second Kruskal–Wallis and Mann–Whitney's *U* tests were carried out to investigate whether this new summed score was different across the four project categories. All tests were performed two-tailed with the significance level $\alpha = 0.05$.

Project characteristics

In total, 55 projects were described by the 34 interviewees. The assumption that was made is that the life-science research projects and, in particular, the call-based projects are complex. The 12 parameters (see Table in Box 1) were scored for the individual projects and when the hypothesis was 'true' a

BOX 1

Project parameters and average score of project categories.

During the semi-structured interview, the project managers were asked to characterize their projects on 11 parameters. This list was supplemented with one additional parameter that was derived from the interviews; because 24 out of 34 project managers themselves indicated that they considered their project different from traditional projects such as construction or IT projects. This table summarizes the parameters and the scores given. Fig. 1 illustrates the average score of each project category.

Parameter	Score = 0	Score = 1
Project duration	≤1 year	>1 year
Number of partners	1	>1
National or international partners	National	International
Background of partners	R&D only	Not just R&D
Milestones	Clear	Vague
Deliverables	Clear	Vague
Principal	Clear	Vague
Pre-competitiveness of project	No	Yes
PhD students	No	Yes
Start-up meeting organized	No	Yes
Project environment[a]	Static	Dynamic
Project differs from traditional project[a]	No	Yes

[a] Parameters that were equally distributed across the project categories. Out of these 12 parameters, 'project environment' and 'project differs from traditional project' were consistently found to be equally distributed among the groups. The importance of a start-up meeting for projects with ill-defined goals and methods of achieving these goals is confirmed by Turner and Cochrane [16]. Furthermore, these authors describe how methods of project start-up and the use of milestone planning can be used effectively in these projects. These data indicated that life science projects in general are considered to be different from traditional projects. The average score of each project category based on summation of the score for the ten non-equally distributed parameters is presented in Fig. 1. The scores for the individual projects are provided as Supplementary Material III.

score of 1 was given. Otherwise the score was 0 (Box 1).

To identify the significance of the contribution of the individual parameters to the distinction between the seven different project types several statistical Chi-square analyses were carried out (data not shown). These project types were EU, technological top institute (TTI), discovery, development and contract research projects. The TTI projects were further subdivided into biomedical materials (BMM) and center for translational molecular medicines (CTMM), top institute food and nutrition (TIFN), and top institute Pharma (TI Pharma) projects. Among the 12 parameters analyzed, the project environment and whether or not the project differed from traditional projects were consistently found to be equally distributed among the groups (Box 1).

Subsequently, Kruskal–Wallis and Mann–Whitney *U* tests revealed a consistent pattern for the remaining ten parameters (the non-discriminating parameters project environment and whether or not the project was considered to be a traditional project were omitted). On the basis of these tests, four project categories were identified in decreasing order of complexity: call-based, discovery, development and contract research (Box 1).

The great uncertainty with respect to 'what' and 'how' [5] was particularly eminent for the call-based and the discovery projects that scored high with vague milestones and deliverables. The interacting, dynamically complex character [6], especially of the call-based and to a more limited extent the discovery and development projects, was confirmed in the current research by the large numbers of involved partners. The presence of partners from various countries resulted in additional complexity owing to, e.g., geographical distribution and linguistic and other cultural differences [10–12]. Exceptions were the BMM, CTMM and TIFN projects for which all partners were based in The Netherlands.

The finding that call-based projects are considered to be the most complex projects has been confirmed in the literature for EU projects. Urstad *et al.* [8] proposed that the underlying causes of this complexity are the large number of consortium partners all with their own wishes and desires, language and cultural barriers (national and international as well as organizational, that is, between academia and industry and between organizations in general) and the necessity to adhere to the very strict EU rules regarding reporting, project control and release of funds. In particular, the involvement of various countries is a key issue for these EU projects.

According to Gareis and Herlitschka [13], EU projects are not only more complex because of the number of partners and their international character but also more challenging in view of the identification of the right partners for cooperation and the alignment of corporate strategies with project objectives. Failure to achieve the latter two results in limited prioritization of the project, limited motivation of project members, personnel changes, irrelevant results and disinterest in future collaborations. A study of six university–industry R&D collaborations in the automotive and aerospace industry revealed that project success depended on the proper management of these same parameters [14].

On the basis of the above-mentioned studies, the list of predictors for complexity that was addressed in the questionnaire used in the

TABLE 1

Challenges identified by the interviewees categorized with subcategories and sub-subcategories with numbers referring to the amount of times a certain topic was mentioned

Category		Subcategory		Sub-subcategory	
Project members	32	Scientists	21	Interested in content	6
				Dislike project management	5
				Abstract reasoning, reduced empathetic ability	4
				Reduced interpersonal skills	3
				Not used to reporting	3
		Headstrong, opinionated experts	8		
		PhD needs	3	PhD has to wait too long for results	1
				PhD requires training, will not deliver in first year	1
				PhD timeline is long: 4 years	1
Team setup	25	Leadership without authority	7		
		Project partners that know each other before project begins	5		
		Different nationalities	4		
		Academia versus industry	4	Academia versus industry, no further specification	2
				Confidentiality: publish versus patent	1
				Industry more used to delivering	1
		Virtual teams and/or distant locations	2		
		Different expertise	1		
		SME (small–medium enterprise) afraid of loss of IP	1		
		Large number of partners	1		
Project	21	Content knowledge required	5		
		Uncertainty (i.e. alteration of content)	4		
		Focus on shared aim	4		
		Rules change	2		
		Long trajectory	2		
		Planning tools useless	1		
		Responsibility for results	1		
		Multiple partners	1		
		R&D and/or discovery cannot be managed	1		
Project environment	10	Lesser commitment from parent organization	7		
		Political issues	3		

current research should probably be complemented with: leadership without authority, shared aims and the level of empathy. Empathy is even more important as a predictor of complexity when the partners do not already know each other.

Project challenges

The interviewees were revealed four different categories of challenges that they were facing: project members, the team set-up, the project itself and the project environment. The score on each of these four categories and subcategories is presented in Table 1. Concerning the project members in particular: the participation of project scientists and dealing with experts were factors that were reported to be challenging. The project scientists were said to present challenges because of their focus on content, their dislike of project management, their focus on abstract reasoning at the cost of empathetic ability and having weaker interpersonal skills compared to other groups of people (Table 1). The latter two challenges, empathetic ability and interpersonal skills, are essential for effective communication.

Furthermore, with respect to the team set-up, leadership without authority was frequently put forward as was the impact of whether or not the project partners knew each other before the start of the project. Likewise, a lack of commitment from the parent organization was seen as a challenge in the context of the project environment (Table 1). These findings are in line with research by Barnes *et al.* and by Geraldi [14,15].

Finally, different nationalities and differences between academia and industry were mentioned as team set-up challenges, in line with previous research [14]. The need to have content

TABLE 2

Overview of the success factors, the attended training and the training interests of the interviewees, and observations made during a top institute Pharma (TI Pharma) project management training

	Interviewees		Observed trainees	
	Success factors	Attended training and training interests	Training interest	Total score
Communication, person specific	7	7		14
Manage stakeholders	7	5		12
Motivate team	11			11
Focus on shared aim	9		2	11
Leadership without authority	4	2	5	11
Monitoring	10			10
Focus on process, not on content	9			9
Clear assignments and responsibilities	9			9
Planning	7	2		9
Accounting		5	4	9
General soft project management skills		1	7	8
Time management		4	4	8
Personal effectiveness		5	2	7
Set priorities	5	1		6
Deadline reminders	5			5
Patience	4			4
Communicate bad news		2	2	4
Negotiation with partners		2	2	4
Delegate	3			3
Inform principal	3			3
Helicopter view	2		1	3
Consider cultural differences	1		2	3
Team communication			3	3
Contact customer	2			2
Reduce burden on scientist	2			2
Preparation	2			2
Meet all partners	2			2
Be honest	2			2
Look for opportunities	2			2
Influencing			2	2
Conflict management			2	2
General hard PM skills			2	2
Number of responses	108	36	40	184

knowledge, uncertainty (i.e. alteration of content) and keeping focus on the shared aim were most frequently mentioned as challenges relating to the project itself (Table 1).

Overall, the challenges that project managers of life-science research projects face depend partly on the project type. For instance, the project start-up and milestone planning have to be approached differently for more-complex projects where the 'what' and the 'how' are unclear [16]. Preparation of the project proposal, team building and application of call-specific rulings are the main challenges for the call-based and, particularly, the EU projects [8]. All the projects in which international partners are involved should pay special attention to trust building and effective interpersonal relationships, communication and culture [14,17–19]. Interpersonal skills were the most important success factor for the formation of product development collaborations and alliances [20].

Project management training experiences and needs

By far the greatest majority of the interviewees (75%) that received training were trained in 'hard' (tool-oriented) and 'soft' (people-oriented) project management skills. In addition to their experiences with project management courses, the interviewees were asked whether they would be interested in additional training. Indeed, 62% indicated that they would be interested in supplementary training. To get an idea of the topics that are most relevant to project management of these life-science projects, the project managers were asked about their experiences regarding 'dos & don'ts'. These experiences were acquired either on the job or through training. Furthermore, they were asked about the topics that were addressed in the courses that they attended and the topics that they considered to be of interest for supplementary project management courses. All the topics that were mentioned at least twice are depicted in Table 2. The topics mentioned by the interviewees represent the hard and the soft skills required for the project management of these life-science projects.

Several success parameters to improve project management courses were given. The introduction of real-life cases was the most mentioned parameter, followed by course design tailored to a research target group and the sharing of best practices (Table 2). The remaining suggestions for improvement were the introduction of a personal coach (of which one interviewee indicated that this had been implemented), the provision of possible solutions rather than just an inventory of the problems and the registration of the real life situation. The so-called 360° interviews with supervisors and project members could be applied to measure the impact of these factors. Private discussions about their impressions and judgments should be avoided to reduce the risk of polarization [21].

In line with the major challenges of project leaders of pharmaceutical projects [22] the interviewees faced challenges to meet the deadlines and goals as well as those regarding people interactions. In line with these concerns, planning, communication, self-confidence (poise) and team building are the most important project management skills [20,22]. Person-specific communication, team motivation, keeping focus and leadership without authority were more frequently mentioned by the interviewees than the hard skills. This is most likely because of the involvement with discovery and call-based projects. Similar findings were obtained in a survey among EU project managers and program managers where the project managers expressed an interest in training on soft skills and program managers considered hard skills more relevant for project management training [23]. Interestingly, it was reported that the courses currently on offer do not cover the needs of the project managers [23,24].

Concluding remarks

On the basis of this article several conclusions can be drawn. First of all, the life-science research projects are complex projects. Second, especially the development projects and to an even greater extent the discovery and call-based projects are considered to be very challenging by the interviewed project managers compared to contract research projects and, in particular, to traditional projects. The project members, especially the project scientists, the team set-up and the project itself are the most discriminative features of these life-science research projects. Additional attention should probably be paid to leadership without authority, shared aims and the level of empathy including whether or not the partners knew each other up front.

The focus of this research was on life-science projects. Although the development times in the pharmaceutical industry are known to be lengthy, a similar distinction among contract research, development, discovery and call-based projects is anticipated to apply to other innovation-focused industrial sectors. Furthermore, the parameters that were found to be indicative of project complexity, such as 'the presence of scientists', are characteristics of innovation projects in general. These results therefore suggest that the findings were extrapolated to other industrial sectors that rely on innovation.

Third, the top ten project management training topics as mentioned by the interviewees are person-specific communication, stakeholder management, team motivation, leadership without authority, monitoring, keeping focus, focus on process rather than on content, clear responsibilities and assignments, planning, and accounting. Thus, hard and especially soft skills are essential for a project manager to be successful.

Ideally, education of the project managers of these projects should be tailor-made to this target group, should emphasize soft skills next to hard skills and should be based on real life cases. Unfortunately, as stated earlier in this article, currently offered training by educational institutes does not match the project managers' needs.

Acknowledgements

The input of E.M. Hoogervorst and all interviewees that have contributed to this research is gratefully acknowledged.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.drudis.2010.11.015.

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