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IT Mega Projects: What They Are and Why They Are Special

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Abstract

In the last few years an increasing number of very large, publicly funded, IT development projects have gained significant media attention due to cases of budget overrun, management problems or outright failure. Examples of such projects include the European Galileo, the German Toll Collect project, or the Australian Custom's Integrated Cargo System (ICS). Further projects in an earlier life-cycle stage are the British NHS project or the renewal of the US Air Traffic Control system. These projects show a number of common characteristics, such as largeness, technological and institutional complexity, political involvement and public awareness, which set them apart from the average IT project. Drawing on both the literature on IT project management and the growing body of literature on mega projects we describe this type of project as "IT mega projects". Since IT mega projects and their management challenges are not well understood, we aim to improve our conceptual understanding by identifying and discussing typical characteristics of IT mega projects that impact on management and the resulting research issues. By pointing out their particularities we hope to pave the way for future research on IT mega projects.

Keywords: IT Mega Projects, IT Project Management, Public Private Partnerships

1 INTRODUCTION

In this paper we focus on a novel IT management phenomenon, the IT mega project, a particularly challenging type of IT project, which has gained increasing attention by public media outlets due to some spectacular and widely discussed project failures with significant repercussions for businesses and the general public. While the term 'mega projects' has been coined to describe a number of very large engineering projects, mainly dealing with the construction of public infrastructure[1], in recent years we have witnessed some very large projects dealing with the development of publicly funded information technology infrastructures.

Hence, IT mega projects typically feature the involvement of public institutions. Public funding and their potential impact on society are only two causes for the public awareness these projects enjoy in the mass media. While these projects are prominently discussed in the public space, our understanding of the particularities of such projects and their implications for both management and research is still very limited. We argue that, in order to both successfully manage and research IT mega projects, one has to gain a precise understanding of the characteristics and particularities of this type of project.

We carried out an inter-disciplinary literature analysis in which we included two large, but currently more or less unconnected, bodies of literature: literature on IT project management and literature on engineering-type mega projects. We began our study by defining the relevant search spaces within these two domains, which we subsequently searched for typical characteristics of projects belonging to the two groups 'large IT projects' and 'mega projects'. After analyzing these two types of projects we synthesised their characteristics in order to provide a characterisation of IT mega projects. In doing so, it becomes obvious that IT mega projects are essentially mega projects that aim at developing a particular type of artefact, i.e. large, complex, and novel IT infrastructures. Since IT mega projects share similar characteristics with general engineering type mega projects, such as large timeframe, high amounts of public funding, strong impact on the general public, as well as high public awareness, we argue that we need to transfer existing knowledge from the engineering domain to the IT project management community.

To better illustrate this type of project, some prominent examples are briefly introduced in the following section before we present a characterisation of large IT projects and then of mega projects. After that we synthesise our results in order to describe IT mega projects as a distinct type of project with regards to the information systems domain. We conclude with the discussion of management implications of IT mega projects and a brief outlook on future research.

2 POPULAR EXAMPLES OF IT MEGA PROJECTS

Typically, mega projects deal with the development of public infrastructure and thus receive a lot of public attention, especially in cases where things go wrong. The following projects are examples of mega projects concerned with information technology development.

2.1 The UK National Programme for Information Technology

The National Programme for Information Technology in the NHS is a prominent IT mega project launched in the UK in 2002. By making the relevant parts of a patient's clinical record available, the

[1] Many very large infrastructure projects were conducted in history: Some recent and prominent examples are the Panama Canal (formally opened in 1914), the Channel Tunnel (a rail tunnel connecting UK and France; completed in 1994), the "Big Dig" (a very large tunnel project in the centre of Boston/MA; partly opened in 2003 but still under progress), the Great Belt in Denmark (a strait linking the two main Danish Islands Funen and Zealand: opened in 1997).

project aims at improving the services and the quality of patient care. Being originally funded with a total sum of £ 12,4bn, it is the biggest IT project currently carried out in the UK.[2] In 2006, it became obvious that the project would overrun its budget estimate. In contrast to the original figures, the total amount of funding required is now calculated at £ 20bn. Also, first delays in project progress are being reported.[3]

2.2 The European Galileo global navigation satellite system

Another prominent example on the European level is the development of Galileo, a global navigation satellite system, mainly driven by the European Union and European Space Agency and positioned as an alternative to the widely known GPS or the Russian GLONASS system with a focus on commercial applications. After developing the technology and running the first prototypes, the future development is unclear today due to the change of stakeholders involved, questions about financing, responsiveness and further issues. From a project management perspective, Galileo shows many problems, such as cost overrun (due to recent changes in the consortium, the actual public funding requirement is predicted to be at least 3,4bn in contrast to 2bn estimated earlier) and schedule overrun (original estimates saw the system launch in 2008[4]; today, the system is expected not to work before 2012[5]).

2.3 The Australian Custom's Integrated Cargo System (ICS)

A particularly spectacular case of a media-attractive project can be found in Australia: the development of the so-called 'Integrated Cargo System' (ICS) undertaken by the Australian Customs authority since 1998. The project, which has been aimed at modernising the processes of the Customs authority to interact with its trading partners, exhibited the same phenomena as the other projects – cost overrun, schedule slippage and an unsatisfactory fulfilment of stakeholder requirements. These phenomena were severe enough to cause a controversial discussion in the media even before the go-live of the system in October 2005. Public attention peaked at the end of 2005 when shortly after its launch the system was responsible for country-wide impediments of cross-border logistics processes and was reported to have caused "a clear and present crisis" of Australia's foreign trade (Barker, 2005).

2.4 The German Toll Collect road charge system

Another famous example that recently attracted mass media attention and that was, at some stage, considered by public media to have 'failed' or to be a 'debacle' is the development of the German 'Toll Collect' road charge system for heavy trucks. While some mega projects might be publicly perceived as outright failures or under-performers at the end of the project, one phenomenon typical of mega projects is the changing message communicated in the mass media. The Toll Collect case illustrates this change in public opinion quite nicely. The project started with being highlighted by the administration as promising and seminal. After multiple schedule overruns and changes in the consortium[6] the project was perceived as highly problematic or even on the verge of disaster.[7] However, after its launch, which came much too late, the image of the project gradually improved due to its functioning properly. Today, it is considered a success by many[8] and regarded as a showcase of innovative technology with the potential for worldwide export.[9]

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[2] http://www.nao.org.uk/publications/nao_reports/05-06/05061173.pdf
[3] http://news.bbc.co.uk/1/hi/health/5086060.stm; http://news.bbc.co.uk/2/hi/health/6991540.stm
[4] http://www.tagesschau.de/ausland/meldung232490.html
[5] http://www.spiegel.de/wirtschaft/0,1518,472018,00.html
[6] http://www.sueddeutsche.de/wirtschaft/artikel/863/26837/
[7] http://www.zeit.de/politik/dlf/interview_040216
[8] http://www.spiegel.de/wirtschaft/0,1518,509823,00.html
[9] http://www.spiegel.de/wirtschaft/0,1518,509823,00.html

2.5 Similarities between the four projects

All presented projects show similar phenomena such as cost overrun, schedule overrun and unsatisfactory functionality or technical features.[10] Next to exhibiting these problems, the four projects have other commonalities: First, each of them was considered to be "large" or a "large IT project" (Bonner, 2005; Welchering, 2005; Zeller, 2004). Moreover, they all involve a public entity, a high amount of monetary resources and a (relatively) long time required for their development. These observations lead us to view these projects as both *large IT projects* and *mega projects*. While a number of publications in the IT project management domain explicitly deal with large IT projects, it is the research on mega projects that is particularly interesting for our purpose. Mega projects have been described and researched in the fields of public infrastructure construction and engineering. Existing work particularly deals with projects involving a public entity and large amounts of funding and time. Furthermore, literature on mega projects is especially outspoken about the problems associated with this type of project. We begin by reviewing the literature on large IT projects.

3 LARGE IT PROJECTS

3.1 Mapping the relevant literature

In order to elicit characteristics of large IT projects we first of all aimed at defining the relevant search space with regards to the body of literature that deals with large IT projects. In doing so, we had to first clarify our understanding of what 'IT' refers to. We then concentrated on literature that deals with IT project issues and also focuses on 'large' projects. Information technology is a wide and heterogeneous field; it "refers broadly to the technology of computers and electronic communications as applied to processing, transfer, and storage of information." (Peterhans, 1997, 37) Information technology can then further be distinguished in hardware and software. Moreover, information technology is normally part of an *information system,* which adds to the technology part the human and organisational dimension, i.e. information systems are socio-technical systems. Consequently, our search space comprises literature dealing with projects involving IT, information systems, and hardware technology and software applications. According to Heinrich and Lehner (2005), an IT project can deal with different tasks, e.g. the development of new information systems, the migration or outsourcing of existing systems, as well as the procurement of systems. In our context, the development of new systems can be seen as the most relevant aim of IT projects. However, it has not yet been clarified which research areas are particularly relevant to *large* IT projects. In fact, most sources in the above mentioned areas are not explicitly dealing with largeness or any other kind of measurement dimensions (e.g. complexity). Consequently, we particularly looked for those sources that include an explicit reference to size or largeness by mentioning the terms *large*, *big*, *large-scale* or *complex* either in the title or text/abstract. For the further identification of the characteristics of 'largeness' in IT projects a first step is to find out what dimensions are normally used to describe the size of IT projects and then to determine which values commonly function as the threshold distinguishing large IT projects from smaller projects. Here, it quickly became obvious that definitions of project size change rapidly over time.

3.2 Characteristics of large IT projects

The first and most obvious characteristic of large IT projects is that these projects aim at the *creation of information technology*, independent from any matter of project size. With regard to project size,

[10] For the virtual job market see Anon (2004); Lange (2003); for the Toll Collect system refer to Schwenn (2005); Anon (2004); and for the health card refer to Germis (2006); Knop (2006); Grimme (2005).

firstly the *long project duration* can be identified – large IT projects typically run for a certain amount of time. The time span that is required for a project to be regarded as large changed significantly over time. In 1980, Zmud (1980) considered a development period of more than six months as an indicator of largeness. This is in strong contrast to what Eckstein and Josuttis (2004) consider large 24 years later: they regard 20 years as an example of long project duration. While the range is very broad it indicates that largeness has to do with project duration.

In addition to duration, project size also refers to the number of people involved in a project. In 1985, Floyd and Pasch (1985) consider software projects involving more than one developer to be large, whereas newer sources define large software projects as those involving between 50 and 100 developers (Elshamy & Elssamadisy, 2006), or, in more general terms, large IT projects involve more than 100 and up to 1000 people (Eckstein & Josuttis, 2004). Typically, the two dimensions 'number of people' and 'duration' are combined and more generally referred to as the *large amount of resources required* for carrying out the project (Eckstein & Josuttis, 2004; Floyd & Pasch, 1985). Consequently, a large project is considered to require an effort greater than 25 person-years (Floyd & Pasch, 1985). Another aspect of size closely linked to effort is high cost. As such, cost is typically dependent on other dimensions, e.g. the amount of staff employed.

A further aspect of size is the *involvement of multiple stakeholders* according to the number and diversity of participating organizations or groups of individuals. Jones and McLean (1970) give several examples of what they consider as large software projects and these all involve a high diversity of organizations. Additionally, Zmud (1980) refers to the number of management levels when discussing the definition of 'largeness'. With regards to the human factors, it is worth mentioning that in the 1996 special issue of IEEE software on large software projects the editorial highlighted as "particularly striking" the fact that all articles dealt with the same aspects, namely the "cultural and sociological concerns that help or hinder large projects" (DeMarco, 1996, 26).

Finally, we are able to identify technology-related dimensions for the size of IT projects. This follows from the assumption that the size of the project corresponds with the size of the system that is being developed. Hence, it can be reasonably expected that the size of the system allows distinguishing large IT projects from smaller ones; we subsume these aspect under *complexity of the IT solution*. The complexity of an IT system is usually defined by either the diversity of its functions (Morgenbrod & Remmele, 1985; Jones & McLean E. R., 1970) or the amount of code (Weyuker, 1999; Floyd & Pasch, 1985). Again, the measure is subject to change. In 1985, large systems were seen as having between 10.000 and 100.000 lines of code, while in 1999 large software systems featured a million or more lines of code (Weyuker, 1999; Floyd & Pasch, 1985).

In summary, what sets large IT projects apart from the mass of IT projects is two core features: (1) they involve the development of large and complex IT artefacts, (2) they require large amounts of resources, e.g. in terms of time, number of people, cost, participating organisations and groups. Hence, they are complex both in technical and social/organisational terms. See figure 2 for a summary of characteristics.

4 MEGA PROJECTS

4.1 Mapping the relevant literature

When engaging with the literature on mega projects it becomes immediately obvious that mega projects are generally concerned with the development of technology, i.e. they are typically engineering projects aiming at developing large parts of public infrastructure. Another prominent characteristic is the problems typically associated with mega projects such as budget overrun, management problems and project failure. In order to identify the relevant characteristics of mega projects we aimed to not only rely on sources that feature the term "mega project" in their title, but to enlarge the search space

by way of identifying literature that deals with the same phenomena. Hence, relevant information on mega projects was also expected to exist in other studies on technology projects or technology management, and in sources that are explicitly devoted to project management problems. An example for the latter is Hall's (1980) book 'Great Planning Disasters' as it involves physical, technology-related projects and particularly deals with the problems of cost escalation and quality issues.

Conceptually, we identified a topic map (or landscape) of keywords that on the one hand describes and characterises the domain of mega projects and on the other hand guided our literature research, e.g. the identification of relevant sources (see figure 1). In doing so, further literature sources that were identified deal with complex technologies such as resource projects, transportation infrastructure or scientific projects. Hence, 'engineering' is a general keyword representing a research area that is potentially relevant for describing mega projects. Another important search keyword of course was *size*, derived from the prefix *mega,* which is "used to add the meaning 'extremely big' or 'a large amount'" (Cambridge University Press, 2007). This served to identify more relevant sources, e.g. Miller and Lessards's (2000) book 'The Strategic Management of Large Engineering Projects' and Collingridge's (1992) book 'The Management of Scale. Big Organizations, Big Decisions, Big Mistakes', which both contributed to our understanding of mega projects.

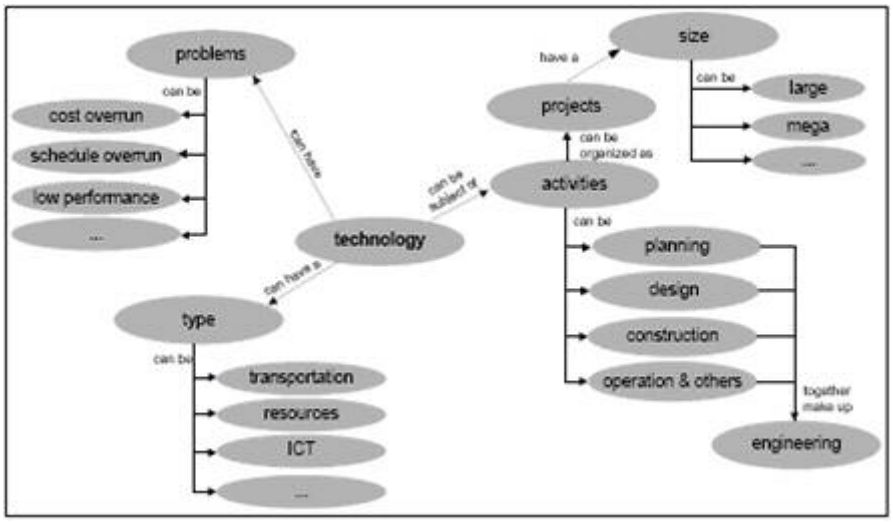

Figure 1: Mega projects topic landscape

4.2 Characteristics of mega projects

As discussed above, mega projects and the relevant body of literature are first and foremost characterised by the size of the projects, the common perception that mega projects often exhibit typical managerial problems and the fact that complex technologies are developed. This leads us to the identification of the first characteristic: Mega projects usually aim at the *construction of a technological product* of considerable size and complexity. Prominent examples are construction projects in the fields of transport infrastructure and resources extraction.[11] Other types of technologies are described as 'high-tech' or scientific artefacts, such as particle accelerators (Stough & Haynes, 1997).

Second, typical for mega projects is their *very long project duration*, e.g. it can take up to several decades for the final product to be delivered (Capka, 2004; Haynes, 2002; Stough & Haynes, 1997; Merrow, 1988). This poses a challenge to project participants and planners as the long time provides

[11] See (Flyvbjerg, Bruzelius & Rothengatter, 2003), (Gunton, 2003), (Kumaraswamy & Morris, 2002), (Szyliowicz & Goetz, 1995), (Merrow, 1988) and (Sewell, 1987).

plenty of opportunities for changes to occur within the project or its environment, and these may cause a different project outcome than originally intended and planned (Merrow, 1988).

Third, many authors refer to the *very large amounts of resources* needed, e.g. physical supplies, funds and labour. The total amount of funding that is regarded typical for a mega project varies between authors, but figures of up to $1 billion are not considered unusual (Sewell, 1987). As Hall puts it, mega projects typically require "a great deal of money by almost anyone's standard" (1980, 1).

As the fourth characteristic, mega projects exhibit the *involvement of public entities and public spending* – this serves as a possible explanation for why mega projects are often an issue of public interest and attract significant attention from public media outlets (Feldmann, 1985). What also follows from the involvement of public entities is that the reputation of the project participants involved, in particular that of public officials and the government, may be highly dependent on the success of these projects (Altshuler & Luberoff, 2003).

Fifth, following from the above, mega projects are usually *embedded in a network of public interests*, where often complex and interdependent goals oppose each other. This is particularly challenging as these may change over time and because political decisions in various areas might be intertwined and impact on the project: For example, the revenue generation that follows from the construction of commercial buildings may depend on whether traffic policy facilitates easy access to the buildings (Flyvbjerg, Bruzelius & Rothengatter, 2003). In this sense, traffic policy can have a strong effect on the performance of the construction project. Next to policy conflicts, mega projects may also depend on values and judgments of society: the public perception of a mega project and its advantages and disadvantages along with the attitude towards the project can change with changes in the political climate or after elections (Hall, 1980). When the attitude becomes negative, this can, in turn, lead to a change in public policies causing sudden mega project abandonment or hold-up (Hall, 1980).

The next characteristic to be mentioned here is the *multiplicity of stakeholders* usually involved in a mega project. This can be seen as a consequence of the potential for creating large-scale impacts. As a consequence, it may be difficult to fulfil each stakeholder's requirements, and a large number of stakeholders may be difficult to manage (Altshuler & Luberoff, 2003; Kumaraswamy & Morris, 2002; Miller & Lessard, 2000; Kumaraswamy, 1997; Feldmann, 1985). Diverging interests among public vs. private stakeholders are only one example for this type of challenge (e.g. public administrations might aim to increase security while private companies look for increased economic return). Even in homogenous looking groups, e.g. the public administration, goals might diverge (according for example to local or temporal political initiatives). Moreover, large impact and long project duration often act as a kind of multiplier for this inherent complexity.

As the seventh characteristic, *technological challenges* are often mentioned as a typical mega projects issue. First, the technology applied in the project is often very complex or even novel and innovative – in this case, the behaviour and functioning of the technology can be very hard to predict, and past experiences are typically not applicable (Hall, 1980). Secondly, the mega project might be dependent on technological trends outside of the project itself (Feldmann, 1985). This poses management challenges since trends are often subject to change and hard to predict and may force the project to adapt (Feldmann, 1985).

Eighth, in conjunction with being technologically challenging, *uniqueness* is a constituent characteristic of mega projects as they aim at developing "unique, dedicated, and usually one-off products" (Miller & Lessard, 2000, 7), for which past experiences do not necessarily apply or not exist. Hence, mega projects are considered an "engineering craft business" (Miller & Lessard, 2000, 7).

The ninth characteristic is concerned with the *high impact on society and the general public* (also related to the public spending) that mega projects can have on the world around them and the reactions they provoke (Goemans & Visser, 1987). Some research on mega projects has even been devoted exclusively to this topic, e.g. by Stough and Haynes who say that these impacts are usually "large-scale and complex" and "unevenly distributed in time and space" (1997, 387). Furthermore, the impacts

may be trans-national, occur on a long-term basis affecting multiple generations (Stough & Haynes, 1997), and affect the economy, the civil society, and the natural environment (Flyvbjerg, Bruzelius & Rothengatter, 2003; Warrack, 1993; Sewell, 1987). Because mega projects are "embedded in contexts that are complex and adaptive" (Stough & Haynes, 1997, 388), they usually have unforeseen and unintended consequences that are difficult to forecast or to plan. Consequently, possible responses to mega projects comprise the rejection by the public or the protests of special-interest groups, e.g. environmental protectionists. These are often cited in literature as common problems in mega projects with sabotage being the extreme case (Altshuler & Luberoff, 2003; Flyvbjerg, Bruzelius & Rothengatter, 2003; Sewell, 1987; Feldmann, 1985; Hall, 1980). Derived from the former characteristic but also related to other attributes, like spending of large amounts of public funds, we identify the *public awareness* that is devoted to mega projects (e.g. in mass media) as the final characteristic.

5 IT MEGA PROJECTS

5.1 Particularities of IT mega projects as compared to large IT projects

In the previous two sections we presented characteristics describing both large IT projects and mega projects based on an intensive literature analysis of two, currently more or less unconnected, bodies of literature. This was motivated by the observation that a new type of large-scale, media-attractive, public-interest IT project has emerged that exhibits characteristics, which go beyond what is typically known from the IT project management literature. While the literature on large IT projects led us to identify a certain set of characteristics indicative of this new type of IT projects, it quickly became clear that they differ in many respects. Having analysed both types of projects described in extant literature, large IT projects and mega projects, we are able to conclude that the latter body of literature comes much closer in describing this new phenomenon. Consequently, we argue that we have to draw on and in fact import into the information systems domain this existing knowledge from the field of engineering in order to understand what we term 'IT mega projects'.

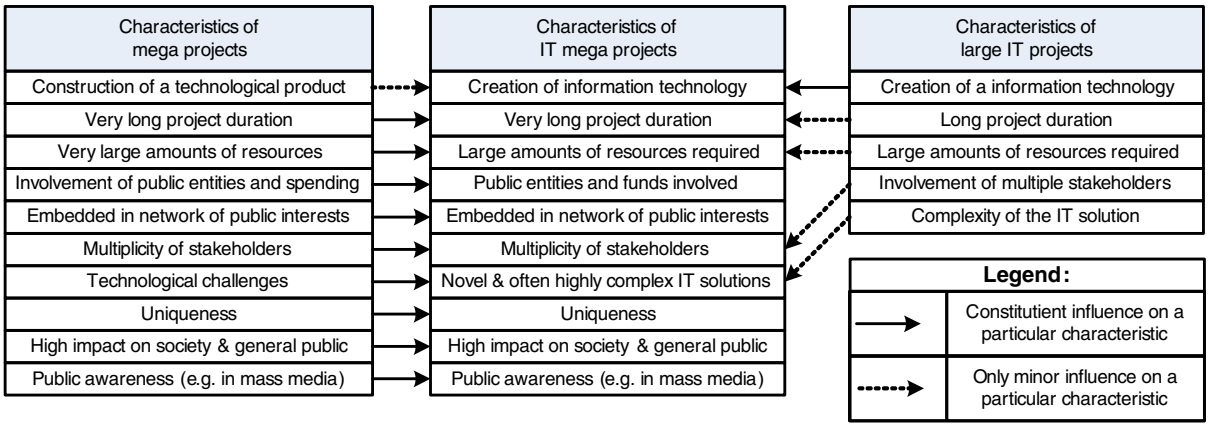

Figure 2: Characteristics of IT Mega Projects and their origins in mega projects and large IT projects

By drawing mainly on the characteristics of mega projects we are then able to characterise IT mega projects in order to provide a sound basis for future research. In fact, we can portray IT mega projects as mega projects that aim at developing a highly complex, innovative IT artefact as part of public infrastructure. As figure 2 shows, an IT mega project draws its constituent characteristics largely from mega projects, apart from its application domain. Indicated by the arrows, the different antecedents and their influence on the resulting IT mega project characteristics are illustrated. For example, the duration of a typical mega project typically exceeds the duration of large IT projects. Technology-wise IT mega projects also differ from large IT projects in that the IT artefacts being developed in IT mega projects are typically novel, innovative and exceed the levels of complexity normally known from

large IT projects. For example, while the implementation of an ERP system in a large multi-national corporation might be regarded a large IT project it is certainly no mega project as described here. Moreover, in large IT projects (e.g. ERP projects) the intended result is more or less known upfront, no public institution is involved, and the impact on the general public is minimal.

In order to arrive at a precise definition of terms, this also means that the sequence *IT projects → large IT projects → IT mega projects* reflects some kind of progression in terms of the characteristics that these projects possess. The first can be seen as a generic project involving IT, whereas the second shows characteristics of largeness (as listed in the right part of figure 2). IT mega projects finally are distinguished by an additional five characteristics: (1) the involvement of public entities, (2) the public interests involved, (3) its uniqueness, novelty and innovativeness, (4) its impact on the world and finally, (5) the resulting public awareness. Consequently, the relationship between IT mega projects and large IT projects can by visualised according to the following figure.

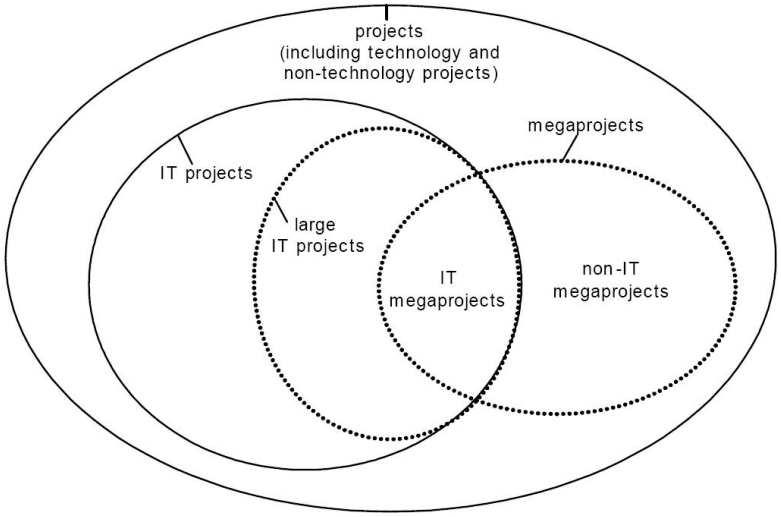

Figure 3: Visualisation of the relationship between the various project terms.

5.2 Typical problems associated with IT mega projects

As mentioned above, in the literature mega projects are often portrayed in terms of typical problems such as cost overrun, schedule slippage and the failure to meet stakeholders' requirements or to deliver the intended outcome. In particular, when the generation of revenue is an aim of mega projects, it often occurs that the generated amount of revenue is below expectations and that the project becomes unviable from an economic point of view. In fact, these unfavourable outcomes can be seen as the main motivation for much of the existing work on mega projects (Altshuler & Luberoff, 2003; Flyvbjerg, Bruzelius & Rothengatter, 2003; Haynes, 2002; Szyliowicz & Goetz, 1995; Merrow, 1988).

However, such problems are generally not new to the IT project management domain. Large IT projects are often associated with similar problems as mega projects. As early as 1970, Jones and McLean (1970) examined a variety of what they consider large software projects, and all of them exceeded the expected amount of time, budget and other resources, some "by several hundred percent" (Jones & McLean E. R., 1970, 1). When researching large software systems, Jones (1995) found that many are cancelled prematurely and a substantial amount of the remaining ones shows schedule delays, cost overruns as well as unsatisfactory levels of reliability and quality. However, besides these general symptoms of large/mega projects, we are able to identify further management challenges of IT mega projects that are new to the IT project management domain, since they stem from their unique characteristics of being mega projects.

5.3 Selected management challenges of IT mega projects

In contrast to typical IT projects described in the IT project management literature IT mega projects exhibit management challenges that stem from the involvement of public stakeholders (e.g. the project client is a ministry or government agency). Quite often, IT mega projects are subject to significant political interest. The outcome is often instrumentalised for political purposes, i.e. it is part of the political agenda of a governing party. As such, political groups are interested in the project to be finished within their government term. Consequently, project deadlines are often motivated not by project requirements but by the political calendar. This leads to short term thinking and management problems with regards to resource allocation, staffing and project planning. Moreover, unrealistic deadlines are often upheld too long for political purposes, e.g. to save face in the public perception, with the necessary decisions to change the project plan, to commit extra resources or to cancel parts of the project being put on hold for far too long. Hence, deadline and budget overrun might be attributed to unrealistic expectations and subsequent project planning in the beginning of the project, and not to particular management problems; more research is needed to better understand these interdependencies.

Also, special attention has to be paid to the typical shortcomings of mega projects (schedule und budget overrun) in an IT environment, because the development of innovative IT on this scale is likely to be more difficult to predict than IT in other large projects or than predicting schedules or budgets in traditional (engineering-type) mega projects. This is largely due to the dynamic nature of the IT domain: Since IT is a fast moving field, much faster than many other technology fields, the long project duration implies a strong risk of developing "outdated" technology at the end of the project.

Moreover, the potential changes of stakeholders in IT mega projects might put more severe risks on the overall project than it does in other mega projects. As technological innovation is the focus of IT mega projects, the knowledge required for developing the solutions might be unique to some of the participating companies. Compared to traditional infrastructure projects, one partner leaving a consortium might put the entire project at risk; traditional infrastructure, e.g. a bridge or a tunnel, might better be continued by a new project partner than in IT projects. Again, more research is needed to investigate this assumption.

6 CONCLUSION

The aim of this paper was to provide a conceptualisation of an emerging type of IT project, the IT mega project. In doing so, we have argued that we need to draw on and import existing knowledge from the engineering domain in order to characterise IT mega projects (which we have done in this paper) and in further researching IT mega projects in the future. With this paper we hope to provide the basis and a starting point for such research endeavours. While we tried to provide some potential management challenges in the section above, more research is needed to better understand the unique management challenges of IT mega projects. Moreover, research is needed with regards to the ways and means with which IT mega project managers can avoid the typical problems and unfortunate outcomes typically associated with mega projects.

Methodology-wise case studies seem to be the only promising research vehicle with which to research IT mega projects, because large scale, cross-sectional studies are not feasible due to the uniqueness of each one of the few IT mega projects in existence at any point in time. Within the case studies a multitude of data gathering techniques might be used – ranging from participation/observation over interviews to distributing surveys to the multiple stakeholders and participants involved. Also, content analysis of public media might yield interesting results on the changes and evolution of public awareness and opinion of IT mega projects over time. Multi-case study investigations might be suited to look at mega projects from a lifecycle perspective by researching finished projects, those in their later stages as well as newly established ones. The latter provide the opportunity to specifically learn about the project dynamics of IT mega projects, such as shifts in requirements set by the public project cus-

tomer, changes in the IT landscape, as well as the changes in public awareness and media opinion regarding the project and its success. Finally, more research is needed to better understand which parts of the existing IT project management literature might still be applied to IT mega projects.

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