

# ICT-project failure in public administration: The need to include risk management in enterprise architectures

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## ABSTRACT

The failure of large and complex ICT projects has gained the attention of politicians and public managers. Decision-makers are looking for ways to reduce the number of project failures. As one of the instruments, they are looking at architectures to mitigate project management risk in order to reduce ICT project failures. Enterprise Architecture (EA) has been heralded as a way to advance digital government developments. This has resulted in the development of building blocks, standards, principles, models and other architectural instruments.

Despite the importance of this topic, little is known about the actual relationship between project failure and enterprise architecture. Although architectures might include risk management instruments, there is no insight in their actual use and experience. In this paper, the relationship between EA and project failure is investigated by creating a retrospective view on the use of EA in large and complex ICT-projects. A simple questionnaire is developed aimed at measuring the use of enterprise architecture in organizations and factors related to ICT project risks. During an interactive policy workshop, participants from various public organizations in the Netherlands were asked to fill in this survey for the ICT projects they were experience with. This was followed by a discussion about EA and risk management. The findings show that a disappointingly number of projects use either EA or risk management in a sufficient way. From the results, we conclude that architecture was hardly used as an instrument to mitigate project risks. This implies that one way of mitigating project failure is to ensure that the enterprise architecture and its use provide explicit attention to the subject of project risks. Six recommendations are formulated to improve risk management.

## Categories and Subject Descriptors

H.1.1. [General System Theory]: Models and Principles – *Systems and Information Theory*; J.1 [Administrative Data Processing]: Administrative Data Processing – *Government*; K.6.4 [Management of computing and Information Systems] Management of Computing and Information Systems– *System Management*.

## General Terms

Management, Performance, Design, Economics.

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dg.o 2010, May 17-20, 2010, Puebla, Mexico.  
ACM [ISBN] 978-1-4503-0070-4/10/05

## Keywords

Project failure, project management, Prince2, e-government, enterprise architecture, information architecture, service-oriented architecture, risk management

## 1. INTRODUCTION

Within the public sector and government organizations, enterprise architectures (EA) have been developed [9, 16]. The main driver for developing these architecture is to provide an overview of the various systems, improve interoperability, stimulate standards, disseminate experiences and best practices, and lower development costs. EA provides a tool for policy makers to enhance digital government and stimulate the use of ICT. It is used as an instrument to provide direction to the development of the digital government infrastructure [8].

EA aims to bridge the gap between organizational and technology aspects [22]. It can describe or prescribe the dependencies among a large number of heterogeneous elements. In this way, it is an instrument to guide design decisions and provide direction for progressing towards the next generation of infrastructure [7]. EA can serve various goals, including communication, evaluation, design and change [5]. The goals of directing projects and enabling change suggest that risk management is an integral part of EA. Yet, EA as a project risk mitigation instrument has been hardly mentioned as an explicit goal in the literature.

In the Netherlands, a variety of architectures exist ([www.e-overheid.nl](http://www.e-overheid.nl)). The national and domain architectures do not have the aim to reduce project failure or to mitigate development risks. This does not mean that they do not include any methods or guidelines to mitigate risks. For example the project management recommendations might be viewed as a way to mitigate risk. However, there is no explicit attention for this aspect in the current architectures and it is not clear if EA is used as a risk mitigation instrument.

Many ICT projects do not live up to expectations [12]. The last couple of years the failure of ICT projects has gained the attention of politicians. A paper in a Dutch ICT magazine shows 22 large project failures in both the public and the private sector, each responsible for wasting millions of Euros [21]. In the Netherlands, the national Accountability Office has analyzed large projects and concluded that most projects failed in one or more aspects [1, 2]. In these reports, project failure was attributed to the complexity and ambition of ICT-projects, which were caused by a mix of political, organizational and technical factors. The Office's report has resulted in discussions in parliament and politicians demanded

that risks should be mitigated and a higher level of success rate should be ensured. One of the questions that was asked by politicians was the role of EA in risk management. In particular it was asked *how the national reference architecture and enterprise architectures can be used to reduce project failure*. The research that we present in this paper is a response to this call of politicians. The research was aimed at understanding the existing role of EA in relationship to project failure. The premise underlying this research is that in the existing practices there would be limited relationship between EA and risk management.

This paper is structured as follows. In the next section the background of EA and project failure are described. This background is used to develop a measurement instrument which was used in the workshop to position projects in relation to the EA and risk management approach. This approach is discussed in the subsequent part. Finally, the research findings are discussed and conclusions draw.

## 2. BACKGROUND

### 2.1 Enterprise architecture

In the very foundation, Enterprise Architecture (EA) aims to bridge the gap between organizational and technical aspects. EA should address the dependencies among a large number of heterogeneous elements at both the organizational and technical levels [6]. Traditionally, the purpose is to effectively align the strategies of enterprises with their business processes and the coordination of their resources [22]. EAs define and interrelate data, hardware, software, and communication resources, as well as the supporting organization required to maintain the overall physical structure required by the architecture [9, 18].

EA supports projects by providing them the starting points, the vision that should be realized and support for the transformation process. For this purpose, frameworks, principles, methods and other tools can be included in a architecture [17, 22]. EA bridges conceptual- and implementation design by defining a composition from various viewpoints. It often incorporates a blueprint of the existing and desired design and an overall plan regarding realizing part of it. There is no generally accepted definition of EA [20]. EA has been characterized as a system of systems [10], and the “master plan” or “city plan” [19], detailing policies and standards for the design of infrastructure technologies, databases, and applications [4, 20]. EA efforts are often aimed at creating some kind of coherence and structure in a chaotic environment using systematic approaches [3, 6]. Enterprise architecture models provide ways to deal with a complex setting, including work (who, where), function (how), information (what) and infrastructure (how to) [20]. The main idea of enterprise architecture is that it can be used to guide design decisions and to ensure that the dependencies between elements and activities are managed.

There is a variety of enterprise and reference architectures developed in the Netherlands. These architectures range from general at the national level to highly specific at an organizational level. Whereas there is only one national architecture, there are various architectures for specific domains and many organizational architectures, as visualized in Figure 1. In the ideal situation the architectures of organizations are based on the domain architectures, which is – in turn – based on the national architecture. Organizations might be directly deviated from the

national architecture if no domain architecture is available. In practice this might not always be the case, as public organizations might have developed their architecture before the domain or national reference architecture was developed. Furthermore, organizations might want to deviate from the national or domain architectures to accommodate their unique characteristics better. This is possible as the Dutch national architecture is not mandatory.

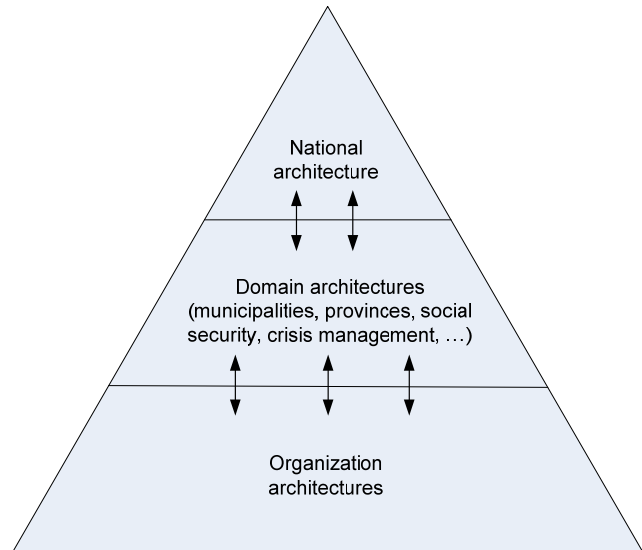


**Figure 1. Architectures in the various layers of government**

The use and effectiveness of an architecture is determined by the actual use. The various architectures in the Netherlands are used to guide ICT projects by providing good practices and constraining possible choices by providing requirements. For example the selection of technology and the use of standards. These requirements can be mandatory (some organizational EA) or can be used voluntary (e.g. domain and national references architecture). Although there are discussion to make EA mandatory this is not the case yet.

### 2.2 Risks Management and project failure

Project can be deemed failures from various views, including an inability to meet requirements, and exceeding time and/or budget. In this paper we investigate projects that have failed in the sense that the delivered products (if any) are not used and the system is abandoned.

Risk has been extensively studies in ICT projects [11, 14]. There is a diversity of risk management methods which address similar problems with different methods[11]. There are many rational approaches based on decision theory which attempt to control the situation in order to mitigate risks. These often look at undesired outcomes, their variation in distribution, their likelihoods and impacts, and how to deal with them. This assumes that risk can be estimated in advance and that measures are taken to avoid losses. There are several categories of risks, including people, process, product and technology [13]. Nelson [14] uses this to create a list of classical mistakes.

Risk management methods make important recommendations like the use of project management, standards, involving users early on, and so on [11]. Nelson [15] identifies success factors and in another work [14] recommends to give explicit attention to

scheduling, stakeholder involvement, risk management, planning, quality assurance, human resources, and project sponsorship.

Another type of approach is to view risk management as an organizational attention shaping routine [11]. This approach is based on the idea that “risk management approaches fundamentally embody organizational routines of attention shaping which represent causal dependencies between managerial action and observed events” [11 p. 234]. Taking this approach should help decision-makers to get better grip on situations and avoiding risks.

### 3. RESEARCH APPROACH

#### 3.1 Session design

The goal of this exploratory research is to investigate the relationship between enterprise architecture and project risk management. This was done by organizing a session with government representatives involved in EA and ICT projects. In total 15 session participants scored 14 different projects on the dimensions EA and risk in a matrix. The session was facilitated by one of the authors and organized by a government representative. The session was held in October 2009 and the session participants had experiences with the ICT projects they were scoring. The participants included (potential) users, enterprise and information architects, and decision-makers. During the session the main steps followed were:

1. Introduction and background
2. *Selection of projects*: The projects were limited to those large and complex projects in with the participants had explicit knowledge as they were involved in the projects. Furthermore both projects that have failed (the projects are on the list of failed project) and projects that were relatively successful (according to the participants) should be included.
3. *Scoring of the projects*. All participants were asked to score the projects they had knowledge of based on the questionnaire. There were 10 questions for EA and the same number of questions about risk management (see Appendix A for a description of the topics asked in the questionnaire). For each questions one point could be gained, resulting in a maximum score of 10 for risk management and 10 for EA.
4. *Discussion of scores*. Each of the participants positioned the project they scored on a whiteboard displaying the matrix. All scores were discussed and in case of a deviation among scores for one project consensus was sought.
5. *Discussing relationship EA and risk management*. The scores in the matrix are discussed by looking at each single axis first and then discussing the relationship between EA and risk management. Explicit attention was given to explaining the results.
6. *Conclusions and policy recommendations*. Finally, the findings were summarized and participants were asked to support the conclusions. Based on the findings, a number of policy recommendations were drawn.

#### 3.2 Matrix

To position the projects, a matrix based on the use of EA and risk management was created. A short questionnaire, based on aspects mentioned in the literature background, was held among session participants to position the projects. The four quadrants were labelled to ensure the right interpretation of the positioning within a certain quadrant.

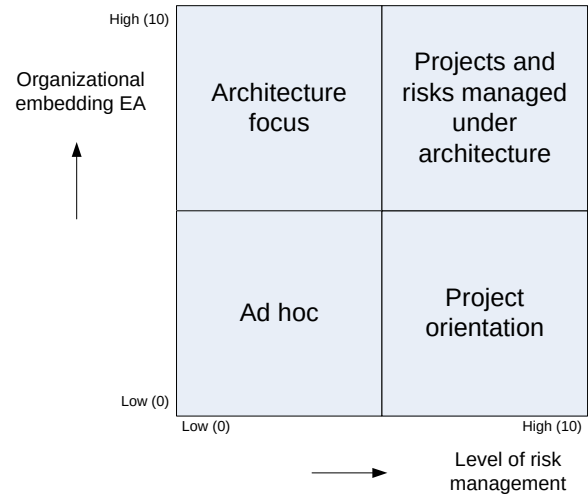


**Figure 2: the EA/risk matrix**

The survey questions (see Appendix A) were purposely limited to the main aspects of EA and risk management; Detailed questions were avoided as our aim was not to create an in-depth and extensive overview of EA and risk management, but to gain an indication about the actual use in past projects. Thereby avoiding that participants would be guessing whether something would be the case and the positioning and discussion would focus on details. The position of the projects should therefore be seen as an indication and not as an exact measure. The naming and explanation of the quadrants should ensure the right positioning. The following quadrants were used.

1. *Ad hoc*: EA and risk management were hardly given attention. There is no EA used or hardly any elements from the EA are translated to the project. Furthermore, no or hardly any risk mitigation mechanisms – such as project planning and the identification of risks factors – were used.
2. *Project orientation*: Risk management was explicitly given attention in these projects, whereas no input from EA was used. Possible risks are identified, risk management techniques and methods are used and the risk mitigation has been given attention to avoid project failure. Often Prince2 (PProjects IN Controlled Environments), a structured and systematic method, was used as a project management approach.
3. *Architecture focus*. Architecture is leading, whereas risk management is hardly given any attention. Often the use of EA is mandatory and architects help shaping the projects. Standards, principles and guidelines from the EA are used.

4. *Projects and risks managed using architecture.* Both EA was used as an important input and risk management methods and -techniques were used.

In our approach it is acceptable that several people would initially position the same project differently. Instead of taking a factual approach based on looking to the answer to the single questions, we opted for discussing the projects' positions with the participants and look for agreement about positioning of the projects. This happened several times. The deviation between these scores was limited and it was easy to find consensus about the final position of the projects in the matrix.

## 4. FINDINGS

### 4.1 Scores

The participants scored the projects in the EA/risk management matrix, resulting in the scored matrix Figure 3. The grey circles show projects that failed and are on the list of the Accountability Office in their analyses of failure of large and complex projects [1, 2].

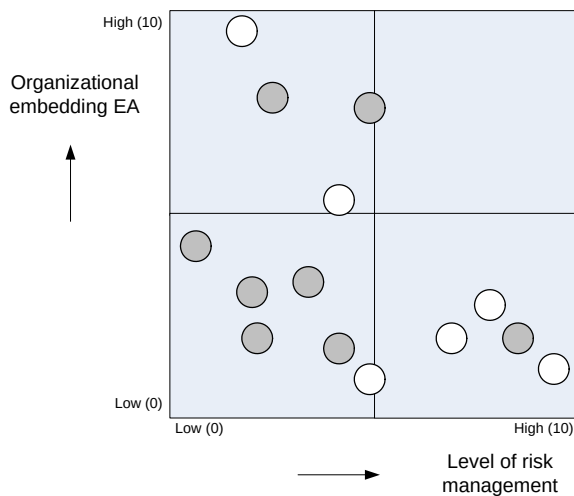


**Figure 3: Scoring by the participants on the EA/risk matrix**

The positioning of the projects was agreed on by the participants and the interpretation of the findings of this matrix was discussed. Generally, the positioning and findings came not as a surprise for the participants. Based on the scores conclusions were drawn.

### 4.2 Conclusions

The first conclusion is that a disappointingly number of projects did not use either EA or risk management in a sufficient way. 6 out of 14 projects (43%) are positioned in the lower left quadrant and no project is found in the upper right quadrant as having high levels of risk management and EA. Based on this observation it was asked whether EA and risk management would be conflicting, i.e. that only one of the two could be used. The participants rejected this proposition, as most of them agreed that it would be possible to combine them. Furthermore, an example from another domain was given in which both aspects were given consideration. This example was used to prove that EA and risk management can co-exist.

The second finding is that when a project has low scores on both EA en and risk management, the project is likely prone to failure.

All projects that fall completely in the lower left quadrant failed. All participants agreed on this conclusion. One person asked how it could be possible that so many of the projects were in this quadrant. In the discussion that followed, it was concluded that most projects started without any explicit check on the use of architecture and risk management techniques, as they are not mandatory. Often, project managers were found to be too optimistic concerning feasibility and risk of the projects.

Third, the use of EA in a project does not guarantee success. Although there are examples of successful projects developed and implemented based on a sound architecture, there are also examples of projects that failed, despite the use of architecture. One possible explanation is that due to the use of architecture, more attention is given to the project which decreases the chance of failure.

A final conclusion is that the use of risk management approaches and techniques helps to avoid failure, but again this is not sufficient to guarantee success. One participant indicated that 'some factors like resistance of certain parties and the use of unproven technology cannot be mitigated. The project will fail, despite having good risk management'. The participants indicated that an important factor to avoid failure is that the starting points should be good.

During the discussion the participants discussed whether EA did or did not provide any risk management methods and tools. The participants indicated that most EA do provide some methods and tools, therefore the score was never zero. Nevertheless, the support from EA for risk management was deemed poor as most EA did not provide explicit attention to this. It could be several lines or a small (sub)section in the architecture document that can easily be overlooked and neglected. One architect indicated that in his opinion, risk management should not be part of any EA. Instead, it should be part of project management methodologies. This resulted in much criticism of the others, as in their opinion EA should also be exploited as a type of risk mitigation instrument. As one participant said, "an architecture not considering the risks and potential failure of its use is a nightmare for everybody using the architecture".

### 4.3 Policy recommendations

Based on the conclusions, a number of recommendations for policy were made. The goal was not to create detailed policy recommendations. Instead the goal was to provide fruitful directions. Recommendations were only accepted if they were supported by all participants. Together with the conclusions, these recommendations would serve as an input for new policies in the future.

*Recommendation 1: EA should give explicit attention to risk management*

Almost all participants agreed that the national reference architecture should give attention to risk management. EA can be viewed as one type of risk management instrument that is complimentary to risk mitigation in project management approaches. The session participants suggested that it would be best to integrate risk management in EA, instead of having it separately. One suggestion was that risk management is defined as a separate layer or view within an architecture. Also, a separate document, website or even a governmental program could be created to guide architects and project managers. This should

preferably be a part of the national enterprise architecture, as this architecture serves as the basis for other architectures and ensure visibility. Also risk managers should be involved in the national EA efforts.

*Recommendation 2: All large and complex projects should use risk management approaches and preferably use Prince2 as a project management approach*

In future large and complex projects much more attention should be given to risk management. General risk management approaches should be used and risks should be identified and mitigated. The participants agreed that risk management should not result in thick documents, but in practical and ready to use recommendations. The government should have risk managers that assess regularly the large and complex projects to help to avoid failure. These risk managers could be part of a separate government program about risk management.

*Recommendation 3: Make the use of EA and risk management mandatory*

Both the use of EA and risk management techniques and tools are voluntary. Project manager can too easily deviate from EA principles and best practices and can manage a project without having assessed risks and implemented any risk controls. This kind of behavior was viewed as undesirable and the participants tended to the mandatory use of EA and risk management. This does not mean that project managers should follow all prescriptions, but they should be given the freedom to motivate a deviation and ask for approval by a governance board.

*Recommendation 4: Allocate the responsibility for risk management in each project*

Instead of the project manager, an independent person should be responsible for risk management in large and complex projects. Preferably a person who is not too heavily involved in the daily operations, has knowledge and understanding of the project and has authority that is accepted by the project manager. This could be a risk manager, but also an architect who regularly assesses the risks and looks for mitigation mechanisms.

*Recommendation 5: Check whether the starting points are satisfactory before the start of the project*

Despite having a good architecture and risk management, a project might fail when the conditions for success are not met. Conditions can be found on a wide variety of areas, like budget, commitment of leaders, resistance and so on [see for example 14]. These types of conditions should be met in advance, as risk mitigation during the project might not work.

*Recommendation 6: Define governance mechanism to ensure that EA and risk management is used in projects*

A final recommendation is that governance mechanisms are defined. This should include organizational routines and procedures to mitigate risks and to use the EA at the start of the project. Furthermore, all project member and participants should be aware of possible failure. This refers to the need of organizational attention shaping routine as mentioned by Lyytinen [11].

The recommendation to start a separate program about risk management to build up expertise and share this with others was not made as not all participants did agree on this. The advocates indicated that a risk management program would bundle and

concentrate knowledge, rise attention and can provide a one stop shop for projects. Others argued that this type of solutions might work and might put risk management on the foreground, but on the long term might have undesirable side effects. Project managers would start looking at the program, trying to move away their responsibility and might start thinking that it is not one of their main concerns. Instead, as one of the persons stated, 'risk management should be everywhere in the whole government ecosystem'.

## 5. RECOMMENDATIONS AND FUTURE RESEARCH

In this paper we investigated the relationship between enterprise architecture and risk management. The results of the session confirmed our initial premise that EA is hardly used as a risk mitigation instrument. Furthermore, many of the large and complex projects did not give any attention to EA or risk management and it is exactly that type of projects that seem to have a higher failure rate. This results in the recommendation to give explicit attention to risk management in EAs in order to avoid failure of ICT projects and during the session this was worked out in six main recommendations. Especially, the national reference architecture should give explicit consideration to risk management and help to draw the attention to this. Both risk management and EA have similarities as they should be embedded in the organization. EA has a relationship to risk management as it is often used as a change management instrument guiding projects. Yet, the exact relationship is unclear and need further research attention.

This research was exploratory and has several limitations. Firstly, only one session was held, and although the participants and projects were selected with care, they may not adequately represent the whole population of participants and projects. We suggest the generalization of the findings using a large random sample. Secondly, we primarily used the experiences of the session participants and did not look at EAs themselves. The EA used in a project might include risk mitigation approaches and practices. The cause of not using the EA might be on the governance level, due to a lack of procedures and routines to use EA. As such we recommend the detailed analysis of the relationship between EA, governance and project failure. Various governance mechanisms should be investigated and their effects evaluated. Thirdly, we used a limited number of questions to position the projects. This was due to time limitation within the session, and matched our aim to have only a rough indication instead of focusing on all kind of details. We recommend the development of more detailed and comprehensive questionnaires and checklists to evaluate and position projects based on the questionnaire presented in this paper. This comprehensive list could be used if there is a relationship between certain factors and project failure. The results of such a comprehensive analysis could be used to let decision makers, and risk and project managers explicitly focus on the most important factors when attempting to reduce project failures.

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## Appendix A: Topics asked in questionnaire

### Organizational embedding architecture

1. Availability of an architecture
2. Stakeholder knowledge of architecture
3. Elements included in architecture
4. Relationship among elements
5. Inclusion of organizational and technical principles
6. Clear goals
7. Use of EA in projects
8. Definition of building blocks
9. Involvement of architects in projects
10. Stable EA

### Risk Management

1. Use of stable and proven technology
2. Involvement of ICT and business persons
3. Clear planning and budgeting
4. Anticipation of future creep
5. Annual evaluation and assessment
6. Stakeholder commitment
7. Technology and process knowledge
8. Relationships among stakeholders
9. Level of complexity
10. Active involvement of businesses and users