A method for valuing architecture-based business transformation and measuring the value of solutions architecture
Slot, R.G.
9. Conclusions and Summary

This chapter reconsiders the key research questions which were stated in Chapter 1 and considers the results and conclusions that can be drawn from the research described in this thesis and provides an overall summary.

9.1 Research Questions
In chapter 1, the following key research questions were stated:

1. Can we define a suitable method for measuring and quantifying, in financial terms, the value of enterprise architecture-based business transformation?
2. Is the method usable in practice to determine the value of enterprise architecture-based business transformation?
3. Can we define a suitable method to measure and to quantify, in financial terms, the value of solution architecture?
4. Can we apply this method to determine the value of solution architecture?
5. How is the business value of IT related to the value of enterprise and solutions architecture?

9.2 Research Questions 1 and 2
In Chapter 4 we presented an approach to adapt the standard Black-Scholes approach for Real Options Analysis, to incorporate two sources of uncertainty into the analysis. Chapter 5 demonstrates the applicability of Real Options Analysis for enterprise architecture, using a case example. Using Real Options Analysis, we analyzed the expected cash flow from this investment, considering potential benefits and potential costs. Real Options Analysis has the advantage of providing a much broader insight into the consequences of investing in business architecture compared to other analysis methods such as net present value and decision tree analysis. We find that the option value, which comes out of the real options analysis, provides higher value estimation than other analysis methods, because it incorpo-
rates the additional value that management has to steer and control the implementation of the architecture.

### 9.2.1 Real Options Analysis and Uncertainty

ROA is most useful when the Net Present Value of an architectural investment is neither very negative nor very positive and there is considerable uncertainty in the possible outcome. Management can use this uncertainty to steer the investment in the desired direction. More uncertainty means more value, because more uncertainty translates in more room to maneuver for management, and this translates in an increased value of the option. This argumentation assumes that the decision-makers will always take the value-maximizing decision at each point in the Enterprise Architecture investment lifecycle. To illustrate the value of high uncertainty, Kodukula and Padudesu (2006) provide the following graph:

![Figure 9.1. Benefits of real options analysis (Kodukula, et al., 2006).](image)

The draft can be illustrated with the case that was discussed in the previous paragraphs. The standard scenario has a high, positive net present value of € 6.39M (see Table 5-10), with a small probability (2%) of negative outcome. As a result, the expected value and the option value are almost the same (see Table 5-14) and the benefit of calculating the option value is limited. In the case of the Contract Scenario, the Net Present Value of the scenario decreases and even turns negative when the Fixed-Price increases. Because of this, we find that the value of Real Options Analysis differs significant from the NPV, which exemplifies the additional space decision-makers have.
9.2.2 Valuing Infrastructural Investments
In the case example for the domain Input Handling, the architecture has strong infrastructural characteristics. The architecture lays the foundation for improving business process efficiency and improving business agility. Based on this foundation, business can add various services, with high added value. Architectural investments tend to have this infrastructural characteristic. According to Ross, Weill and Robertson: “[Architecture describes] a foundation for execution, [which] is the IT infrastructure and digitized business processes.” (2006).

Furthermore, infrastructural investments are generally difficult to valuate. “Infrastructure investments are hard to value because their benefits are elusive, spread across the company, and contingent upon follow on investments. The real options approach can be used to take a broad look at the alignment of the investment and corporate strategy. For instance, a telecommunications firm that buys the right to use the auction of the radio frequency can realize its value only after building a radio network and offering various services. The decisions to build the network [...] and offer services would be contingent on the degree of success of the preceding stages in the attractiveness of the realized market for the services.” (Amram, et al., 1999).

9.2.3 Valuing Subsequent Investments
In this chapter, we showed that real options analysis is a viable approach for measuring and assessing the added value of architecture in financial business terms. Real Options Analysis provides an approach to calculate the benefits and costs in terms of a Probability Density Function. The revenue and the cost PDFs can be combined to one cash flow PDF and this is the basis for the investment analysis, i.e. to optimize business value, minimize risk, optimize option value, etc. In this analysis, we did not include the factor of time. Implementation of enterprise architecture takes timeframes from three to maybe ten years. Net present value calculations calculate the value of an investment based on interest based cash flows over a number of years. To include this type of analysis in the approach that we have developed, see Appendix 1 (page 128). In this Appendix, we are using our approach to analyze the financial effects of business transformation programs over several years.

9.2.4 Conclusions
Real Options Analysis provides a suitable approach to valuate enterprise architecture based business transformation. This method provides clear advantages compared to other valuation methods. There are two main reasons for this.
First, architectural investments generally have an uncertainty about the value of future services. Because of this nature of architectural investments, it is often not clear beforehand how the investments will be applied for maximal usefulness. Future users of the architecture implementation may find novel ways to use it and to generate additional value from it. This uncertainty provides its own value, which is not recognized by other valuation methods.

Second, architectural investments tend to have an infrastructural character. Infrastructural investments are hard to value, because their benefits are spread across company and are contingent upon follow on investments.

We can conclude that real options analysis is a valid approach to quantify architecture-based business transformation.

Our case study illustrates that the fact that Real Options Analysis provides continuum of possible outcomes allows decision-makers be better informed and that ROA allows for inclusion of the value of future contingencies.

### 9.3 Research Questions 3 and 4

#### 9.3.1 Statistical analyst approach

In chapter 6 a statistical approach is described which allows this to measure the value of solution architecture for IT software development projects. In the case study, 49 projects are surveyed and the subsequent analysis showed clear positive results, which are described in Chapter 7 (see Table 7-11, page 105). The question is whether the type of effects and the direction of the effects that we have measured (architecture lowers budget overrun, lowers time overrun, increases the percentage delivered, etc.) are valid in the general situation. Based on this one study, we cannot provide definitive statements on this, also because of the conclusions of § 7.7 (page 110), where we found that there are significant differences in project budget overrun between various organizations. Nevertheless, one of the major findings of the analysis of § 7.5 is that

“A ‘better’ value of a project variable correlates with a ‘better’ outcome of the success variable, for all identified significant correlations. 

[...] This positive-positive trend gives an intuitive confirmation that the use of architecture is beneficial for projects; use of architecture does not counteract project objectives.” (Page 106.)
None of the identified correlations between architecture project variables and success variables counteracts project success; all correlations are in the same positive direction. We did not detect indications that architecture may have a negative effect on project results and conclude that the application of enterprise architecture at tactical level is beneficial for IT software development projects.

### 9.3.2 Conclusions

If we consider again the statement of §6.2 (page 74):

*IT software development projects are more successful when they are developed under architecture.*

We find that the characteristics for project success may differ substantially, for different organizations. Because of the size of our survey and the fact that the survey is limited to one organization, we cannot make a statement on the role of project architecture in general. On the other hand, the correlations that we identified in the survey were all positive. In the general case, we can conclude that we found convincing indications that the use of solution architecture is correlated with a substantial improvement of several key success variables, but that further research – with a broader survey base – may provide more definitive answers.

### 9.4 Research Question 5

#### 9.4.1 IT effectiveness

In Chapter 3, we discussed the value of IT for organisations. The research of Straßman (1997) and others indicate that there is no direct correlation between organizational performance and IT spending. As a solution to this dilemma, Soh and Markus (1995) discussed the concept of “The IT Use Process” which distinguishes between appropriate or inappropriate use of the assets, and which gives the relation between IT Assets and Impacts (see Figure 3-1, page 15). They remark that “While necessary, quality IT assets are not sufficient for IT impacts to occur. As [...] many [...] have observed, impacts from IT require ‘appropriate’ IT use. [...] Most treatments of the topic have assumed variance theory formulations of the “greater IT use leads to greater IT impacts” form. A large body of research [...] suggests that the value of reconceptualizing IT use as a probabilistic process that affects whether and how IT assets become IT impacts rather than as an input variable in a necessary and sufficient relationship.” (p. 38).
The majority of the published research on the value of IT, does not consider the measure to which the IT assets are used effectively or appropriately. The underlying assumption that “greater IT use [automatically] leads to greater IT impacts” is evidently not correct. The IT Use Process acts as a leverage point for improving the business impact of IT. In considering the business value of IT, one should consider the level of IT spending and the scale to which IT assets are used effectively or appropriately within the organisation. In chapter 8 we describe the four enterprise architecture maturity stages identified by Ross et al. These enterprise architecture maturity stages can help to understand the current maturity level of the enterprise architecture and, as a consequence, the relationship between IT spendings and business performance.

### 9.4.2 Commodization of IT

Still, there are more conclusions that can be drawn from this research. In an article by Nicholas Carr in the Harvard Business Review (2003) and the subsequent discussions (HBR, 2003) on the value of IT for organisations, Carr states “As IT’s core functions […] have become cheaper, more standardised, and more easily replicable, their ability to service the basis for competitive advantage has steadily eroded. Given this continuing and indeed inexorable trend, companies would be wise to manage IT as a commodity input, seeking to achieve competitively necessary levels of IT capability at the lowest possible cost and risk.” He argues that IT has become a commodity and, as a consequence, it cannot be used as a strategic competitive factor anymore, because it is equally available for everyone. He illustrates this with other examples of technology commodization, such as the commodization of Railways and Electric Power about 100 years ago. Based on this argument, he advocates a conservative approach for IT investments and taking a defensive position. In his view, the phase for IT to be used as a strategic, offensive competitive instrument is over.

We do not argue with his statement that IT becomes more and more commodity. With 1.2 billion PCs in use (Computer Industry Almanac, 2009) and Google reported to hit the one trillion unique URLs (2008), the commodity aspect of IT cannot be denied. But Carr’s implicit assumption seems to be that using IT as a commodity or as a strategic instrument is an ‘either-or’ choice – you either bring down the cost of IT and focus on reliability and continuity, or you invest heavily in IT and treat it as an offensive strategic instrument to gain competitive advantage.

While this choice may be applicable in the other examples that Carr mentions, the research of § 8.4 shows that this assumption is simply not correct for the IT industry. IT can be managed in such a way that the business impact and the use of
IT as strategic instrument for competitive advantage increases, while simultaneously the cost decreases and continuity and reliability increase.

This finding invalidates the argument of Carr and the subsequent debate about business impact versus commodization. By improving the enterprise architecture maturity along the lines described by Ross, both goals are achieved simultaneously. Therefore business impact versus commodization is not an ‘either-or’ choice but an ‘and-and’ choice. It is a very interesting further line of research to understand the exact reasons for this and why IT differentiates itself in this respect from other examples.

9.4.3 Conclusions
Based on our research finding and the literature, we conclude that enterprise architecture plays a pivotal role in improving the effectiveness of the use of IT assets within a corporation, improves IT impact on business performance and, consequently, allows IT investments have measurable effects on business performance.

9.5 Overall Summary
In this paragraph we will revisit the five key research questions and provide an answer based upon the research in this thesis.

Question 1: Can we define a suitable method for measuring and quantifying, in financial terms, the value of enterprise architecture-based business transformation?
Yes, the Real Options Analysis approach, which was developed in this thesis, is a suitable method for valuing enterprise architecture based business transformations.

Question 2: Is the method usable in practice to determine the value of enterprise architecture-based business transformations?
Yes, applicability of the method is illustrated using the real-life case example.

Question 3: Can we define a suitable method to measure and to quantify, in financial terms, the value of solution architecture?
Yes, by comparing and statistically analyzing multiple projects we are able to measure and quantify in financial terms the value of solution architecture.

Question 4: Can we apply this method to determine the value of solution architecture?
Yes, the method is applied using a survey of 49 projects. The value of solution architecture was clearly demonstrated by the results of this survey. The
question whether these results are general applicable, needs to be determined by further research with a larger survey base.

**Question 5: How is the business value of IT related to the value of enterprise and solutions architecture?**

Based on our research and relevant literature, there are clear indications that enterprise architecture plays a pivotal role in improving the effectiveness of the use of IT assets within a corporation and improves IT impact on business performance. As a consequence, higher maturity levels of enterprise architecture would allow IT investments have measurable effects on business performance.