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ICT in Business

Key Factors for reducing IT complexity

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MASTER'S THESIS

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Master's Thesis

Key Factors for reducing IT complexity

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In partial fulfillment of the requirements for the degree of Master of Science (M.Sc.) of ICT in Business

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Acknowledgments

The great writer Ernest Hemingway once said: "For a true writer, each book should be a new beginning where he tries again for something that is beyond attainment. He should always try for something that has never been done or that others have tried and failed. Then sometimes, with great luck, he will succeed."

This quote embodies the struggle I faced the last three years in writing this thesis combined with my parental responsibilities and my full-time job. So, writing these acknowledgments feels like climbing the final meters towards a mountain top.

Just as climbing a real mountain, I had to overcome obstacles and problems. Sometimes it was exhausting and I felt like quitting, but now, near to the summit, I am happy to have pushed through.

This document concludes my study Master of Science ICT in Business Leiden University. It is the result of my intellectual curiosity and creativity but most of all perseverance. Therefore, I would like to express my gratitude and appreciation to my supervisors, Robert Hewins and Hans Le Fever for their support during the long process. Your reviews and comments and insights were highly valuable. Furthermore, your patience with me is greatly appreciated.

I would also like to thank Steve Foster for his time and advice regarding the methodology and analysis used in this thesis. Your suggestions substantially improved the foundation for my research.

Next, a big thank you to the people that have taken the time to respond to the online survey. Without you, this research would not have been possible.

Lastly, I would like to thank my girlfriend, (step) daughters and friends who always provided support at difficult moments.

Arjan Jutte

Schiedam, February 2020.

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Abstract

This research aims to identify key factors that, if addressed by an IT complexity reduction approach, will have a positive effect on the outcome of this approach. The key factors were categorized into three groups: governance-related factors, organization-related factors, and factors relating to the execution of the IT complexity reduction approach.

The foundation for this research is delivered through a literature review and an online survey. The survey contained 78 questions and 13 statements. A total of 114 persons responded to the survey, of which 95 answered the survey completely. Of these 95 respondents, only 84 were considered relevant for this research as they had been involved in an initiative or project aimed at reducing IT complexity and their organization was faced with a complex IT landscape. These 84 respondents represented at least 33 organizations both in the public and private sectors.

The information provided by the respondents was coded and translated into 21 variables and 28 sub-variables. These were statistically analyzed to identify a potential association among them.

For governance-related factors, 3 variables and 2 sub-variables that have a statistical relationship to the success rate of the IT complexity reduction approach were identified. No statistical relationships for organization-related factors were found. Lastly, for factors relating to the execution of the IT complexity reduction approach, 5 variables and 7 sub-variables were identified to have a statistical relationship to the success rate of the approach.

Keywords: IT complexity, IT complexity reduction, information technology, information systems, information systems landscape, IT governance, IT architecture, IT projects, legacy information systems, technical debt, technology debt.

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1. Introduction

1.1 Problem Definition

Nowadays, organizations critically depend on their information systems. These information systems are vital not only for their success but also for their survival [Ward, & Peppard, 2002]. Over time, information systems have undergone years of maintenance and enhancement efforts. For many organizations, this resulted in reduced modularity and increased complexity [Sarissamlis, 2006].

Duncan [1995] defines modularity as the ability to easily reconfigure technology components and the standardization of business processes for shareability and reusability. Modularity enables organizations to quickly build new applications or to quickly modify their existing applications.

Ross, Weill, and Robertson [2006] state that those organizations that have more standardized technology components and more digitized business processes are faster to market with new products and thus get more revenue from these new products. They call this contradiction the agility paradox.

Next to lower agility, increased complexity results in higher maintenance and support costs constituting almost 70 percent of an information system's lifecycle cost. [Sarissamlis, 2006].

The third effect of IT complexity relates to the success rate of IT projects. Complexity is generally noted for its high incidence of problematic realization in IT projects as "many IT projects involve complexities such as compatibility and synchronization issues between different systems" [Groen, 2015]. Ting Liu, Sterritt, and Jingjing Wang, [2006] add that complexity creates and potentially overwhelms a project with much uncertainty and risk. So, complexity is linked to this project failure. But project failure also leads to more technical complexity. A vicious cycle could be noticed in which complexity leads to IT project failure and IT project failure leads to more complexity.

Organizations need to start the risky endeavor by reducing the complexity of their information system landscapes to remove constraints on their business agility, cut costs and decrease continuity risks of their IT systems

1.2 Research Objective

This study investigates literature and various approaches aimed at reducing IT complexity. The purpose is to find common factors that correlate to success in reducing IT complexity. The assumption is that those IT complexity reduction approaches who address these factors are more likely to be successful in their

attempts than those who do not. The objective of this study is to identify these key factors.

A preliminary literature review learned that potential key factors can be categorized into three groups:

- Governance factors: Factors relating to rules, norms, actions and the manner in which these are sustained, structured and regulated within an organization.
- Organizational Factors: Factors relating to the organization, her stakeholders and her departments;
- Execution factors: Factors relating to the actual execution of the IT complexity reduction approach.

The conceptual model looks as follows:

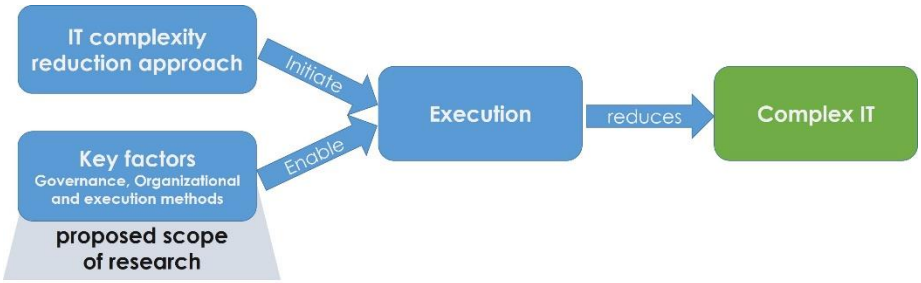

Figure 1 *The conceptual model*

1.3 Research Relevance

As described above, organizations need to reduce the complexity of their information system landscapes to remove constraints on their business agility, cut costs and decrease the continuity risks of their IT systems. Many organizations have this on their agendas and try to achieve this in various ways.

The purpose of this study is to investigate both literature and the various approaches to find common factors that can pose as representatives for success in reducing IT complexity.

1.4 Practical Relevance

Section 1.1 discussed IT complexity negatively impacting the success rate of IT projects and a failed IT project potentially increasing IT complexity.

This study delivers factors that correlate to a positive outcome of an IT complexity reduction approach; thus potentially leading to reduced IT complexity, increased business agility and lower maintenance and support costs.

1.5 Research Questions

The purpose of this master's thesis is to identify factors that, if addressed by an IT complexity reduction approach, will have a positive effect on the outcome of the IT complexity reduction approach. Thus, the main research question for this thesis is:

> *Which factors, when considered by an IT complexity reduction initiative, will have a positive effect on the outcome of the IT complexity reduction initiative?*

This question will be answered by examining scientific literature and case studies, followed by an online survey.

1.5.1 Sub-questions

To address the research question the following sub-questions will be answered.

S1. What are drivers causing complexity in the IT-landscape?
S2. What are noticeable artifacts of IT complexity in the IT-Landscape?
S3. Which main methods are used to reduce complexity in the IT-landscape?
S4. What are noticeable organizational artifacts relating to the IT complexity reduction approach?
S5. To what extent is management committed to the IT complexity reduction approach?
S6. What are the governance mechanisms in place relating to the IT complexity reduction approach?
S7. What contributes to a successful execution of an IT complexity reduction approach?
S8. What do experts recognize as dominant factors that might positively affect IT complexity in the organization?

1.6 Research Scope

This research intends to assess literature, papers and various IT reduction approaches to find common factors that correlate to success in reducing IT complexity.

To reach this aim a research approach based on literature review and quantitative online surveys will be used.

1.7 Expected outcomes

This study aims to find factors that have a positive impact on the success rate of an IT complexity reduction approach. The results of this study will describe:

1. A description, analysis and formal definition of IT complexity.
2. A set of factors believed to have an impact on IT complexity reduction. These factors will be divided into four categories:
   i. Governance factors;
   ii. Organizational factors ;
   iii. Factors relating to the execution of IT complexity reduction approach and
   iv. Other factors recognized by subject matter experts.

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2. Research strategy and methodology

The main research question for this thesis is: Which factors if addressed by an IT complexity reduction approach, will have a positive effect on the outcome of the IT complexity reduction initiative?

To address this question a total of eight sub-questions will be answered as discussed in section 1.5.1. When answering these sub-questions various research strategies can be considered. The table below shows an inventory of the different forms of research questions and the most appropriate research strategy [Yin, 2003].

Form of research question	Research requires control of behavorial events	Research focuses on contemporary events	➔	Most appropriate research strategy
How why?	Yes	Yes	➔	Experiment
Who, what, where, how many, how much?	No	Yes	➔	Survey
Who, what, where, how many, how much?	No	Yes/No	➔	Archival analysis
How why?	No	No	➔	History
How why?	No	Yes	➔	Case Study

Table 1 *Appropriate strategies relating to research questions [Yin, 2003]*

As all sub-questions contain "what" or "which", both the archival analysis and survey are seen as the most appropriate research strategies. For this study the archival analysis will be conducted via literature research and the survey will be conducted via an online survey. The results of the online survey will be evaluated via statistical analysis.

The next figure shows the research questions, the research method for answering them and the expected outcomes.

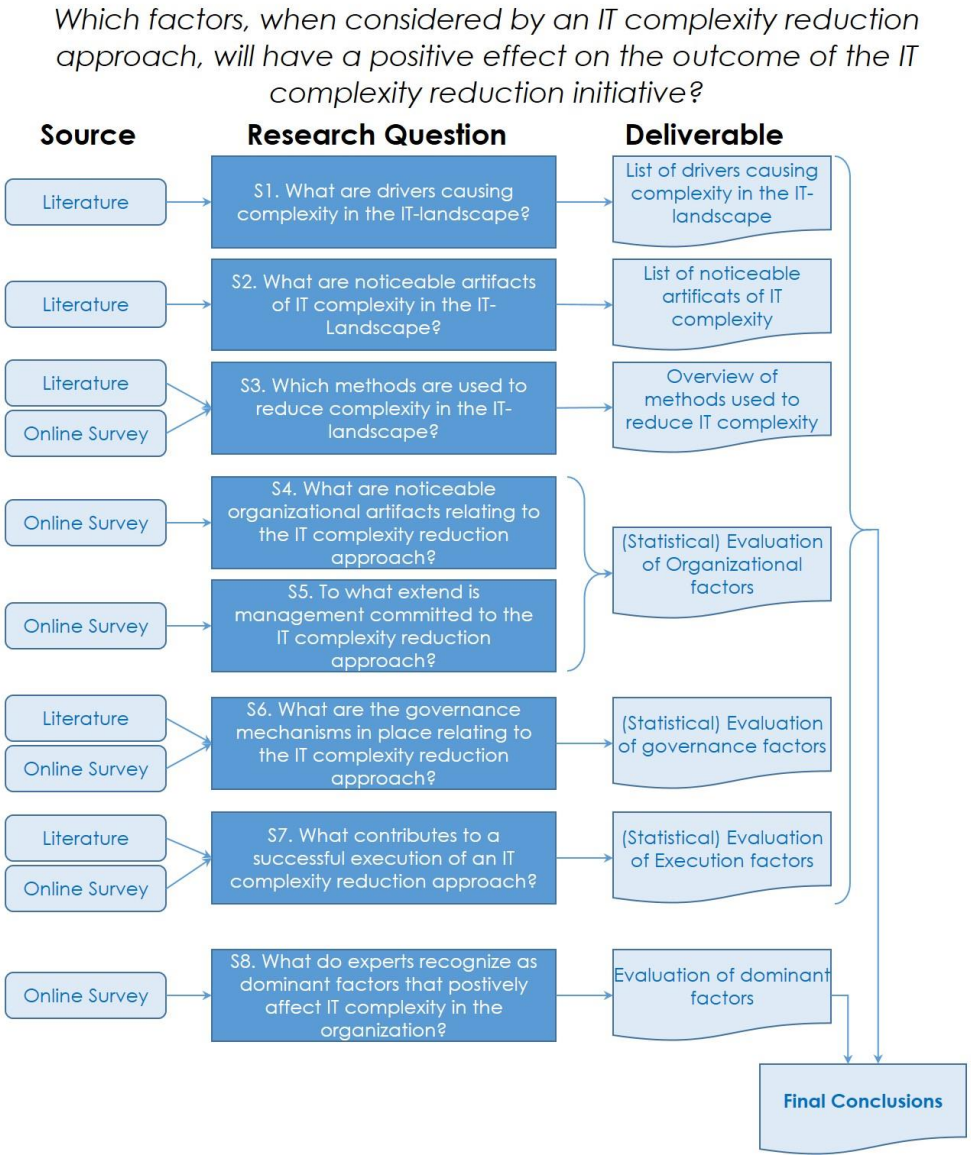

***Figure 2** Research Methodology*

The next sections reflect on the methodology used for the literature review, data gathering, and statistical analysis.

2.1 Methodology for literature review

Before starting the literature review a frame of reference needs to be determined. Tversky and Kahneman [1981] define a decision frame of reference as "the decision-maker's conception of the act, outcomes, and contingencies associated with a particular choice." So, a frame of reference is the overall context in which a problem or situation is placed, viewed, or interpreted.

For this study, reducing complexity in the IT information systems landscape will act as the frame of reference for the literature review. The literature review will start with a search on complexity and information systems on the Leiden University's library database and the internet. The review includes theses, journal papers, conference proceedings, book sections white papers, papers, and brochures. To identify further relevant literature, the list of references will be scanned.

2.2 Methodology for data gathering

This section covers the methodology used for the data collection phase of this thesis. The foundation for this research is delivered via quantitative research. Marczyk, DeMatteo, and Festinger [2005] state that quantitative research involves studies that make use of statistical analyses to obtain their findings.

An online survey will be used as the method for data collection.

2.3 Conceptual Framework for quantitative analysis

As stated in section 1.7 this thesis aims to identify a set of factors, believed to have a positive impact on the success rate of an IT complexity reduction approach. These factors are divided into governance, organizational, execution factors and other factors.

The foundation for identifying these factors will be delivered via the literature review discussed in chapter 3 and quantitative research discussed in section 4.1.

For the quantitative analysis constructs and variables will be used. According to Hobbs [2010], "a construct is a broad mental configuration of a given phenomenon while a variable is a measurable configuration derived from a construct".

2.3.1 Constructs

For this thesis, the above-mentioned factors are seen as constructs. To aid the statistical analysis the constructs "approach success" and IT complexity are also identified.

The constructs are presented in the next table:

Construct	Explanation	Links to subquestion
Mitigation Methods	A construct used to identify methods for mitigating IT Complexity.	S2
Organizational Factors	A construct used to identify concepts relating to the organization, her stakeholders and her departments	S3, S4, S5
Governance factors	A construct used to identify concepts relating to rules, norms, actions and the manner in which these are sustained, structured and regulated within an organization.	S6
Execution factors	A construct used to identify concepts relating to actual execution of the IT complexity reduction approach.	S7
Statements	A construct used to identify concepts identified by subject matter experts as contributing to success in lowering IT complexity	S8
IT Complexity	A construct used to identify the concept IT complexity. This concept will be used to aid the statistical analysis.	-
Approach success	A construct used to identify the amount of success of an IT complexity reduction approach. This concept will be used to aid the statistical analysis.	-

***Table 2** Constructs identified*

2.3.2 Variables

Variables will be used to analyze the survey results. The variables will have a measurable form and can either be qualitative or quantitative depending on the survey questions relating to them.

For the data analysis two groups of variables are used:

- Dependent Variable: This variable depends on other factors/variables measured in the survey [Penslar & Porter, 2010].
- Independent Variable: This variable is stable and unaffected by other factors/variables measured in the survey [Penslar & Porter, 2010].

The independent variable causes a change in the dependent variable. Otherwise, a dependent variable can never cause a change in an independent variable.

For this research, the independent values are defined as the questions in the online survey. A dependent variable is defined when multiple independent values are used to calculate an outcome that can be analyzed further.

In this thesis, independent variables are identified as [QUESTION_##z]. Whereby ##z is composed of the number of the relating question in the online survey. Dependent variables are identified by the prefix "V_".

All variables will be used

- to answer a research question via a construct, or
- to check for the respondent's relevancy, or
- to provide background information.

This is illustrated in the next figure.

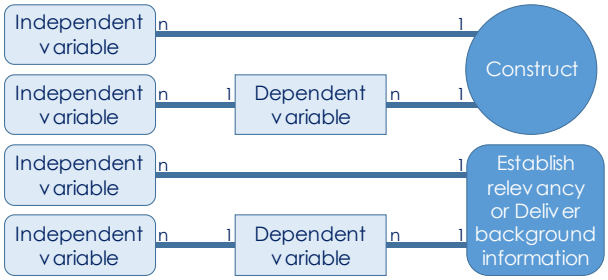

***Figure 3** Variables and relations*

Details about the variables used will be discussed in chapter 5 Analysis and results.

2.3.3 Conceptual framework

The constructs, variables and dependent variables combine to a conceptual framework that can be found in appendix A.

The variables used in the framework will be discussed in-depth in Chapter 5 Analysis and results.

2.4 Methodology for statistical analysis

The online survey used to gather a respondent's knowledge contains dichotomous, multiple-choice and rating scale questions. This diversity in question formats leads to the calculated variables being either binary/categorical or continuous.

During the data analysis the table below will be used to determine the most appropriate method for statistical analysis:

		Calculated variable	
		Binary/ Categorical	**Continuous**
Calculated variable	**Binary/ Categorical**	Bias corrected Cramér's V	Point Biserial Correlation
	Continuous	Point Biserial Correlation	Spearman's Rho **or** Kendall's Tau

***Table 3** Methods to be used for statistical analysis [Medium, 2019]*

2.4.1 Methods to be used

As shown in Table 3 four methods will be used for statistical analysis. These will be discussed in the next sections.

2.4.1.1 Bias corrected Cramér's V

Cramér's V is a popular method to measure the association between two variables [Bergsma, 2013].

$$V = \sqrt{\frac{\chi^2}{n * t}}$$

In this formula [Gingrich, 2004]:

n relates to the sample size used in the test,

t relates to the smaller of the number of rows minus one or the number of columns minus one. So, if r is the number of rows, and c is the number of columns, then t = minimum (r – 1, c - 1) and

χ^2 relates to chi-square statistic which will be calculated using:

$$\chi^2 = \sum \frac{(x_i - y_i)^2}{x_i}$$

With x_i and y_i relating to the values for variables (X and Y) that need to be associated.

The Cramér's V values range from 0 to 1 in which a higher value indicates a stronger relationship between two variables. [Cramér, 1946] It is worth noting that Cramér's V is known to be biased, which makes interpretation difficult [Bergsma 2013]. Therefore Bergsma [2013] proposes to subtract $\frac{(r-1)(c-1)}{N-1}$ from the result. When this leads to a negative result, a zero value of the test needs to be assumed.

2.4.1.2 Point Biserial Correlation

The point-biserial correlation coefficient is a variant of Pearson's correlation [Kemery, Dunlap, & Griffeth, 1988]. So before discussing Point Biserial R correlation, it is important to briefly evaluate Pearson's correlation.

Pearson's ρ correlation is a statistical method to measure the strength of a linear relationship between paired data. The strength of this relationship is reflected via the calculated Pearson's correlation coefficient, "r", which can be positive (1), non-existent (0) or negative (-1).

Calculating a relationship using Pearson's correlation requires:

- Data is structured in an interval or ration level;
- Data is linearly related and
- Data is bivariate normally distributed.

So, Pearson's correlation cannot be used to associate a continuous variable (containing ratio or interval data) to a dichotomous variable (containing binary or categorical data) and vice versa. For this, the Point Biserial Correlation, commonly expressed as r_{pb}, is a better option [Kemery et al., 1988].

$$r_{pb} = \frac{\mu_1 - \mu_0}{\sigma}\sqrt{pq}$$

In this formula [Kemery et al., 1988]:

- μ_1 relates to the mean scores for the respondents that answered positive (1) to the binary variable;
- μ_0 relates to the mean scores for the respondents that answered negative (1) to the binary variable;
- σ relates to the population's standard deviation of the scores;
- p relates to the proportion of cases in the "0" group and
- q relates to the proportion of cases in the "1" group; that is (1-p).

2.4.1.3 Spearman's rank correlation

The Spearman's rank correlation is the non-parametric version of Pearson's correlation[Cleff, 2013]. In this, non-parametric means that the distribution of data relies on a ranking or ordering. So, Spearman's correlation coefficient measures the strength and direction of the association between ranked variables [Spearman, 1904]. It is commonly denoted by the Greek letter "*ρ*" (rho) or "r_s".

When determining the correlation between two variables using Spearman's correlation the data needs to be ranked first. Ranking data is done by separately ordering the variables and numbering them based on the order. After the data is ranked two methods to calculate Spearman's correlation are available. The method best used depends on whether the data has some tied ranks [Cleff, 2013]. A rank is tied when two items in a column have the same rank and thus the same number.

The formula below can be used when there are no tied ranks [Cleff, 2013].

$$\rho = 1 - \frac{6\sum d_i^2}{n(n^2 - 1)}$$

In the formula, d_i relates to the difference in paired ranks and n relates to the number of cases. The formula results in a correlation coefficient, like Pearson's. For this thesis the following rule of thumb will be used:

Correlations beyond +0.70 or -0.70 indicate a strong correlation. Correlations lower than +0.5 or -0.5 indicate a weak relationship. Leaving correlations within the range +0.5 to +0.7 or -0.5 to -0.7 showing a moderate relationship [Rumsey, 2009].

When ranking the data delivers some tied ranks the following formula [Cleff, 2013] can be used.

$$\rho = \frac{\sum_i (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_i (x_i - \bar{x})^2 \sum_i (y_i - \bar{y})^2}}$$

In this formula x_i or y_i relate to the ranks and, $\bar{x}$ or $\bar{y}$ relate to the mean ranks. The formula results in a similar correlation coefficient as discussed above.

It should be noted that the reliability in ρ values reduces when more than two tied ranks are present. So, when working with more than two tied ranks Kendall's Tau is a better option to calculate correlation [Kinnear & Gray, 1999].

2.4.1.4 Kendall's Tau rank correlation

Kendall's rank correlation coefficient commonly denoted by the Greek letter "τ" (tau). Therefore, it is also referred to as Kendall's tau coefficient.

Just as Spearman's rank correlation coefficient, Kendall's Tau assesses statistical associations based on the ranks of the data [Kendall, 1938, 1955]. The calculated correlation coefficients take the values between "minus one" and "plus one". Correlations beyond +0.70 or -0.70 indicate a strong correlation. Correlations lower than +0.5 or -0.5 indicate a weak relationship. Leaving correlations within the range +0.5 to +0.7 or -0.5 to -0.7 showing a moderate relationship [Rumsey, 2009].

When using Kendall's Tau, it is important to determine the probabilities of concordance and discordance between the variables (X and Y) for which correlation needs to be calculated. The X-values and Y-values are concordant when the larger of the two X-values is associated with the larger of the two Y-values. Alternatively, when the larger X-value is associated with the smaller Y-value, they are discordant [Conover, 1999]. Conover [1999] explains that given the pairs (Xi,Yi) and (Xj,Yj), then

- A pair is concordant when $\frac{(y_j - y_i)}{(x_j - x_i)} > 0$
- A pair is discordant when $\frac{(y_j - y_i)}{(x_j - x_i)} < 0$
- A pair is considered a tie when $\frac{(y_j - y_i)}{(x_j - x_i)} = 0$
- A pair is not compared when $x_i = x_j$

The following formula will be used to calculate Kendall's Tau [Kendall, 1938; Kendall, & Gibbons, 1990]:

$$\tau_a = \frac{n_c - n_d}{\left(\frac{n(n-1)}{2}\right)}$$

In this formula n_c relates to the number of concordant (x, y) pairs, n_d relates to the number of discordant pairs and n is the data size. This formula is often referred to as tau-a. The tau-a coefficient doesn't adjust for tied ranks. When confronted with tied

ranks the Kendall tau-b statistic is better [Agresti, 2010]. The Kendall tau-b coefficient will be calculated by:

$$\tau_b = \frac{n_c - n_d}{\sqrt{\left(\left(\frac{n(n-1)}{2}\right) - \left(\frac{\sum_i t_i\,(t_i-1)}{2}\right)\right) - \left(\left(\frac{n(n-1)}{2}\right) - \left(\frac{\sum_j u_j\,(u_j-1)}{2}\right)\right)}}$$

Where n_c relates to the number of concordant pairs, n_d relates to the number of discordant pairs, n is the data size, t_i relates to the number of tied values in the i^{th} group of ties for the first quantity and u_j relates to the number of tied values in the j^{th} Group of ties for the second quantity.

Chok [2010] has reviewed Pearson's, Spearman's and Kendall's correlation coefficient. According to Chok the degree of discordance and concordance within data often carries essential information about the correlation. Chok continues that "the Pearson's correlation coefficient considers both the number and degree of concordances and discordances, whereas Kendall's tau correlation coefficient reflects only the numbers of concordances and discordances regardless of their degree. Spearman's correlation is in between of the Pearson's and Kendall's, reflecting the degree of concordances and discordances on the rank scale." [Chok, 2010].

So for this thesis, Spearman's correlation coefficient is preferred over Kendall's correlation coefficient. Only when requirements for Spearman's correlation coefficient cannot be met, Kendall's tau-a method will be used when no tied ranks are present and tau-b when tied ranks are present.

2.4.2 Calculating Statistical Significance

After correlation has been calculated a significance test needs to be performed. Significance is the likelihood that the calculated correlation between two variables is not caused by a random chance. The determined significance level should reflect the accepted risk tolerance and confidence level [Baarda & De Goede, 1990].

As discussed in the previous paragraphs a total of four statistical methods will be used. Each statistical method requires its significance test. For each statistical method, a minimum significance level of 95 percent will be used.

2.4.2.1 Significance testing for corrected Cramér's V

Significance testing for corrected Cramér's V can be done using the significance test for the chi-square test of independence [Gingrich, 2004]. To calculate significance first the degrees of freedom (df) needs to be defined by:

$$df = (\#rows - 1)(\#columns - 1)$$

Using degrees of freedom and the first table in appendix b the critical value can be determined based on a p-value of 0,05 (95 percent significance level) or lower.

2.4.2.2 Significance testing for Point Biserial Correlation

Determining significance for Point Biserial Correlation can be done using a T-test [Kemery et al., 1988].

$$t = \frac{r_{pb}}{\sqrt{\frac{\left(1 - {r_{pb}}^2\right)}{(n-2)}}}$$

$$df = n - 2$$

In this formula, n relates to the number of cases.

Both the calculated t-value and the df will be used to find the significance value in table 2 in appendix B. When the t-value is greater than the significance value, a significant relationship can be concluded.

2.4.2.3 Significance testing for Spearman Rho

For significance testing of the Spearman rank correlation coefficient for n as large as 100, Zar [1972] recommends that a t-test, as mentioned below, should be used.

$$t_\rho = \rho \frac{\sqrt{n-2}}{\sqrt{1 - \rho^2}}$$

In this formula, ρ refers to the calculated correlation coefficient and n refers to the number of cases used to calculate the correlation coefficient. Lastly, the number 2 indicates two degrees of freedom. The calculated t-value will be used to determine the significance level via the second table in appendix B [Zar, 1972].

Hays [1988] adds that the formula above is "only approximately correct with ρ but is recommended provided n ≥ 10." [Hays, 1988, p. 836] For this thesis t_ρ is suitable as the survey results relevant for calculation are expected to fall between 10 and 100.

2.4.2.4 Significance testing for Kendall Tau

Regarding significance testing of the Kendall rank correlation coefficient Abdi [2006] advises that "for N larger than 10, a null hypothesis test can be performed by transforming τ_a into a z value." For this he uses the next formula:

$$z_{\tau_a} = \frac{\tau_a}{\sqrt{\frac{2(2n+5)}{9n(n-1)}}}$$

In this formula τ_a refers to the calculated Kendall tau-a correlation coefficient and n refers to n relates to the number of cases used to calculate the correlation coefficient.

For significance testing of Kendall's tau-b correlation coefficient the next formula will be used:

$$z_{\tau_b} = \frac{n_c - n_d}{\sqrt{\frac{v_0 - v_t - v_u}{18 + v_1 + v_2}}}$$

In this formula:

$$v_0 = n(n-1)(2n+5)$$

$$v_1 = \frac{\left(\sum_i t_i\,(t_i-1)\right)\left(\sum_i u_i\,(u_i-1)\right)}{(2n(n-1))}$$

$$v_2 = \frac{\left(\sum_i t_i\,(t_i-1)(t_i-2)\right)\left(\sum_i u_i\,(u_i-1)(u_i-2)\right)}{\left(9n(n-1)(n-2)\right)}$$

$$v_t = \sum_i t_i\,(t_i-1)(2t_i+5)$$

$$v_u = \sum_j u_j\,(u_j-1)(2u_j+5)$$

The calculated z-value will be used to determine the significance level with an alpha level of either $\alpha = 0.05$ or $\alpha = 0.01$ via the third table in appendix B.

2.5 Reliability and validity of the research

Next to determining a potential statistical correlation using the methods discussed in the previous chapter, it is important to ensure that:

A. The constructs and survey questions measured precisely and consistently. Thus that the survey responses are reliable. *and*

B. The constructs and survey questions measured what they intended to measure. Thus that the survey responses are valid.

The concepts of validity and reliability are closely related but should not be confused. "An instrument cannot be valid unless it is reliable. However, the reliability of an instrument does not depend on its validity" [Tavakol & Dennick, 2011].

2.5.1 The reliability of the research

"Reliability is the tendency of a respondent to respond in the same or in a similar manner to an identical or a near-identical question [Burns &Bush, 1999]." So the reliability of a survey score concerns the overall consistency of a respondent's score [Warrens, 2015]. Reliability is usually estimated via Test-Retest and internal consistency [Hernon & Schwartz, 2009].

The Test-Retest is a reliability test that is measured over time. This is done by giving the same test twice to the same people at different times and check if the scores are the same [Davidshofer, Murphy, & Charles, 2005].

Internal consistency is a method for determining a survey's reliability by comparing the respondent's scores on different questions within the same survey. These different questions should measure the same general construct. The outcome of the survey is reliable when the answers to the different questions show similarity.

The primary difference between test-retest and internal consistency is that test-retest requires two administrations for each respondent, and the internal consistency method involves only one administration for each respondent [Tavakol & Dennick, 2011]. For this thesis keeping two administrations for each respondent was not feasible. Therefore reliability will be determined via internal consistency.

The following methods can be used to assess internal consistency [Heale & Twycross, 2015]:

- item-to-total correlation;
- split-half reliability;
- Kuder-Richardson coefficient and
- Cronbach's alpha.

Cronbach's alpha (Cronbach's α) is the most popular statistical methods used to determine internal consistency [Heale & Twycross, 2015; Santos, 1999; Tavakol & Dennick, 2011;]. Warren [2015] concludes in his research that "the difference between alpha and the mean of all split-half reliabilities is less than 0.01 if the test consists of at least eleven items. We conclude that, given a moderate number of items alpha is approximately identical to the mean of all (Flanagan-Rulon) split-half reliabilities" [Warren, 2015]. So for this thesis, Cronbach's α will be used to assess the reliability of the survey results.

The following formula will be used to calculate the Cronbach's α [Cronbach, 1951]:

$$\alpha = \frac{K}{K-1}\left(1 - \frac{\sum_{i=1}^{K} \sigma_{Y_i}^2}{\sigma_X^2}\right)$$

In this formula

K refers to the number of scale items

$\sigma_{Y_i}^2$ refers to the variance associated with item i

σ_X^2 refers to the variance associated with the observed total scores

The formula delivers a coefficient ranging between 0 and 1. Reliability values ranging between 0.6 and 0.7 are regarded as acceptable for exploratory research. For research in a more advanced stage, a value between 0.7 and 0.9 should be regarded as satisfactory [Nunnally & Bernstein, 1994].

2.5.2 The validity of the research

Validity is the "best available approximation to the truth or falsity of a given inference, proposition or conclusion" [Cook & Campbell, 1979}." This boils down to determining whether the conclusions are correct.

Hartas [2015], Brewerton & Millward [2001], and Litwin [1995] identify content validity, convergent validity, and discriminant validity as the most common forms of validity in research. The latter two are both sub-types of construct validity [Taherdoost, 2016].

2.5.2.1 Content Validity

Content validity (also known as logical validity) "refers to the degree to which an assessment instrument is relevant to, and representative of, the targeted construct it is designed to measure" [Rusticus, 2014]. Through content validation, a survey is evaluated to ensure that all essential items are included and all undesirable items are eliminated [Lewis, Snyder, & Rainer, 1995 and Boudreau, Gefen, & Straub, 2001].

According to Mashaw [2012], content validity cannot be determined by conducting an empirical test. It "usually depends on the judgment of experts in the field" [Kimberlin and Winterstein, 2008]. Zohrabi [2013] adds that content validity can be carried out by inspecting the contents of the measurement.

For this thesis, pre-testing will be used to establish the survey's content validity [Forza, 2002]. Paragraph 4.3 discusses the survey's content validation in detail.

2.5.2.2 Construct Validity

Construct validity refers "to how well you translated or transformed a concept, idea, or behavior that is a construct into a functioning and operating reality, the operationalization. Construct validity has two components: convergent and discriminant validity" [Taherdoost, 2016].

Via convergent validity, the correlation between items of the same construct is measured. This is also referred to as measuring the intra-correlations of a construct [Kimberlin & Winterstein, 2008]. On the other hand discriminant validity measures correlations between different constructs within the research. This is also referred to as measuring the inter-correlation between constructs [Kimberlin & Winterstein, 2008].

Taherdoost [2016] states that convergent and discriminant validity, thus the construct validity, can be verified via an exploratory factor analysis utilizing principal component analysis with varimax rotation method. A factor analysis focuses on

detecting the structure of the data, through analyzing the common variance between variables [Field, 2009; Netemeyer et al., 2003]. Decoster [1998] advises that factor analysis should be used "when you are interested in making statements about the factors that are responsible for a set of observed responses, and you should use Principal Component Analysis when you are simply interested in performing data reduction" [Decoster, 1998]. Stapleton [1997] adds that "In the process of determining whether the identified factors are correlated, EFA [Exploratory Factor Analysis] answers the question asked by construct validity: Do the scores on this test measure what the test is supposed to be measuring via addressing whether or not the factors are correlated?"

Stapleton continues that through exploratory factor analysis:

- several factors underlying a set of variables are identified and
- possible correlations among these factors are determined.

Therefore an exploratory factor analysis can help in the process of evaluating whether a test measured what it was supposed to measure, id est the construct validity [Stapleton, 1997]. So for this thesis, exploratory factor analysis will be used to establish construct validity.

Before starting the exploratory factor analysis, the appropriateness of the data needs to be established. Data is deemed appropriate when the sample size is large enough and the sample is adequate:

1. **Sample size**: UCLA Statistical Consulting Group states that "As a rule of thumb, a bare minimum of 10 observations per variable is necessary to avoid computational difficulties" [UCLA Statistical Consulting Group, 2020]. Winter, Dodou, and Wieringa [2009] add that sample size, N=50 can be seen as a reasonable absolute minimum.

2. **Adequacy of the sample:** To determine the adequacy of the sample used for factor analysis a Kaiser-Meyer-Olkin (KMO) test and Bartlett's Test of Sphericity (BTS) needs to be administered [Tabachnick & Fidell, 2007]. A sample is seen as adequate when the data factors well [Hair, Black, Babin, & Anderson, 2010]

   KMO is a measure to determine the suitedness of the data for factor analysis [Tabachnick & Fidell, 2007]. The measure returns a value between 0 and 1. Kaiser [1974] recommends a value of greater than 0.60 but accepts a value of 0.50 as barely acceptable.

   BTS checks for redundancies between variables that can be summarized with some factors [Snedecor & Cochran, 1989]. According to Hair, Black, Babin, and Anderson [2010] factorability of variables may be assumed when BTS delivers a score significant at $a < 0.05$.

2.6 Thesis overview

To achieve the research objective the study will be divided into four phases:

2.6.1 Phase 1: Literature review

The research regarding scientific theory about complexity and information technology is conducted through a literature study. This activity aims at creating a theoretical framework that forms the basis for the development of the theory discussed in this thesis.

The literature review is discussed in chapter 3.

2.6.2 Phase 2: Data Collection

The foundation for this study is delivered by quantitative research via which the knowledge of subject matter experts is obtained.

During this phase, an online survey will be designed and created. The data collection will be discussed in chapter 4 Data gathering.

2.6.3 Phase 3: Data Analysis and Results

The data collected in the previous phase needs to be analyzed, combined and correlated. Lastly, the findings will be interpreted and reflected upon. Chapter 5 Analysis and results will cover this.

2.6.4 Phase 4: Conclusion

Based on the correlated, interpreted and reflected information conclusions will be drawn. The conclusions will be used to answer the research question including the sub-questions. For this chapter 6 will be used.

3. Literature review

3.1 Introduction

Chapter one discussed the theme of reducing complexity in IT landscapes as the frame of reference for this study. Therefore, the literature review started with a search on complexity and information systems on the Leiden University's library database and the internet. The literature review included theses, journal papers, conference proceedings, book sections, white papers, papers, and brochures.

For all relevant literature, the list of references was scanned to determine the next possible literature. This resulted in the current theoretical and practical perspectives on complexity, information systems and the effects of complexity on information systems. This also includes perspectives on IT project failure specifically due to IT complexity.

Next, the concept of governance was explored. Followed by some noticeable artifacts from IT complexity. Lastly, methods for mitigating IT complexity were investigated. The literature review will end with a summary. This summary delivers the foundation for answering sub-questions 1, 3, 7 and 8.

3.2 Views on complexity

Way back in 1947 Weaver wrote are an article called "Science and Complexity." In this article, Weaver offered a historical perspective of problems addressed by science. He proposed three types of problems that can generally be observed. He stated that these problems are split into simple, disorganized complexity and organized complexity [Weaver, 1947].

Weinberg [2001] comes to a similar categorization of problems using "a degree of organization" and "complexity" as variables.

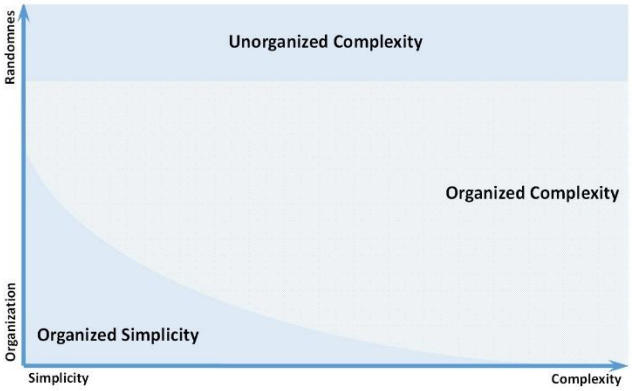

***Figure 4** Systems Map of Randomness versus Complexity [Weinberg, 2001]*

This is illustrated in figure 4 that divides problems into three sections:

1. Problems in the section organized simplicity consist of relatively few, strongly interacting elements. These problems can usually be best analyzed and researched analytically.
2. Problems in the section unorganized complexity consist of many, relatively simple entities that interact heavily. These problems can best be analyzed by statistical means.
3. Problems in the sections organized complexity consist of many entities that interact with each other and their environment. These problems are too complex for analytical methods but too organized for statistical methods.

Crutchfield and Wiesner [2010] have a similar view on the aforementioned categorization. They differ in referring to unorganized complexity as "randomness" and reserving the term "complexity'' to mean structure, pattern, and regularity. They state that a good measure of complexity captures a type of organization and is a necessary complement to understanding randomness, as it enables asking questions like "how much organization a system uses to produce its randomness".

Simon [1962] writes that a "complex system is made up of many parts that interact in a non-simple way. In such systems 'the whole' is more than the sum of the parts given that the properties of the parts and the laws of their interaction infer the properties of the whole" [Simon, 1962].

Paul Cilliers [1998] developed a philosophical framework for understanding complex systems. He explains that complex systems have certain important characteristics [Cilliers, 1998]:

1. Complex systems consist of many elements;
2. Each element in a complex system is ignorant of the behavior of the system as a whole, it responds only to information that is available to it locally;
3. Every element influences and is influenced by, quite a few other ones;
4. These elements have to interact dynamically;
5. The interactions need to have the following characteristics:
6. Non-linearity: the interactions do not clearly or directly follow from another;
7. Short-range: the interactions are primarily performed between immediate neighbors;
8. Recurrence: the effect of an interaction can feed back onto itself, sometimes directly, sometimes after several intervening stages;
9. Complex systems are usually open systems that interact with their environment;
10. Complex systems have a constant flow of energy to maintain the organization of the system;
11. Complex systems evolve through time and their past is co-responsible for their present behavior.

When discussing the concept complexity Cilliers [1998] also states that it is useful to distinguish between the terms "complex" and "complicated". According to Cilliers "If a system— even though it may consist of a huge number of components— can be given a complete description in terms of its individual constituents, such a system is merely complicated. Things like jumbo jets or computers are complicated. In a complex system, on the other hand, the interaction among constituents of the system, and the interaction between the system and its environment are of such a nature that the system cannot be fully understood simply by analyzing its components. Moreover, these relationships are not fixed, but shift and change, often as a result of self-organization" [Cilliers, 1998].

Glouberman and Zimmerman [2002] use the following distinction in problems:

- Simple problems may encompass some basic issues of technique and terminology, but once these are mastered, it carries a very high assurance of success.
- Complicated problems contain subsets of simple problems but are not merely reducible to them. Their complicated nature is often related not only to the scale of a problem but also to issues of coordination or specialized expertise. Complicated problems, though generalizable, are not simply an assembly of simple components.

- Complex problems can encompass both complicated and simple subsidiary problems but are not reducible to either since they too have special requirements, including an understanding of unique local conditions, interdependency with the added attribute of non-linearity, and a capacity to adapt as conditions change. Unavoidably, complex systems carry with them large elements of ambiguity and uncertainty.

Stacey, Griffin, and Shaw [2000] introduce chaos to the distinction of problems through his model for approaching complex situations in management settings. In this model, they use two axes to plot problems.

1. The degree of certainty or the amount of cause and effect linkages to be determined.
2. Level of agreement about an issue or decision within the group, team or organization.

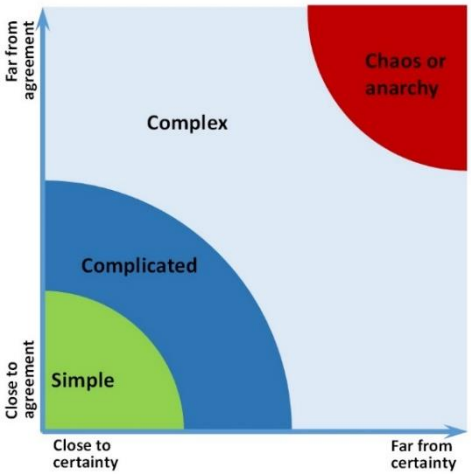

Figure 5 *The continuum from simple to chaos [Stacey et al., 2000]*

The largest region in this diagram lies between the chaos or anarchy region and the complicated region. Stacey calls this large central region the zone of complexity or the edge of chaos. In the zone of complexity, the traditional management approaches are not very effective. This thesis will focus on approaches that aim to reduce IT complexity away from the zone of complexity.

3.3 Information Technology and the Information Systems Landscape

According to Bagad [2010], information systems have three basic components: input, process/transformation, and output. So an information system gets input data and transforms this into information. Stair and Reynolds [2006] offer a more elaborate view by defining an information system as a "single set of hardware, software, databases, communications, people, and procedures configured to collect, manipulate, store and process data into information." [Stair, & Reynolds, 2006]

COMPONENT	DESCRIPTION
Hardware	Hardware refers to the computers including its peripherals, such as servers, routers, monitors, printers and storage devices. An information system can consist of a single computer or thousands.
Software	Software gathers, organizes and manipulates data. It carries out instructions and tells the hardware how to function.
Data	Data is the third element of an information system. The software cannot function without data. Data is the input that an information system transforms into information.
Procedures	Procedures are the rules, descriptions, and instructions for optimally and securely operating an information system. They are usually mentioned in user manuals or instructions for the hardware and software.
People	People refers to every person working on or with an information system. They can vary from being users to the information systems professionals who analyze organizational information needs, design or modify information systems, write code or operate the hardware.
Networks/ Connectivity	When an information system consists of more than one piece of hardware, networks/connectivity is a necessity for it to function. Communication /connectivity consists of hardware and software to facilitate fast transmission and reception data.

Table 4 *Components of an information system*

Based on the before mentioned an information system can be seen as an umbrella term for the hardware, software, connectivity, people and processes designed to create, store, manipulate, distribute and disseminate information [Bourgeois, 2014].

According to Hopstaken and Kranendonk [1990], information technology is "the entirety of hardware, software and communication facilities and their mutual relations, for data processing and/or transport, as well as the knowledge of the application of these resources in processes, products and/or services." [Hopstaken, & Kranendonk 1990]

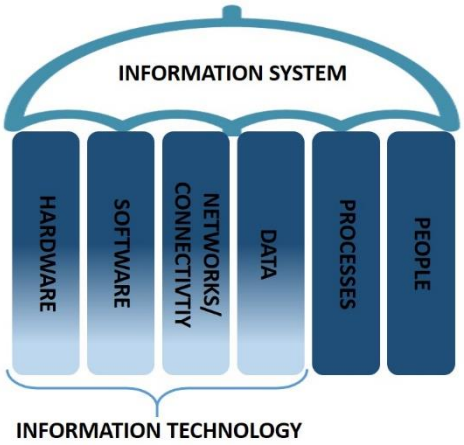

Figure 6 *Information system and Information Technology*

So, information technology falls under the information system umbrella but deals with the technology involved in the information systems themselves. This is shown in the figure on the left.

Several researchers define IT infrastructure from a similar perspective [Earl, 1989; Duncan, 1995].

Carr [2003] examines the evolution of information technology in organizations. In his article "IT doesn't matter" he introduces two patterns. In the first pattern, information technology is seen as a utility like that of earlier technologies such as railroads and electric power. In this pattern information technology should be readily available at the lowest possible cost. Information technology is not seen as delivering a competitive edge for the organization.

On the other side of the spectrum lies the second pattern. In this pattern, information technology is seen as a value creator contributing to the competitive edge of the organization. Carr concludes that organizations should stop spending wildly on advanced information technology products and services when information technology no longer provides a competitive advantage for the organization. Thus, organizations should settle for standardized, best-practice solutions where IT does not provide a competitive advantage.

3.4 Governance

Governance finds its origin in the ancient Greek verb kybernein which means steering, guiding, or maneuvering a ship. The Greek philosopher Plato was the first person to use the term metaphorically for depicting the governing of men or people:

"Imagine then a ship or a fleet in which there is a captain who is taller and stronger than any of the crew, but who is a little deaf and has a similar infirmity in sight, and whose knowledge of navigation is not much better. The sailors are quarreling with

one another about the steering – everyone is of the opinion that he has a right to steer, though he has never learned the art of navigation …" [Plato]

Based on the above one could conclude that governance is about providing leadership and strategy. Schneider [2012] writes that governance itself is a complex concept. He found different theories and approaches that used the term "governance' quite differently. The term also showed up in different concepts with distinctive meanings.

According to Bevir governance is "all the processes of governing, whether undertaken by a government, market or network, whether over a family, tribe, formal or informal organization or territory and whether through the laws, norms, power or language of an organized society" [Bevir, 2013]. Hufty [2011] adds that governance refers to the processes of interaction and decision-making among actors involved in a collective problem leading to the creation, reinforcement, or reproduction of social norms and institutions. He concludes that "governance is neither normative nor prescriptive: it refers to an observable phenomenon. Nor is it limited to any time or space, as it is observable in any human society" [Hufty, 2011 p405]

Naidoo [2002] described six characteristics to highlight the value and necessity for governance within organizations:

- Discipline: All parties involved need to adhere to procedures, processes, and authority structures.
- Responsibility: Each party needs to act responsibly to the organization and its stakeholders.
- Accountability: Decision making and action taking groups are authorized and accountable for their actions.
- Transparency: All implemented actions and their decision support need be available for inspection.
- Independence: all decision-making processes need to avoid conflicts of interest.
- Fairness: No decisions and processes that create an unfair advantage to any party are allowed.

Both Hoogervorst [2009] and Mirela [2011] divide governance into three themes: Corporate Governance, IT Governance and Enterprise Governance.

For this thesis, the focus lies on IT Governance and the resulting IT architecture.

3.4.1 IT Governance

When investigating IT governance Grembergen, Haes and Guldentops [2004] found that many definitions for IT governance do not distinct between IT governance and IT management. According to Grembergen et al. [2004], IT Management should focus on the internal effective supply of IT services and products and the management of IT operations.

IT Governance should have a broader perspective by concentrating on performing and transforming IT to meet the present and future demands of the business and the business' customers. They visualize this via figure 7.

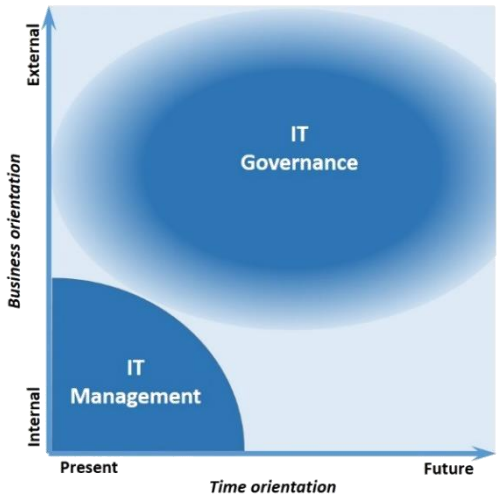

***Figure 7** IT management versus IT governance [Grembergen & De Haes, 2004]*

Grembergen and De Haes define IT governance as "an integral part of corporate governance and addresses the definition and implementation of processes, structures, and relational mechanisms in the organization that enable both business and IT people to execute their responsibilities in support of business/IT alignment and the creation of business value from IT-enabled investments " [Grembergen, & Haes, 2009].

Looking at this definition, IT-governance is associated with management as it only concerns structures for decision making and responsibilities for IT developments. Hoogervorst [2009] offers a broader perspective on IT-governance. He states that "IT governance is more than committees, decision-making, and accountability structures, but must primarily concern the substance that must be decided upon" [Hoogervorst, 2009]. He sees the substance as an organization competence being a unified whole of IT skills, knowledge and technology that rests on employee competencies.

So according to Hoogervorst, it is not the structure of governance but the governance competencies that determine success. This view is backed by Weill [2004] who states that top-performing companies distinct themselves by implementing effective IT governance in support of their strategies. In this view effective IT governance means "an actively designed set of IT governance mechanisms (e.g., committees, budgeting processes, approvals, IT organizational structure, chargeback, et cetera) that encourage behavior consistent with the organization's mission, strategy, values, norms, and culture" [Weill, 2004]. So according to Weill [2004], top-performing organizations encourage "desirable" behaviors in the use of IT via their IT governance. Thus, IT governance could be used as a means for preventing IT complexity.

3.4.2 IT architecture

The previous paragraph discussed that IT governance should primarily concern the substance that must be decided upon and that IT governance should encourage desirable behaviors. To achieve this IT architecture should be an integral part of IT governance. Dietz considers architecture as a "normative restriction of design freedom" [Dietz, 2004]. IT architecture should offer guidance for design, meaning that it should indicate how to realize the design. So "architecture is essentially a prescriptive concept that expresses ex-ante how systems must become, rather than a descriptive system that depicts ex-post how systems are" [Hoogervost, 2009]. This summarizes IT architecture as "a coherent and consistent set of principles and standards that guides how IT systems must be designed" [Hoogervost, 2009].

3.4.3 IT Decision rights

Both IT governance and IT architecture are about decisions regarding information systems. According to Weill and Ross [2004], governance is about determining who makes the decisions. Whereas management is about the process of making and implementing the decisions. They elaborate this via the example: "governance determines who holds the decision rights for how much the enterprise invests in IT. Management determines the actual amount of money invested in a given year and the areas in which the money is invested. The senior management team designs IT decision rights and accountabilities to encourage the enterprise's desirable behaviors." [Weill & Ross, 2004]

Luftman [2003] introduces four models for IT decision rights: centralized, decentralized, federal and customized. These forms typically reflect the authority structure within the organization. Luftman states that pure decentralized IT decision rights are not common. Pure centralized IT decision rights are also not common, small organizations being an exception. But both "highly centralized and highly decentralized forms are found in practice." [Luftman, 2003].

The federal model is a form in "which IT infrastructure responsibilities are highly centralized, but application planning, development, and maintenance responsibilities are highly decentralized…. This enables business units to manage their own application development resources, while a central IT unit ensures platform connectivity and the delivery of cost-efficient IT infrastructure services across the enterprise" [Luftman, 2003]. Usually, the federal form is used to better align.

Lastly, the customized model is present in some large organizations. This is a hybrid model in which both centralized and federal forms are used in different business units or functions with one organization [Luftman, 2003]. "The customized form differs from the other three models in that it is not a monolithic approach to IT decision rights within an enterprise but instead is an enterprise-level response to the differing needs of its business units" [Luftman, 2003]. This is shown in the table below.

	IT decision rights			
	Centralized	**Decentralized**	**Federal**	**Customized**
Management of IT infrastructure services				
Infrastructructure planning	Centralized	Decentralized	Centralized	Centralized
Communication operations	Centralized	Decentralized	Centralized	Centralized or Decentralized
network operations	Centralized	Decentralized	Centralized	Centralized or Decentralized
Management of applications				
Application planning	Centralized	Decentralized	Decentralized	Centralized or Decentralized
Systems development	Centralized	Decentralized	Decentralized	Centralized or Decentralized
Systems maintenance	Centralized	Decentralized	Decentralized	Centralized or Decentralized
End-user support	Centralized	Decentralized	Decentralized	Centralized or Decentralized

***Table 5** Models for IT decision rights according to Luftman*

Complexity in information systems and specifical redundancy can best be managed via a centralized system where all IT requests are decided upon by one agency [Seifert & McLoughlin, 2007]. Although more decentralized IT decision rights give a better sense of ownership and encourage better management of information systems [Seifert & McLoughlin, 2007]; more decentralized IT decision rights ultimately lead to lower visibility in the organization-wide portfolio of information systems. This results in redundant functionalities of information systems and increased maintenance cost [Maizlish & Handler, 2005]; thus, more IT complexity.

3.5 IT Projects

Projects are distinguished from everyday business as usual activities in five ways [Hedeman & Fredriksz, 2009].

1. Projects are the means by which changes are introduced into the business;
2. A project is a temporary organization with a defined start and end date;
3. A project environment is cross-functional in nature as projects often bring together people with different skills from different departments and/or different organizations;
4. A project is unique in what it delivers;
5. Projects have a greater level of uncertainty than business as usual activities.

For this thesis, an IT project is seen as a subtype of a project. The Netherlands Court of Audits uses the following definition for an IT project: "An IT project is a project whose aim is to develop and/or introduce an ICT system. We understand development to mean the specification, procurement, and internal or external construction or modification of the system. The introduction means technical and organizational implementation. An ICT project comprises not only the purchase of hardware or software but the entire process surrounding a schedule of requirements, technical realization and system implementation (successful or otherwise), including all related organizational and personnel matters" [Netherlands Court of Audits, 2007].

So, an IT project delivers (a change in) an information system in a broader sense. Soh and Markus [1995] add that an IT project should also lead to improved organizational performance. Thus, an IT project impacts on business processes. In their paper, they refer to IT projects as IT investments and they present a process model of how, when and why an IT investment is converted to favorable organizational performance.

An IT project is considered successful when it satisfies three factors: compliance with the functionality agreed to in advance, delivery on time and within the agreed budget. When these three factors balance each other, we can speak of a successful project [Noordam, Martijnse, & Derksen, 2007].

Based on the definition above a project can either be successful or a failure. Heeks introduces a third outcome by using three camps to divide e-government initiatives (IT projects):

- "Total failure: the initiative was never implemented or was implemented but immediately abandoned" [Heeks, 2003].
- "Partial failure: major goals for the initiative were not attained and/or there were significant undesirable outcomes" [Heeks, 2003].
- "Success: most stakeholder groups attained their major goals and did not experience significant undesirable outcomes" [Heeks, 2003].

3.5.1 IT complexity and the impact on IT projects

Regarding project success and failure; complexity is generally noted for its high incidence of problematic realization in IT projects [Groen, 2015]. Ting Liu et al. [2006] add that complexity is an important contributor to, because it creates and potentially overwhelms a project with much uncertainty and risk.

Complexity having a negative impact on the success of projects is also discussed in The Standish Group 2015 Chaos Report. The Standish Group 2015 Chaos Report complexity index shows a correlation between complexity and risk of project failure. The more complex and bigger an IT project is; the higher the risk of failure [The Standish Group, 2015]. According to this report, only 29% of IT projects are realized successfully. The next 52% of IT projects are regarded as problematic and the last

19% as complete failure [The Standish Group, 2015]. So about 71% of all IT projects lead to partial or total failure.

Whitney and Daniels conclude that "complexity paradigms are necessary yet absent in project management education and credentialing frameworks. The inclusion of complexity not only encompasses conventional beliefs about failure; it shifts blame from humans and the technologies they develop and manage by refocusing attention on the powerful, enigmatic nature of a complex system. Teams that perform cohesively and purposefully (under the guidance of an effective project manager, team leader or otherwise) are more likely to successfully identify and overcome uncertainties in a complex adaptive system." [Whitney & Daniels, 2013]

So, a vicious cycle could be noticed in which complexity correlates to IT project failure whereas IT project failure leads to more complexity.

3.6 Noticeable artifacts of IT complexity

3.6.1 Higher rigidity and higher maintenance and support cost

Nowadays organizations typically compete along with several competitive dimensions, such as cost, quality, delivery, flexibility, etc. [Wheelwright, 1984]. This combined with today's hyper-competitive environment characterized by constant change and market unpredictability [Eisenhardt & Brown, 1998]. Organizations are also faced with drastically shortened market visibility and increased uncertainty due to complex technological advances, shortened product life cycles, diverse customer requirements, and increased demand for product variety in fragmented global markets have. To be successful organizations must remain competitive while adapting to these pervasive changes [Eisenhardt & Brown, 1998].

Over time organizations became critically dependent on their information systems. These information systems are vital not only for their success but also for their survival [Ward & Peppard, 2002]. Partly due to adapting to the pervasive changes the information systems have undergone years of maintenance and enhancement efforts. For many organizations, this resulted in reduced modularity and increased complexity [Sarissamlis, 2006].

According to Duncan [1995], modularity is the ability to easily reconfigure technology components and the standardization of business processes for shareability and reusability. So, Modularity gives organizations the ability to quickly build new applications and modify existing applications more. Weill, Ross, and Westerman state that those organizations that have more standardized and digitized business processes are faster to market and to get more revenue from new products. They call this apparent contradiction the agility paradox. [Weill, Ross & Westerman, 2006]. Otherwise one could conclude that increased complexity will lead to lower agility making them less adaptable to change. Also, increased

complexity results in maintenance and support costs constituting almost 70 percent of the total cost of an information system lifecycle [Sarissamlis, 2006].

When looking at complexity in information systems Steger, Amann, and Maznevski [2007] define four interacting dimensions:

1. Diversity: Diversity arises due to a large and various number of (sub) systems. Schwandt defines diversity as "the ability of a system to incorporate a certain number of different states in a given time span" [Schwandt, 2009].
2. Ambiguity: Ambiguity leads to complexity when organizational goals or missions are unclear and/or when predicting the future situation is impossible and/or when the amount of information is not complete or invalid [Schwandt, 2009].
3. Interdependence: interdependence arises when different organizational elements and/or information systems must transmit information with other organizational elements and/or information systems. Organizations must manage the effect of interdependence to an unprecedented degree: when everything is related to everything else; the impact of failure or change is felt more rapidly and pervasively.
4. Fast flux: Fast Flux relates to the speed of change in the organization and its environment. These changes can occur overnight. So, today's information systems may be outdated tomorrow. Therefore, an organization must meet these changes by having a flexible strategy in order to prevent and/or reduce the complexity.

When reducing complexity one or more of these dimensions should be addressed. As mentioned before, not tackling complexity leads to rigidity and higher maintenance and support costs.

Three other tangible results of complexity are legacy information systems, technical debt and the existence of rationalization projects.

3.6.2 Legacy information systems

A legacy system is a symptom of complexity in the IT-systems landscape. Bennett [1995] states that legacy systems are build years ago using outdated techniques, yet they continue to do useful work. Based on this Bennett [1995] defines legacy systems as large software systems that an organization doesn't know how to cope with but that are vital to the organization.

Both Brody and Stonebraker [1995] and Paradauskas and Laurikaitis [2006] further specify a legacy information system as "any information system that significantly resists modification and evolution" [Brody & Stonebraker, 1995 and Paradauskas & Laurikaitis, 2006]. According to Lehman [1979], information systems become increasingly less useful if it isn't regularly updated. Lehman [1979] also observed that the structure of evolving software degrades unless remedial action is regularly taken. Lehman implies that as information systems evolve, they grow more complex unless some action is taken to reduce their complexity.

Sommerville broadens the definition by stating that "legacy systems are not simply old software systems although the software components of these systems are the focus of this chapter. Legacy systems are socio-technical computer-based systems so they include software, hardware, data, and business processes." [Sommerville, 2000].

Continuing to use legacy information systems, exposes an organization to the following problems [Bisbal, Lawless, Wu, & Grimson 1999 and Paradauskas & Laurikaitis, 2006]:

- Legacy information systems depend on obsolete hardware that is slow and expensive to maintain.
- Documentation and understanding of information system details often lacks; making maintenance expensive and time-consuming.
- Clean interfaces are lacking thus making the integration of the legacy information systems with other information systems difficult.
- Legacy information systems are very difficult to extend.

"Despite the fact that legacy systems may be obsolete, this kind of system usually has a critical mission within the company and represents a valuable asset for companies, since legacy systems embed a lot of business logic and business rules that are not present elsewhere" [Sommerville, 2006].

Paradauskas and Laurikaitis [2006] use the term business knowledge to describe the business logic and business rules present in legacy systems. Over time organizations maintain their legacy systems. Via this maintenance, increasingly more functionality supporting the organization's operations and activities were added, resulting in legacy systems with embedded business knowledge. Therefore, organizations cannot simply discard their legacy systems. On the other hand, should organizations deal with the underlying problems of software erosion in their legacy systems [Paradauskas & Laurikaitis, 2006].

3.6.3 Technical debt and technology debt

The term technical debt is metaphorically used to describe the phenomenon of increasing software development costs overtime [Tom, Aurum, & Vidgen, 2013]. The metaphor relates financial debt via which organizations can raise capital to grow their business by issuing debt. Issuing debt requires the payment of interest. In this analogy issuing debt is good, as long as the organization can service it. But trouble arises once the organization has too much debt and cannot pay the interest.

So technical debt refers to the consequences of poor software development. As with financial debt small level of technical debt can be helpful in speeding up the development process in the short term [Guo & Seaman, 2011]. But in the longer term "every hack, workaround, bad piece of code builds up technical debt" [Tom et al., 2013]. This technical debt will ultimately lead to higher complexity. Thus, resulting in slower development, less productivity and quality, and maintainability issues.

A 2015 research of technical debt showed that 42% of the executives and business managers are largely unaware of their technical debt and only 10% of the executives and business managers are actively managing their technical debt [Ernst, 2015].

Magnusson extents to the concept of technical debt to technological debt via the following three assumptions: "First, previous decisions within IT have created a

situation where the organization is faced with a debt. Second, debt is associated with an obligation of repayment with interest, and in the case of technology management, interest is argued to be materialized in a limitation of maneuverability. Third, debt is regarded in line with corporate finance theory as a necessary element of the corporate capital structure, and not something inherently negative." [Magnusson & Bygstad, 2014].

Magnusson and Bygstad [2014] identify three areas of technology debt:

- **Staff** referring to debt directly relating to the workers of the IT function. Ideology and competence are identified as sub-areas.
- **Users** referring to debt directly related to the customers and/or users of the IT function. Within this value, Magnusson identifies the working environment, user satisfaction and reputation as sub-areas.
- **Systems** referring to debt directly relating to the technological content and its governance context. Infrastructure, shadow-IT, technical and governance are identified as sub-areas where debt could be taken.

Each decision regarding IT holds with it the possibility of either increasing or decreasing technology debt. So, decision-makers have to manage the distribution of debt between the different categories and types, to avoid unbalanced distribution detrimental to future performance [Magnusson & Bygstad, 2014]. Thus, each decision regarding IT holds with it the possibility of either increasing or decreasing IT complexity.

3.6.4 The existence of rationalization projects or methods

Many organizations are faced with a complex portfolio of applications with significant redundant functionalities [Fabriek, Brinkkemper, & Dullemen, 2007]. In this context, redundant functionality can be seen as two or more applications providing similar functionality in supporting a process [Buckl, Ernst, Lankes, Schneider, & Schweda, 2007].

Maintaining redundant functionality uses manpower, thus costing money. When organizations start structuring their IT landscapes one could speak of a rationalization project or method. Fabriek et al. [2007] define a rationalization method as reducing the complexity of existing information systems in the portfolio. By using a rationalization method, an organization can analyze its portfolio and thereby decide to discard (parts of) them, replace them, redevelop them or invest in new information systems.

3.7 Mitigating IT complexity

In the next paragraphs, some methods aimed at reducing the complexity in the IT landscape found in the literature will be discussed.

3.7.1 Portfolio management

A portfolio can be best be seen as a collection of items grouped together to facilitate their efficient and effective management [Benson, Bugnitz, & Walton, 2004].

By using application portfolio management organizations can harmonize and simplify their landscape and thus reduce their IT complexity [Betz, 2007]. Before discussing application portfolio management more in-depth; the term application should be elaborated. An application can have different interpretations within different organizations. Riempp and Gieffers-Ankel [2007] state that the term application is often used as a synonym for an information system. They define an application as a specific class of information systems that support business processes because applications are the interface between business user requirements and the support provided by IT departments. "The sum of all applications run by a specific organizational body is called its application portfolio" [Riempp & Gieffers-Ankel, 2007].

By describing applications in this manner Riempp and Gieffers-Ankel reject information system components such as middleware, databases, and operating systems as being applications. Maizlish and Handler [2005] use a somewhat broader definition for an application by stating that "an application is:

- An aggregation of software code impounding business logic and rules
- Transforming users or system input into data output
- For the purpose of automating and optimizing business functions, processes, tasks, and activities therein"

Based on this broader perspective Maizlish and Handler [2005] define a broader form of portfolio management called IT portfolio management. According to Maizlish and Handler "IT portfolio management is an integral framework, language, and tool in realizing the positive correlation between the amounts spent on IT and the corresponding increase in productivity." [Maizlish & Handler, 2005]

They state that certain elements of IT portfolio management exist in all organizations. These are maximizing IT value while managing risks and costs. But they also state that organizations should implement key criteria and conduct the entire IT-portfolio framework uniformly, across the entire organization and over the entire life cycle of an IT investment. Maizlish and Handler [2005] identify "three primary areas of IT portfolio management:

1. Processes and a framework to plan, create, assess, balance, and communicate the execution of the IT portfolio. For best-practice companies, these processes are standardized, consistent, and visible across the enterprise.
2. Tools that analyze information and data, such as value, costs, risks, benefits, requirements, architecture, and alignment to business and strategic objectives. Information and data are derived from the strategic intent, strategic plan, and business and strategic objectives. Information and data are fluid. Weighting and scoring are applied against information and data in order to prioritize and rank investments. What-if analysis can be performed, which will impact and alter the ranking and prioritization of IT investments.

3. A common business taxonomy and governance that communicates and defines the principles, policies, guidelines, criteria, accountability, range of decision-making authority, and control mechanisms." [Maizlish & Handler, 2005]

So, portfolio management is about determining the value of IT by comparing the benefits with the costs of maintenance and ongoing operations [Quartel, Steen, & Lankhorst, 2010]. Looking at the descriptions for portfolio management and rationalization it can be concluded that both terms can be used interchangeably. This is also concluded by Ramshorst [2013].

Portfolio management execution

Regarding the execution of portfolio management and rationalization three main methodologies were found:

I. Portfolio management as discussed by Weill and Vitale [1999];
II. Portfolio management as discussed by Sarissamlis [2006];
III. Rationalization as discussed by Fabriek et al [2007].

All three methods describe activities that need to be taken to enable successful execution. The activities can roughly be divided into Boyd's [1976, 1987] Observe-Orient-Decide-Act (OODA) loop stages. Boyd developed the OODA loop attempting to explain why American fighter pilots were more successful than their adversaries in the Korean War. "Boyd never published a conventional paper or book on his OODA model, preferring to give two-day, 200-slide briefings to influential politicians, civil servants, and military officers. Moreover, the content of his briefings evolved over time. As a result, there is no definitive OODA material available for study that is scientifically tested in the conventional sense. Despite this, we should not abandon the OODA model out of hand" [Grant & Kooter, 2005]. A search on scholar.google.com using "ooda" results in about 12.400 results [March 2019]. And searching with "ooda" and "information systems" yields 2.750 results [March 2019]

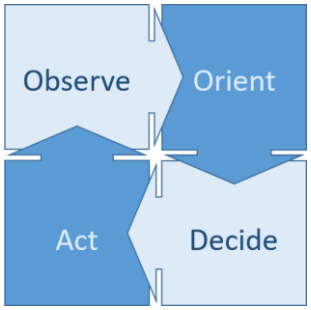

***Figure 8** OODA loop*

Plotting the activities mentioned in the three main methodologies against the OODA loop stages results in the next figure.

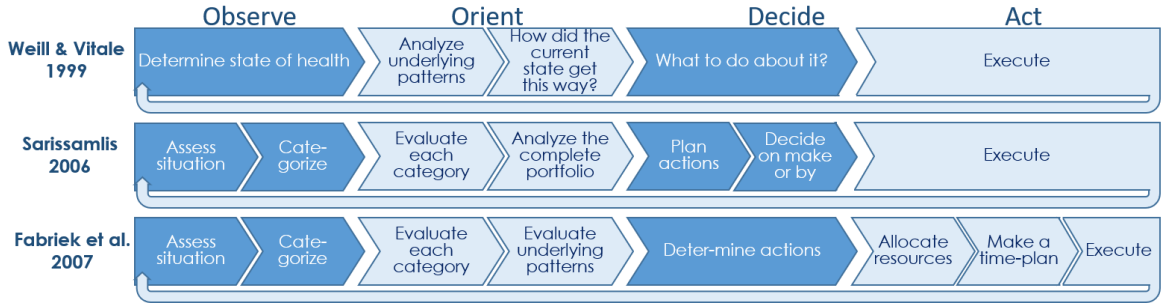

***Figure 9** OODA Loop stages and portfolio management activities*

Observe involves taking note of some feature in the environment. In the original version of the OODA loop, this meant detecting an enemy aircraft. Regarding portfolio management and rationalization this is about assessing and determining the current situation of the portfolio. The observe stage focuses on gathering and depicting relevant information about the portfolio.

Sarissamlis [2006] proposes to visualize the information systems by categorizing them to certain dimensions like common business process contribution, redundant functionality, common infrastructure, common data(base) use and common programming language. The information found will be used in the orient stage.

The **Orient** stage originally referred to pilots orienting their aircraft towards their enemy in order to be in a good position. This was critical for entering the third stage that involves deciding what to do next. Regarding portfolio management and rationalization this stage is about analyzing and evaluating the portfolio.

Koning, Bos and Brinkkemper [2006] propose to "capture the essentials of the business and link them to the essentials of the IT-support." Also, the value of an information system needs to be determined. Invaluable information systems just increase portfolio complexity and cost money. Weil and Vitale [1999] recognize Value for the business unit, Investment value, Technical value, Value of use and Management value.

The third stage is about **decisions**. The assessment of a portfolio, during the orient stage, should lead to a judgment or strategy regarding an information system. These judgments and strategies should focus on the reduction of portfolio complexity [Fabriek et al. 2007]. Literature shows the following judgment/strategy combinations:

- create, modify or delete [Simon, Fischbach & Schoder, 2010]
- tolerate, invest/innovate, migrate or eliminate [Gartner, 2009]
- sustain, replatform, decommission, remediate, consolidate, enhance/extend, Migrate or replace [Juurlink, 2011]
- Maintain/evolve, re-engineer/modernize, reevaluate/reposition or phase out/replace [Maizlish & Handler, 2005]

It should be noted that literature shows many more judgment/strategy combinations, such as quadrant approaches, Gartner's Pace Layered Application Strategy, Bedell's method, et cetera. These will not be reviewed as part of this research as these are essentially variants of the before mentioned.

After a decision is made, it is time to **act**. During the fourth stage, the IT complexity is reduced. As this change generally impacts business processes and should lead to improved organizational performance an IT project is considered to be an effective method for execution [Soh & Markus, 1995]. IT projects were discussed in depth in paragraph 3.5.

The before mentioned is summarized via the table below.

		MAIN METHODOLOGIES			Short explanation
		Weill & Vitale	Sarissamlis	Fabriek et al.	activities during stage
OODA	Observe	Determine state of health	Assess situation Categorize	Assess situation Categorize	Assessing and determining the current situation of the portfolio by focusing on gathering and depicting relevant information about the information systems in the portfolio. Finally categorizing them based on the information found.
	Orient	Analyze underlying patterns How did the current state get this way?	Evaluate each category Analyze the complete portfolio	Evaluate each category Evaluate underlying patterns	Prepare for decisionmaking by Analyzing and evaluating the portfolio of information systems. Also the value of an information system needs to be determined.
	Decide	What to do about it?	Plan all actions Decide on make or buy	Determine actions	Deciding how to reduce IT complexity via a judgement or strategy regarding an information system.
	Act	Execute	Execute	Allocate resources Make a time-plan Execute	Actually reducing the IT complexity via an IT-project.

***Table 6** OODA Loop stages and portfolio management activities*

3.7.2 ERP Implementation

Mahmood [2013] defines an ERP system as "a set of packaged application software modules with an integrated architecture, which can be used by organizations as their primary engine for integrating data, process and information technology, in real-time, across internal and external value chains" [Mahmood, 2013].

So, an ERP system combines different modules like human resources, sales, finance, materials management, and production. These modules support organizations by integrating their business processes [Nazemi, Tarokh, & Djavanshir, 2012; Klaus, Rosemann, & Gable, 2000; Motwani, Subramanian, & Gopalakrishna, 2005]. An ERP system also delivers organizations the possibility of replacing their largely fragmented information systems [Ahmad & Pinedo Cuenca, 2013; Boudreau, Robey, Marie-Claude, & Daniel, 1999]. Thus, lowering the complexity of the information systems landscape.

But implementing an ERP system is also disputed as being a contributor for lowering complexity in the information systems landscape. According to Janssens [2017] "implementing an ERP system is a very complex project. An ERP implementation project not only introduces new technology in an organization but in general also causes organizational change. The complexity of ERP projects, resulting from the interaction of technology and organizational changes, makes them hard to manage" [Janssens, 2017].

Mahmood [2013] concludes that "an ERP system is primarily implemented to integrate business processes and enhance productivity. However, an ERP system comes with a high price tag, implementation complexities, and prerequisite changes in how an organization and its staff functions. Implementing ERP is a challenging task for organizations since it consumes a major portion of limited resources and carries a high risk of causing adverse consequences" [Mahmood (2013)].

Both Janssens and Mahmood are backed by Amid, Moalagh and Ravasan [2012] "It is said that about 70% of ERP implementations fail to deliver anticipated benefits and three-quarters of these projects are unsuccessful. These projects are, on average, 178% over budget, took 2.5 times longer than intended and delivered only 30% of promised benefit".

So, an ERP implementation offers possibilities to address complexity within organizations. On the other hand, the before mentioned researchers consider ERP implementation as risky. This is partly due to the complexity of the IT systems landscape.

3.7.3 Service-Oriented Architecture (SOA)

Perepletchikov, Ryan, and Frampton [2005] describe Service-Oriented Architecture (SOA) as "an approach for constructing integrated enterprise software systems that employ services, where a service represents a function that is self-contained and does not depend on the context or state of other services. SOA-based systems are defined as a collection of interacting services that offer well-defined interfaces to their potential users. One of the driving factors behind SOA is its business alignment. Businesses depend on information technology for their everyday tasks, and as such, the logic and rules that drive the business are an integral part of software. The traditional approach is to code business logic into software itself, whereas SOA in conjunction with Business Process Modelling (BPM) allows situating business logic within executable business processes that can be designed and implemented by business modelers with the aid of tool support, thus providing a higher level of abstraction for encapsulating business logic, and facilitating reconfiguration."

Meersman, Tari, and Herrero [2005] add that SOA's primary goal is to expose application functions in a standardized way so that they can be leveraged across multiple projects. Thus, migrating to SOA leads to reduced time, effort and costs for maintaining and expanding information technology [Meersman, Tari, & Herrero 2005]. Long term benefits are reduced management costs and the collection of a unified information taxonomy and thus providing a data bridge between incompatible technologies [Chatarji, 2004].

Almonaies, Cordy, and Dean [2010] found that even though SOA has become popular, the majority of legacy systems are still not SOA enabled. They also found that the increase in the amount of information handled by organizations has resulted in a considerable increase in the complexity of the legacy systems that store this information. Migrating to SOA can be beneficial in handling this increase but it is also potentially expensive, risky and time-consuming. They conclude that "modernizing legacy information systems for SOA has clear potential benefits, but there is no perfect strategy. The strategy depends on the goals for the SOA architecture, the available budget, resources and the time needed to complete the project" [Almonaies, Cordy, and Dean, 2010].

Almonaies et al. [2010] therefore advise "to retire the application and replace it with an off-the-shelf package or a complete rewrite of the legacy system from scratch. Two possible reasons are if the business rules in the application are well understood in the organization, and the legacy system involves obsolete or difficult to maintain technologies" [Almonaies et al., 2010].

3.7.4 Cloud strategies

Berkeley RAD Lab provided the following definition for cloud computing: "Cloud Computing refers to both the applications delivered as services over the Internet and the hardware and systems software in the datacenters that provide those services. The services themselves have long been referred to as Software as a Service (SaaS). The data center hardware and software are what we will call a Cloud. When a Cloud is made available in a pay-as-you-go manner to the general public, we call it a Public Cloud; the service being sold is Utility Computing. We use the term Private Cloud to refer to internal datacenters of a business or other organization, not made available to the general public. Thus, Cloud Computing is the sum of SaaS and Utility Computing but does not include Private Clouds. People can be users or providers of SaaS, or users or providers of Utility Computing." [Armbrust et al., 2009]

Armbrust et al, [2009] also conclude that "cloud computing has become increasingly popular due to the clear advantage of reducing capital expenditure and transforming it into operational costs. This advantage manifests as the saving of fixed costs by leasing rather than buying infrastructure using the pay-per-use model offered by many Cloud providers." [Armbrust et al., 2009]

McAfee [2012] adds that cloud computing offers a new suite of digital tools and approaches to deal with IT complexity. He explains this by stating that cloud computing offers a radically different paradigm via which organizations lease their digital assets from the cloud rather than owning them on-premise. By renting what is "just needed" from the cloud organizations can offload their own software and hardware and even their data centers or other specialized facilities.

As many organizations are faced with complexity in their IT landscapes, they want to move their existing legacy applications to the cloud [Shrikant, 2013]. By doing this these organizations hope to achieve:

- **More agility** as less effort is required to make changes to existing applications;
- **Shorter time to market** as rolling out new services and features to support business expansion is faster;
- **Lower cost of maintenance** as less staff is needed for ongoing maintenance;
- **Better integration** as integrating legacy applications with newer and modern standards-based applications, special tools, and services will be less difficult;
- **Easier upgrades for legacy applications** as applications no longer require client software to be installed on desktop computers for users to access the applications [Shrikant, 2013].

But the process of migrating legacy systems to cloud computing environments is a complex process as cloud migration is the process of moving data, applications or other business elements from an organization's computers to the cloud [Hussein, Hashem, & Li, 2013]. Also, legacy applications often were developed before the cloud computing era. So, the characteristics of cloud environments (like elasticity, interoperability, multi-tenancy, et cetera) were not considered. Thus "moving existing legacy systems to cloud platforms is a difficult and high-cost process that may involve technical and non-technical resources and challenges. There is evidence that the lack of understanding and preparedness of cloud computing migration underpin many migration failures in achieving organizations' goals" [Gholami, Daneshgar, Beydoun, & Rabhi, 2017].

This conclusion is backed by Fox et al. [2009] who state that information system complexity and costs of (partial or full) is a caveat for migrating a legacy information system to the cloud. "While migration is a one-time task, the amount of effort can be significant, and it needs to be considered as a factor in deciding to use cloud computing." [Fox et al., 2009].

3.7.5 Agile Methodologies

Back in 1998 Mintzberg, Ahlstrand and Lampel described a shift in strategic management thinking in organizational contexts towards a perspective that acknowledges the existence of environmental uncertainty and complexity. He noticed that planned approaches that historically exploited past experiences were inflexible and ill-suited for an agile response to environmental change. Organizations should bridge the gap between strategic management and implementation through incremental learning. Via this focus on learning through exploration organizations will become successful in addressing their turbulent and complex environments. This has led many strategists to reposition formulation closer to implementation [Mintzberg, Ahlstrand, & Lampel, 1998].

In software development, a similar shift appeared through the emergence of agile methods. These agile methods[1] aimed at delivering software in a shorter time with

[1] See appendix C for the most popular agile methods.

higher quality, less waste and less over-head [Leffingwell, 2007]. The philosophy behind agile is captured via four values and twelve principles in the Agile manifesto [Beck, Beedle, Cockburn, & Cunningham, 2001].

Value	→	Explanation
Individuals and Interactions Over Processes and Tools	→	It is the people who respond to business needs and drive the development process. If the process or the tools drive development, the team is less responsive to change and less likely to meet customer needs.
Working Software Over Comprehensive Documentation	→	Agile does not eliminate documentation, but it streamlines it in a form that it holds what is needed to do the work without getting bogged down in minutiae
Customer Collaboration Over Contract Negotiation	→	Engaging and collaborating the customer throughout the development process/making ensures that the product meets the business needs of the customer.
Responding to Change Over Following a Plan	→	Traditional project management develop detailed, elaborate plans, with a defined set of features. Within this a change is seen as an expense that has to be avoided. Agile viewa changes as improving a project; changes provide additional value. By working with short iterations, priorities can be shifted from iteration to iteration and new features can be added into the next iteration.
Principle	→	**Explanation**
Our highest priority is to satisfy the customer through early and continuous delivery of valuable software.	→	The customer is the most important stakeholder, and what is most important to them is knowing that you will solve their problem for them. It is even better if they can receive something of value early.
Welcome changing requirements, even late in development.	→	Agile processes harness change for the customer's competitive advantage. Requirements change for all sorts of reasons. Agile teams expect this and anticipate it.
Deliver working software frequently, from a couple of weeks to a couple of months, with a preference for the shorter timescale.	→	The best way to know if something is right is to see it in action. This helps to refine requirements for future releases, raises customer confidence in the software development team and offers the potential to realise value early.
Business people and developers must work together daily throughout the project.	→	Most projects are too complicated to assume that written down requirements will capture every detail. Being able to ask questions and clarify understanding throughout the project is essential – the best way to do that is face to face.
Build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done.	→	People build solutions, and people do better work when they are motivated, empowered and have the right tools for the job. The impact on quality and productivity caused by not doing this should not be underestimated.
The most efficient and effective method of conveying information to and within a development team is face-to-face conversation.	→	While other forms of communication are important, for many things, face to face is by far the best.
Working software is the primary measure of progress.	→	It is better to measure progress in terms of the actual thing you are delivering, rather than other factors (like effort spent) since that's what the customer really cares about.
Agile processes promote sustainable development. The sponsors, developers and users should be able to maintain a constant pace indefinitely.	→	People build solutions, and people don't do good work when they are overworked, stressed or neglecting other parts of their life. Good agile teams don't rely on a hero culture.
Continuous attention to technical excellence and good design enhances agility.	→	Delivering quickly is not an excuse for poor engineering. In fact, good design can make it easier to add new capability quickly.
Simplicity – the art of maximising the amount of work not done – is essential.	→	It is easy to make things hard, big and complex. Often, it is harder, but far more valuable, to make things simple.
The best architectures, requirements and designs, emerge from self-organising teams.	→	A self-organising team that is fully focused on the goal will offer more relevant answers than those imposed upon them.
At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behaviour accordingly.	→	No team is ever perfect and the environment it operates in is never static. The best teams identify regularly the adjustments they should make in order to improve.

***Table 7** Agile Values and Principles*

So agile methodologies replace "upfront planning with incremental planning that adopts to the most current information available, building in quality upfront, addressing technical risks as early in the process as possible, to minimize the impact of changing requirements, delivering frequent and continuous business value to the organization, entrust and empower staff, encouraging ongoing communication between the business areas and project team members, and increase in the client's involvement" [Sohi, Hertogh, Bosch-Rekveldt, & Blom, 2016]. Thus implicitly addressing budget overruns, missed deadlines, low-quality outputs, dissatisfied users and IT complexity. [Cooke, 2012].

Although agile methods can be used to battle complexity, literature also reports difficulties relating to complexity and adopting agile methodologies [Dyba & Dingsoyr, 2009]. Both Abrahamsson, Ebert, and Oza [2012] and Vilkki, Abrahamsson and Oza [2010] conclude that agile methods often focus on a team or project level.

But battling IT complexity needs the entire organization working agile. Thus, it is not enough for implementing agile methodology on a team or project level [Kettunen, & Laanti, 2008].

In large and distributed organizations, implementing agile methodologies could be a time-consuming and complex process [Korhonen, 2013]. However, several studies indicate that correctly implemented agile methodologies improve quality and add value over the traditional, plan-driven approaches [Sfetsos & Stamelos, 2010] and thus could be used to battle IT complexity.

3.8 Literature summary

This chapter reviewed current theoretical and practical perspectives on complexity, governance, information systems, and complexity reduction methods. This review enables answering sub-question S1 and S2. It also provides a theoretical foundation for answering sub-question S3, S6 and S7.

In the next paragraphs, the literature review will be summarized based on the sub-questions.

3.8.1 S1. What are drivers causing complexity in the IT-landscape?

The literature review learned that an information system is a "single set of hardware, software, databases, communications, people and procedures configured to collect, manipulate, store and process data into information." [Stair, & Reynolds, 2006] So basically an information system gets input data and transforms this into information. This makes the IT-landscape the entirety of information systems used within an organization.

A complex information system is made up of a large number of parts that interact in a non-simple way. This results in 'the whole' being more than the sum of the parts [Simon, 1962]. The following characteristics are present in complex information systems [Cilliers, 1998]:

1. Complex systems consist of a large number of elements;
2. Each element in a complex system is ignorant of the behavior of the system as a whole, it responds only to information that is available to it locally;
3. Every element influences and is influenced by, quite a few other ones;
4. These elements have to interact dynamically;
5. The interactions need to have the following characteristics:
   a) Non-linearity: the interactions do not clearly or directly follow from another;
   b) Short-range: the interactions are primarily performed between immediate neighbors;
   c) Recurrence: the effect of an interaction can feed back onto itself, sometimes directly, sometimes after a number of intervening stages;
6. Complex systems are usually open systems that interact with their environment;
7. Complex systems have a constant flow of energy to maintain the organization of the system;
8. Complex systems evolve through time and their past is co-responsible for their present behavior.

3.8.2 S2. What are noticeable artifacts of IT complexity in the IT-Landscape?

The presence of complexity in the IT-landscape can be noticed via the presence of the following artifacts.

Reduced modularity and higher maintenance and support cost

Over time organizations became critically dependent on their information systems. These information systems are vital not only for their success but also for their survival [Ward & Peppard, 2002]. Partly due to adapting to the pervasive changes the information systems have undergone years of maintenance and enhancement efforts. For many organizations, this resulted in reduced modularity and increased complexity [Sarissamlis, 2006]. Also, increased complexity results in maintenance and support costs constituting almost 70 percent of the total cost of an information system lifecycle. [Sarissamlis, 2006].

Legacy information systems

A legacy system is a symptom of complexity in the IT-systems landscape. Bennet [1995] states that legacy systems are build years ago using outdated techniques, yet they continue to do useful work. Based on this Bennet [1995] defines legacy systems as large software systems that an organization doesn't know how to cope with but that are vital to the organization.

Technical debt and technology debt

Technical debt refers to sub-optimal choices for the IT landscape being made in order to speed up project delivery. But "every hack, workaround, bad piece of code builds up technical debt in the longer term" [Tom et al., 2013]. This technical debt will ultimately lead to higher complexity. Thus, resulting in slower development, less productivity and quality, and maintainability issues.

The existence of rationalization projects or methods

A rationalization project method focuses on reducing the complexity of existing information systems in the portfolio [Fabriek, Brinkkemper, & Dullemen, 2007]. Thus, the existence of this type of project implies complexity in the IT landscape.

The lower success rate of IT projects and IT complexity itself

The last tangible effect of IT complexity relates to the success rate of IT projects. Groen [2015] states that "Many IT projects involve complexities such as compatibility and synchronization issues between different systems." The compatibility and synchronization issues arise when the user needs to have collated and coherent information and this collated and coherent information needs different IT systems having to communicate with each. Ting Liu et al. [2006] add that complexity creates and potentially overwhelms a project with much uncertainty and risk.

But project failure will lead to more technical complexity. So, a vicious cycle could be noticed in which complexity leads to IT project failure and IT project failure leads to more complexity.

3.8.3 S3. Which main methods are used to reduce complexity in the IT-landscape?

The following methods aimed at reducing the complexity in the IT landscape were found in literature and discussed.

Portfolio management

Portfolio management is about determining the value of IT by comparing the benefits with the costs of maintenance and ongoing operations [Lankhorst et al., 2010].

ERP Implementation

An ERP system is "a set of packaged application software modules with an integrated architecture, which can be used by organizations as their primary engine for integrating data, process and information technology, in real-time, across internal and external value chains" [Mahmood, 2013]. Implementing an ERP system delivers organizations the possibility of replacing their largely fragmented information systems [Ahmad et al., 2013]; Boudreau et al., 1999]. Thus, lowering the complexity of the information systems landscape.

It is worth noting that implementing an ERP system is also disputed as being a contributor to lowering complexity in the information systems landscape. Implementing an ERP system is considered to be a very complex project as it not only introduces new technology in an organization but in general also causes organizational change According to [Janssens, 2017]. Literature showed that "about 70% of ERP implementations fail to deliver anticipated benefits and three-quarters of these projects are unsuccessful. These projects are, on average, 178% over budget, took 2.5 times longer than intended and delivered only 30% of promised benefit" [Amid et al., 2012].

Service-Oriented Architecture (SOA)

A Service-Oriented Architecture (SOA) is "an approach for constructing integrated enterprise software systems that employ services,…, and does not depend on the context or state of other services." [Perepletchikov et al. 2005]. SOA's primary goal is to expose application functions in a standardized way so that they can be leveraged across multiple projects. Thus, migrating to SOA leads to reduced time, effort and costs for maintaining and expanding information technology [Meersman et al., 2005]. Long term benefits are reduced management costs and the collection of a unified information taxonomy and thus providing a data bridge between incompatible technologies [Chatarji, 2004].

Cloud strategies

Cloud Computing refers to both applications and the hardware and systems software in the datacenters that provide those services being provided over the internet [Armbrust et al., 2009]. Next to reducing capital expenditure and

transforming it into operational costs, cloud computing offers a new suite of digital tools and approaches to deal with IT complexity [McAfee, 2012]. In dealing with IT complexity cloud computing offers a radically different paradigm via which organizations lease their digital assets from the cloud rather than owning them on-premise. By renting what is "just needed" from the cloud organizations can offload their own software and hardware and even their data centers or other specialized facilities.

Migrating legacy systems to cloud computing environments is a complex process as cloud migration is the process of moving data, applications or other business elements from an organization's computers to the cloud [Hussein, et al., 2013]. Also, legacy applications often were developed before the cloud computing era. This, among others, makes "moving existing legacy systems to cloud platforms is a difficult and high-cost process that may involve technical and non-technical resources and challenges. There is evidence that the lack of understanding and preparedness of cloud computing migration underpin many migration failures in achieving organizations' goals" [Gholami et al., 2017].

Agile Methodologies

Several agile methodologies were found in the literature. The methodologies have in common that they address budget overruns, missed deadlines, low-quality outputs, dissatisfied users and IT complexity by replacing "upfront planning with incremental planning that adopts to the most current information available, building in quality upfront, addressing technical risks as early in the process as possible, to minimize the impact of changing requirements, delivering frequent and continuous business value to the organization, entrust and empower staff, encouraging ongoing communication between the business areas and project team members, and increase in the client's involvement" [Sohi et al., 2016].

In large and distributed organizations, implementing agile methodologies could be a time-consuming and complex process [Korhonen, 2013]. However, several studies indicate that correctly implemented agile methodologies improve quality and add value over the traditional, plan-driven approaches [Sfetsos & Stamelos, 2010] and thus could be used to battle IT complexity.

3.8.4 S6. What are the governance mechanisms in place relating to the IT complexity reduction approach?

Governance is about providing leadership and strategy for decision making and responsibilities for IT developments. But this does not only concern the committees, decision-making, and accountability structures; it should primarily concern the substance that must be decided upon [Hoogervorst, 2009]. In this view, the substance is seen as an organization's competence being a unified whole of IT skills, knowledge and technology that rests on employee competencies. So, it is not the structure of governance but the governance competencies that determine

success. Thus, IT governance could be used as a means for preventing IT complexity.

When using IT governance to prevent IT complexity, IT architecture should be an integral part of IT governance. In this IT architecture is a normative restriction of design freedom offering guidance for the design. So, architecture indicates how the design should be realized.

Both IT governance and IT architecture are about decisions regarding information systems. So, determining who makes the decisions should be an integral part of the IT governance for management to be able to make the decisions. The literature review discussed four models for IT decision rights: centralized, decentralized, federal and customized. These forms typically reflect the authority structure within the organization. Complexity in information systems and specifical redundancy can best be managed via a centralized system where all IT requests are decided upon by one agency [Seifert & McLoughlin, 2007]. Although more decentralized IT decision rights give a better sense of ownership and encourage better management of information systems [Seifert & McLoughlin, 2007]; more decentralized IT decision rights ultimately lead to lower visibility in the organization-wide portfolio of information systems.

3.8.5 S7. What contributes to a successful execution of an IT complexity reduction approach??

Regarding complexity in information systems four dimensions interact:

1. Diversity: Diversity arises due to a large and various number of (sub) systems. Schwandt defines diversity as "the ability of a system to incorporate a certain number of different states in a given time span" [Schwandt, 2009].
2. Ambiguity: Ambiguity leads to complexity when organizational goals or missions are unclear and/or when predicting the future situation is impossible and/or when the amount of information is not complete or invalid [Schwandt, 2009].
3. Interdependence: interdependence arises when different organizational elements and/or information systems have to transmit information with other organizational elements and/or information systems. Organizations have to manage the effect of interdependence to an unprecedented degree: when everything is related to everything else; the impact of failure or change is felt more rapidly and pervasively.
4. Fast flux: Fast Flux relates to the speed of change in the organization and its environment. These changes can occur overnight. So, today's information systems may be outdated tomorrow. Therefore, an organization must meet these changes by having a flexible strategy in order to prevent and/or reduce the complexity.

For successfully reducing complexity one or more of these dimensions must be addressed. Addressing these dimensions leads to a change in the information system and/or the IT landscape. This change is can best be realized via an IT project. An IT-project delivers (a change in) an information system leading to improved organizational performance and generally impacting business processes.

In order to reduce complexity, it is important that an IT-project is successful. An IT-project is considered successful when it satisfies three factors: compliance with the

functionality agreed to in advance, delivery on time and within the agreed budget. But "complexity paradigms are necessary yet absent in project management education and credentialing frameworks. The inclusion of complexity not only encompasses conventional beliefs about failure; it shifts blame from humans and the technologies they develop and manage by refocusing attention on the powerful, enigmatic nature of a complex system. Teams that perform cohesively and purposefully (under the guidance of an effective project manager, team leader or otherwise) are more likely to successfully identify and overcome uncertainties in a complex adaptive system." [Whitney and Daniels, 2013 p325-330]

Regarding the using methodologies mentioned in paragraph 3.8.3 the following aspects should be addressed to improve the chance on success:

Portfolio management

Regarding the execution of portfolio management and rationalization three main methodologies were discussed:

I. Portfolio management as discussed by Weill and Vitale [1999];
II. Portfolio management as discussed by Sarissamlis [2006];
III. Rationalization as discussed by Fabriek et al [2007].

All three methods describe activities that need to be taken to enable successful execution. The activities can roughly be divided into Boyd's [1976, 1987] Observe-Orient-Decide-Act (OODA) loop stages. The next figure shows the activities plotted against the OODA loop stages.

		MAIN METHODOLOGIES			Short explanation
		Weill & Vitale	Sarissamlis	Fabriek et al.	activities during stage
OODA	Observe	Determine state of health	Assess situation Categorize	Assess situation Categorize	Assessing and determining the current situation of the portfolio by focusing on gathering and depicting relevant information about the information systems in the portfolio. Finally categorizing them based on the information found.
	Orient	Analyze underlying patterns How did the current state get this way?	Evaluate each category Analyze the complete portfolio	Evaluate each category Evaluate underlying patterns	Prepare for decisionmaking by Analyzing and evaluating the portfolio of information systems. Also the value of an information system needs to be determined.
	Decide	What to do about it?	Plan all actions Decide on make or buy	Determine actions	Deciding how to reduce IT complexity via a judgement or strategy regarding an information system.
	Act	Execute	Execute	Allocate resources Make a time-plan Execute	Actually reducing the IT complexity via an IT-project.

Service-Oriented Architecture (SOA)

Migrating to SOA can be beneficial in handling IT complexity but it is also potentially expensive, risky and time-consuming as the majority of legacy systems are not SOA enabled [Almonaies et al., 2010].

Even though "modernizing legacy information systems for SOA has clear potential benefits, but there is no perfect strategy. The strategy depends on the goals for the SOA architecture, the available budget, resources and the time needed to complete the project" [Almonaies et al., 2010]. Therefore it is advisable to either replace a legacy information system with an off-the-shelf package or a to completely rewrite the legacy system from scratch.

Cloud strategies

Cloud migration is the process of moving data, applications or other business elements from an organization's computers to the cloud. Also, many legacy applications are developed before the cloud computing era. So, the characteristics of cloud environments (like elasticity, interoperability, multi-tenancy, et cetera) were not considered. This makes "moving existing legacy systems to cloud platforms is a difficult and high-cost process that may involve technical and non-technical resources and challenges. There is evidence that the lack of understanding and preparedness of cloud computing migration underpin many migration failures in achieving organizations' goals" [Gholami et al., 2017].

So, a clear understanding of cloud computing and good preparation should cover some of the migration risks. Another factor is understanding and accepting that the amount of effort to migrate a legacy information system to the cloud will be significant.

Agile Methodologies

Although agile methodologies can be used to battle complexity, literature also reports difficulties relating to complexity and adopting agile methodologies [Dyba, & Dingsoyr, 2009]. Both Abrahamsson et al. [2012] and Vilkki et al. [2010] conclude that agile methodologies often focus on a team or project level. But battling IT complexity needs the whole organization working agile. Thus, an agile methodology needs to be implemented within the entire organization and not on a team or project level.

4. Data gathering

4.1 Quantitative research

This chapter documents the research method used in the data collection phase of this thesis. The foundation for this thesis is delivered via quantitative research. Marczyk, DeMatteo, and Festinger [2005] state that quantitative research involves studies that make use of statistical analyses to obtain their findings. An online survey is used as the method for data collection.

The questions in the online survey are both quantitative and qualitative in nature. Three types of closed format questions are used:

1. Dichotomous questions: Questions requiring a binary, yes or no, type of response. These are quantitative in nature.
2. Multiple choice questions: Questions via which the respondent is given a choice of multiple answers to choose from. These are quantitative in nature.
3. Rating scale questions: Questions requesting a Likert-type scale response, by giving a symmetric agree-disagree scale for a series of statements. These questions are qualitative in nature.

The online survey needs to be answered by subject matter experts. The potential respondents will be approached either directly via a mailing or via social media. To ensure statistical significance a sample size of at least 30 respondents is needed.

As the research was localized in The Netherlands, the questionnaire was primarily offered in Dutch. By doing this, the barrier for non-English respondents was lowered. An English survey was provided upon request.

4.2 Structure of the survey

The structure of the survey includes a first section in which the research relevancy is explained and where respondents are asked for their background information and experience with the topic. Based on this section the respondent's relevancy will be determined.

In the second section, respondents are asked to answer questions based on their experience with one complexity reduction initiative or project. The questions in the second section aim to find factors that have a positive effect on a complexity reduction execution. The factors are divided into five categories:

- IT systems landscape;
- Governance;
- Organization;
- Method of complexity reduction used and
- Execution of the complexity reduction approach.

Validation questions form the sixth category. These questions are asked to validate the answers given or to determine the current state and working of the respondent's organization, governance and IT systems landscape.

The survey's third and last section contains a set of statements aimed to identify factors that positively affect the complexity reduction initiative/project method. Respondents are requested to rank these statements based on their experience with complexity reduction. Answers are expected on a Likert scale ranging from agree, neutral, to disagree. Respondents are also given the option "do not know". These statements had the sole purpose to give direction in answering sub-question 8: *"What do experts recognize as factors that might positively affect the rationalization method?"*.

The survey is included in Appendix D and Appendix E contains a table via which the survey questions are linked to the constructs.

4.3 Content validation for the survey

As discussed in paragraph 2.5.2.1, the survey's content validation needs to be established to ensure that all essential items are included and all undesirable items are eliminated [Lewis, Snyder, & Rainer, 1995 and Boudreau, Gefen, & Straub, 2001]. Content validation was established by pre-testing the survey, which is recommended by Forza [2002] and Fraenkel, Wallen, & Hyun [1993].

Pre-testing was done via three groups of individuals. The first group was an expert group consisting of three persons. This group was offered the opportunity to improve the survey's design, layout, and sequence of the questions. The second group consisted of the thesis supervisors. Their tips and comments were used to improve the survey. The last group was a test group consisting of five persons. This group answered the survey. Their feedback was used to improve the survey layout and questions. It was also used to improve the explanatory texts in the survey.

4.4 Obtaining expert knowledge

To receive the data, a mailing to potential interviewees was done. Each mailing included an explanation of the purpose of the study and a hyperlink to the survey. As an encouragement to complete the questionnaire, respondents were offered a summary of the study results. Respondents were asked to forward the survey to other potential interviewees.

Also, a mailing was sent via social media (Linked-In) using the methodology discussed in the previous paragraph.

To ensure the highest possible response rate the survey was conducted in Dutch. As the potential interviewees were primarily Dutch this the "English language barrier" was mitigated.

4.5 Completion Rate

The survey was online for a period of seven weeks ending 9 December 2018. During that period a total of 114 respondents entered the survey. Only 95 of them

completed the survey giving a completion rate of 83%. This exceeded the minimum respondent rate of 30 respondents to be statistically viable.

The 95 responses were downloaded to a comma-separated file, which was suitable for import into the data analysis software.

4.6 Respondent Information

Though the survey was partially anonymous[2], the assumption is that the 95 respondents relevant for the survey represent at least 33 different organizations. This assumption is based on the following:

- A total of 95 respondents completed the survey
- A total of 64 respondents (67%) indicated that they would like feedback and they provided their email address.
- Looking at domain names used for the 64 provided email addresses the following can be concluded.
- 33 unique domain names were used; indicating that respondent originate to at least 33 different organizations
- Further investigation to the domain names used for the 64 provided email addresses learns that
- 18 respondents used personal email addresses.
- Gmail, Outlook, Hotmail, iCloud, Ziggo, Quicknet being the largest contributors
- 14 respondents work at consulting firms
- Gartner, Quint Wellington Redwood, Price Waterhouse Coopers, Ordina, Capgemini, Viagroep and CGI being largest contributors
- 13 respondents work at "other" companies in the private sector
- Achmea, Enexis, ExpertWays and Pels Rijcken & Droogleever Fortuijn (State Attorney) being the most noticeable contributors.
- 19 Respondents work in the public sector
- Ministry of Defence, Ministry of Finance and Radboud UMC being CGI being the largest contributors.

Based on the before mentioned the survey can be considered representative.

Other noticeable facts about the respondents are

- Current level in the organization
  - 39 - (Senior) Management level
  - 4 - Architect
  - 29 - Consultant/advisor
  - 8 - Executive level
  - 13 - Operational level
  - 2 -Other
- Size of their organization
  - 1 respondent worked in an organization having 1-10 employees
  - 11 respondents worked in an organization having 11-250 employees
  - 9 respondents worked in an organization having 251-1.000 employees
  - 19 respondents worked in an organization having 1.001-10.000 employees
  - 43 respondents worked in an organization having > 10.000 employees
  - 11 respondents did not answer the question

[2] To receive feedback about the research some respondents provided their e-mail address in the survey.

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5. Analysis and results

In this chapter, the data gathered is analyzed and presented. Data analysis was done via the following steps and sub-steps:

1. Coding, cleaning and organizing data
2. Establish relevancy based on answers to the relating question in the survey;
3. Determine the amount of complexity in the IT landscape prior to the initiative based on answers to the relating questions in the survey *and then*
   a. Rank the results;
4. Determine the success rate of the complexity reduction approach/project based on answers to the relating questions in the survey
5. Determine the number of governance factors addressed in the initiative based on answers to the relating questions in the survey
   and then
   a. Rank the results;
   b. Correlate the governance factors to the success rate using either Bias Corrected Cramer's V, Point Biserial, Spearman's or Kendall's Tau Rank Correlation Coefficient;
6. Determine the number of organizational factors addressed in the initiative based on answers to the relating questions in the survey *and then*
   a. Rank the results;
   b. Correlate the organizational factors to the success rate using either Bias Corrected Cramer's V, Point Biserial, Spearman's or Kendall's Tau Rank Correlation Coefficient;
7. Determine the number of execution factors addressed in the initiative based on answers to the relating questions in the survey *and then*
   a. Rank the results;
   b. Correlate the organizational factors to the success rate using either Bias Corrected Cramer's V, Point Biserial, Spearman's or Kendall's Tau Rank Correlation Coefficient.

Each of these steps will be discussed in the next sections. This chapter ends with a brief analysis of the respondents' reaction to the thirteen statements aimed to identify factors that positively affect the complexity reduction initiative/project method.

5.1 Coding, cleaning and organizing data

The online survey was hosted by SurveyMonkey. At the end of the survey period, the survey results were downloaded into a comma-separated file.

During the coding phase, the survey results were transformed into a format consistent with the identified variables and usable for the data analysis. To ensure this a uniform coding system was used to prepare the data for analysis.

- Dichotomous questions were coded into 1 for positive answers and 0 for negative answers.
- Multiple-choice questions were coded into a numerical format.
- Rating scale questions were coded into a 0 to 1 scale with 0.2 intervals.

Not all questions in the survey were answered resulting in so-called missing values. To ensure transparency of the research the missing values were also coded.

- Many questions offered "I don't know" as an option. Answers containing the "I don't know" option were coded as [-].
- The survey used logic in the questions. Depending on the answers some questions were skipped. This resulted in not all questions being answered by all respondents which resulted in missing values at variables in the data file. Missing values due to the variable not being applicable to the respondent were coded as either [QUESTION SKIPPED] or [QUESTION_LOGIC_SKIPPED].
- Some respondents refused to answer, simply did not answer or had other reasons for the missing value. These were coded as [QUESTION SKIPPED].

Appendix F contains the coding used for the survey.

Appendix G contains the coded survey results per interviewee. Due to GDPR regulations, these results are anonymized.

5.2 Determine respondents' relevancy

Section 4.6 discussed that 95 respondents completed the survey. The first step in the data analysis is verifying the respondents' relevancy.

A respondent is considered relevant for this research when

1. She or he has been involved in an initiative or project aimed at reducing IT complexity. *and*
2. The respondent's organization was faced with a complex IT landscape.

This is shown via the conceptual model shown below.

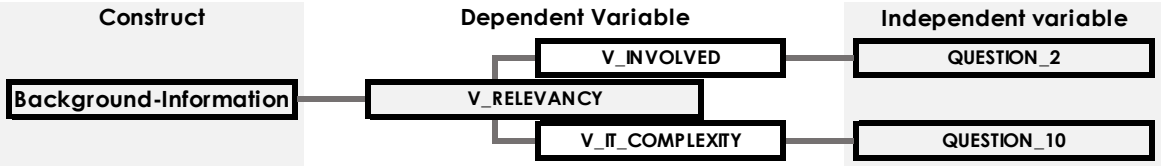

Figure 10 *Conceptual model for IT Complexity*

5.2.1 V_INVOLVED

The variable V_INVOLVED aims to verify the respondent's involvement in an initiative or project aimed at reducing IT complexity. This was measured via question two in the online survey which required a "yes" or "no" answer.

Respondents who answered "yes" (coded as "1") to this question as considered relevant for data analysis. This resulted in 11 respondents being disqualified; thus leaving 84 respondents relevant for data analysis.

These respondents had the following role regarding their IT complexity reduction approach/project

- 16 (19,0%) Sponsor group/steering committee
- 23 (27,4%) Program/project manager
- 23 (27,4%)Team-member
- 19 (22,6%) Consultant / advisor
- 1 (1,2%) Program / project controller
- 2 (2,4%) Enterprise) Architect

5.2.2 V_IT_COMPLEXITY

The variable V_IT_COMPLEXITY aims to measure the amount of complexity in the IT systems landscape prior to the IT complexity reduction approach or project. This variable measures IT complexity as a percentage where 0% relates to a simple IT-systems landscape and 100% relates to a complex IT-systems Landscape. This is based on the answers given to question 10 in the survey.

The scores for the 84 relevant respondents were:

		Simpel		IT Landschap			Complex
		0%	20%	40%	60%	80%	100%
10.	Voor het IT complexiteitsverlagingsinitiatief / -project had uw organisatie een....	0 0,00%	0 0,00%	1 1,19%	4 4,76%	39 46,43%	40 47,62%

***Table 8** Responses relating to V_IT_Complexity*

The scores reported above show that the majority (94%) of respondents reported an IT complexity of 80% and higher with an average IT complexity of 88%. The following table and boxplot show basic statistical information for IT complexity based on the information received from the respondents.

	V_IT-Complexity
Mean	88,67
Variance	136.80
Standard Deviation	11,69
Maximal value	100%
Minimal value	60%

***Table 9** Basic statistical information for V_Approach-Success*

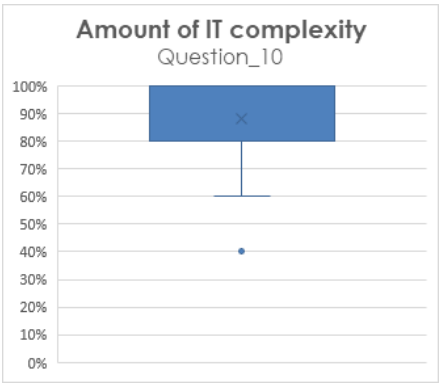

***Figure 11** Boxplot for IT-Complexity*

As this thesis aims to identify factors that could pose as representative for success in reducing IT complexity it is mandatory that the organization was faced with a complex IT systems landscape prior to the reduction approach or project.

Therefore, scores below 60% are considered irrelevant for data analysis. This results in 1 respondent being disqualified; thus, leaving a total of 83 respondents relevant for data analysis.

5.3 The success rate of the complexity reduction initiative/project

Section 3.5 discussed that an IT project is considered successful when it satisfies three factors: compliance with the functionality agreed to in advance, delivery on time and within the agreed budget. When these three factors balance each other, we can speak of a successful project [Noordam, et al. 2007].

In order to determine the success rate of the complexity reduction initiative/project, the dependent variable V_APPROACH_SUCCESS will be used. The calculation will be done, using the conceptual model shown below.

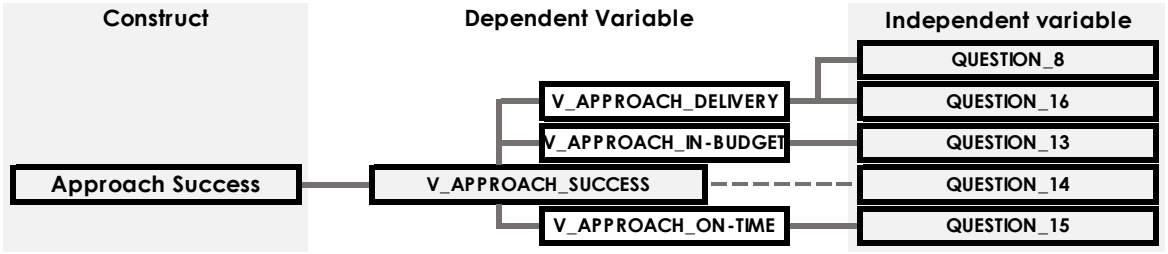

Figure 12 *Conceptual model for Approach Success*

5.3.1 V_APPROACH_SUCCESS

To calculate V_APPROACH_SUCCESS the following variables will be used:

- QUESTION_8 and QUESTION_16 to determine if the initiative/project delivered what was agreed upon upfront.
  The codified responses to both questions were compared to each other. The amount of match was calculated to a score ranging from 0 to 1 with 0.1 intervals. If QUESTION_16 contained the answer "er is niets gerealiseerd" (nothing was realized) the score 0 was given.
  The score was registered under V_APPROACH-DELIVERY.
- QUESTION_ 13 to determine if the initiative/project delivered on time.
- QUESTION_14 wat used to obtain background information. When a respondent answered "Het is voortijdig stopgezet" to QUESTION_13, QUESTION 14 became relevant. Although QUESTION_14 is relevant for V_APPROACH_SUCCESS, it will not be used in the calculation.
- QUESTION_ 15 to determine if the initiative/project delivered within budget.

The dependent variable V_APPROACH_SUCCESS was calculated using the formula:

$$\text{V\_APPROACH\_SUCCESS} = \frac{\sum(V\_APPROACH\_DELIVERY) + \sum(V\_APPROACH\_IN-BUDGET) + \sum(V\_APPROACH\_ON-TIME)}{\sum(MAXIMUM\ SCORES)}$$

The following table and boxplot show the outcome of this formula based on the information received from the respondents.

	V_Approach_ Success
Mean	0.45590
Variance	0.08523
Standard Deviation	0.29194
Maximal value	0.91667
Minimal value	0.00000

Table 10 *Basic statistical information for V_Approach_Success*

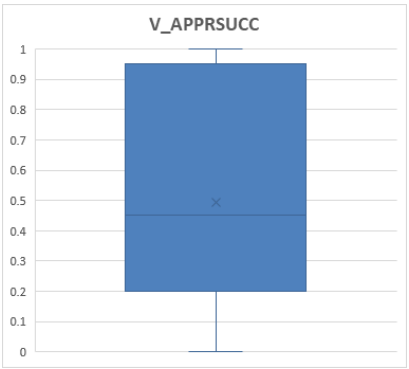

Figure 13 *Boxplot for V_Approach_Success*

The scores are continuous in nature. The scores for V_APPROACH_SUCCESS will be correlated to the factors discussed in the next sections.

5.4 Governance factors

The construct governance factors aims to identify factors relating to the governance, alignment between the approach and the organization and architecture. For this, the conceptual model shown below will be used.

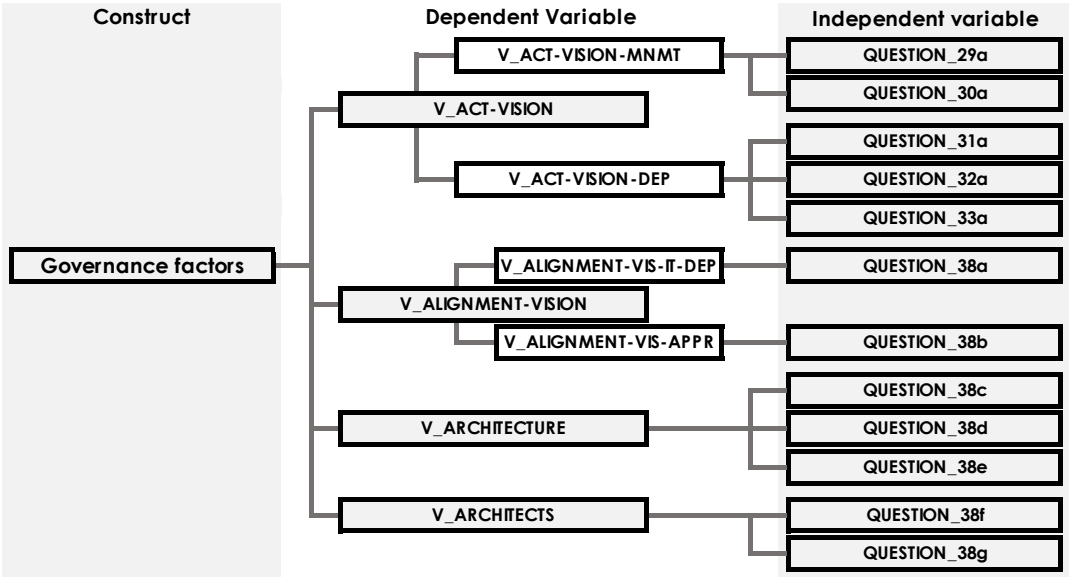

Figure 14 *Conceptual model for Governance factors*

In the next sections, the dependent variables shown in the conceptual model will be discussed and correlated to V_Approach-success.

5.4.1 V_ACT-VISION

Section 3.4 discussed that governance is about relational mechanisms that enable both business and IT people to execute their responsibilities in support of business/IT alignment. In this business/IT alignment can be seen as a process in which a business organization uses information technology to achieve their objectives. Regarding this, it is important that the organization acts in accordance with its mission and vision statement.

This variable captures the amount the organization acted in accordance with its mission and vision statement. It is the assumption that approaches run in companies that constantly act in accordance with their own vision and mission will be more successful.

The variable is measured from both a hierarchical and a departmental viewpoint, so two sub-variables will be used:

- V_ACT-VISION-MNMNT to capture the actions at the management levels as a measure for QUESTION_29a and QUESTION_30a.
  This sub-variable is calculated by computing the mean score from the codified responses to the questions.
- V_ACT-VISION-DEP to capture the actions at the business department levels as a measure for QUESTION_31a, QUESTION_32a, and QUESTION_33a.
  This sub-variable is calculated by computing the mean score from the codified responses to the three questions.

The five questions used to calculate the variables received the following responses:

	Tijdens de looptijd van het complexiteitsverlagingsinitiatief / -project...	Ja	Nee	Weet ik niet	Totaal
29a.	Handelde het executive / top management in lijn met de missie en doelstelling van de organisatie.	68,67% 57	15,66% 13	15,66% 13	83
30a.	Handelde het midden management in lijn met de missie en doelstelling van de organisatie.	65,06% 54	27,71% 23	7,23% 6	83
31a.	Handelde de bedrijfsvoering in lijn met de missie en doelstelling van de organisatie.	61,45% 51	27,71% 23	10,84% 9	83
32a.	Handelde de financiële afdeling in lijn met de missie en doelstelling van de organisatie.	49,40% 41	10,84% 9	39,76% 33	83
33a.	Handelde de IT afdeling in lijn met de missie en doelstelling van de organisatie.	75,90% 63	18,07% 15	6,02% 5	83

Table 11 *Responses relating to V_Act-Vision*

Calculating the mean of the two sub-variables above results in the variable V_Act-Vision. The table below shows the mean, variance and standard deviation of all three variables.

	V_Act-Vision	V_ACT-VISION-MNMNT	V_ACT-VISION-DEP
Mean	0.72185	0.76220	0.71111
Variance	0.10966	0.13552	0.15580
Standard Deviation	0.33115	0.36813	0.39472
Maximal value	1.00000	1.00000	1.00000
Minimal value	0.00000	0.00000	0.00000

Table 12 *Basic statistical information for V_Act-Vision*

5.4.1.1 Correlating V_ACT-VISION

The sub-variables used to calculate V_Act-vision are continuous as is V_Approach-success. Therefore, Spearman's rho will be used to determine their relationship.

		Actions in accordance with mission and vision (V_Act-vision)	Management Actions in accordance with mission and vision (V_Act-Vision-Mnmnt)	Business Department Actions in accordance with mission and vision (V_Act-Vision-Dep)
Approach Success rate (Approach-success)	Correlation Coefficient	.355**	.229*	.317**
	Sig. (2-tailed)	.002	.039	.006
	N	74	82	75

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Table 13 *Correlating V_Act-Vision and its sub-variables*

A Spearman's rho correlation was run to determine the relationship between the approach success rate and the organization's actions in accordance with its mission and vision. A positive weak relationship, which was statistically significant (r_s =.355, n = 74, p = .002) was found. Both sub-variables also showed a weak positive relationship to approach success (r_s =.229, n = 82, p = .039 for V_ACT-VISION-MNMNT and r_s =.317, n = 75, p = .006 for V_ACT-VISION-DEP).

5.4.2 V_ALIGNMENT-VISION

Another aspect of business/IT alignment is the amount of the alignment of both the IT department and the IT complexity reduction approach to the organization's mission and vision statement, that is captured by this variable. The variable V-ALIGNMENT-VISION assumes that a higher alignment towards the organization's mission and vision relates to a higher success rate for the IT complexity reduction approach.

The variable is measured by calculating the mean between QUESTION_38a and QUESTION_38b.

These questions received the following responses:

38	Tijdens de looptijd van het complexiteitsverla-gingsinitiatief / -project...	Ja	Nee	Weet ik Niet	Totaal
a.	sloot de visie en het beleid van de IT aan op de visie en het beleid van de organisatie	69,88% 58	22,89% 19	7,23% 6	83
b.	was de doelstelling van het intitiatief / project in overeenstemming met de IT strategie en IT architectuur	78,31% 65	13,25% 11	8,43% 7	83

Table 14 *Responses relating to V_Alignment-Vision*

The table below shows the mean, variance and standard deviation of all three variables.

	V_Alignment-Vision
Mean	0.81098
Variance	0.09537
Standard Deviation	0.30882
Maximal value	1.00000
Minimal value	0.00000

Table 15 *Basic statistical information for V_Alignment-Vision*

5.4.2.1 Correlating V_ALIGNMENT-VISION

As the variables, V_ALIGNMENT-VISION and V_APPROACH-SUCCESS are continuous variables, Spearman's Rho will be used to determine the relationship.

			alignment with mission and vision (V_Alignment-Vision)
Spearman's rho	Approach Success rate (V_Approach-Success)	Correlation Coefficient	.265**
		Sig. (2-tailed)	.016
		N	82

*** Correlation is significant at the 0.05 level (2-tailed)*

Table 16 *Correlating V_Alignment-Vision*

A Spearman's rho correlation was run to determine the relationship between the approach success rate and the organization's alignment with its mission and vision. A weak, positive relationship was found, which was statistically significant (r_s =.265, n = 82, p = .016).

5.4.3 V_ARCHITECTURE

The literature review, section 3.4.2, found that IT architecture should be an integral part of the IT governance to prevent and lower IT complexity. The variable V_ARCHITECTURE is used to capture elements regarding the role IT architecture plays within the organization. The assumption for this variable is that those organizations that have an IT architecture and act according to it, are more successful in reducing IT complexity. The variable V_ARCHITECTURE is based on the mean between QUESTION_38c, QUESTION_38d, and QUESTION_38e.

These questions received the following responses:

38	Tijdens de looptijd van het complexiteitsverla-gingsinitiatief / -project...	Ja	Nee	Weet ik niet	Totaal
c.	was er een (informatie-)architectuur die richting gaf aan de realisatie van nieuwe IT (applicaties en infrastructuur).	62.65% 52	27.71% 23	9.64% 8	83
d.	was er een (informatie-)architectuur die richting gaf aan het onderhoud van bestaande IT (applicaties en infrastructuur).	50.60% 42	34.94% 29	14.46% 12	83
e.	werkte de organisatie "onder architectuur".	54.22% 45	31.33% 26	14.46% 12	83

Table 17 *Responses relating to V_Architecture*

The table below shows the basic statistical information for V_ARCHITECTURE.

	V_Architecture
Mean	0.66461
Variance	0.16906
Standard Deviation	0.41117
Maximal value	1.00000
Minimal value	0.00000

***Table 18** Basic statistical information for V_Architecture*

5.4.3.1 Correlating V_ARCHITECTURE

The variable V_ARCHITECTURE, as well as V_APPROACH-SUCCESS, are continuous in nature. Therefore, Spearman's rho will be used to determine the relationship.

			V_Architecture
Spearman's rho	Approach Success rate (V_Approach-Success)	Correlation Coefficient	.265*
		Sig. (2-tailed)	.017
		N	81

** Correlation is significant at the 0.05 level (2-tailed)*

***Table 19** Correlating V_Achitecture*

A Spearman's rho correlation was run to determine the relationship between the approach success rate and elements relating to architecture. A weak positive relationship was found, that was statistically significant (R_s =.265, n = 81, p = .017).

5.4.4 V_ARCHITECTS

Architects being the guardians of architecture play an important role in preventing and lowering IT complexity. The variable V_ARCHITECTS is used to establish the activity of (enterprise) architects within the approach and the organization. This assumes that having active (enterprise) architects leads to lower IT complexity. The variable is based on the mean between QUESTION_38f and QUESTION_38g.

These questions received the following responses:

38	Tijdens de looptijd van het complexiteitsverlagingsinitiatief / -project...	Ja	Nee	Weet ik niet	Totaal
f.	zijn (enterprise) architecten actief betrokken bij het initiatief / project.	63.86% 53	24.10% 20	12.05% 10	83
d.	zijn (enterprise) architecten actief betrokken binnen de organisatie.	61.45% 51	21.69% 18	16.87% 14	83

***Table 20** Responses relating to V_Architects*

The table below shows the basic statistical information for V_ARCHITECTS.

	V_Architecture
Mean	0.73377
Variance	0.16613
Standard Deviation	0.40759
Maximal value	1.00000
Minimal value	0.00000

***Table 21** Basic statistical information for V_Architects*

5.4.4.1 Correlating V_ARCHITECTS

To determine the relationship between V_ARCHITECTS and V_APPROACH-SUCCESS a Spearman's rho correlation will be used as both variables are continuous in nature.

			Approach Success rate (V_Approach-Success)	V_Architects
Spearman's rho	Approach Success rate (V_Approach-Success)	Correlation Coefficient	1.000	.063
		Sig. (2-tailed)	.	.586
		N	83	77

***Table 22** Correlating V_Achitects*

A Spearman's rho correlation was run to determine the relationship between the approach success rate and elements related to architecture. No statistically significant relationship was found.

5.5 Organizational factors

The construct organizational factors aims to identify factors relating to the organization, her stakeholders and her departments. For this, the conceptual model shown below will be used.

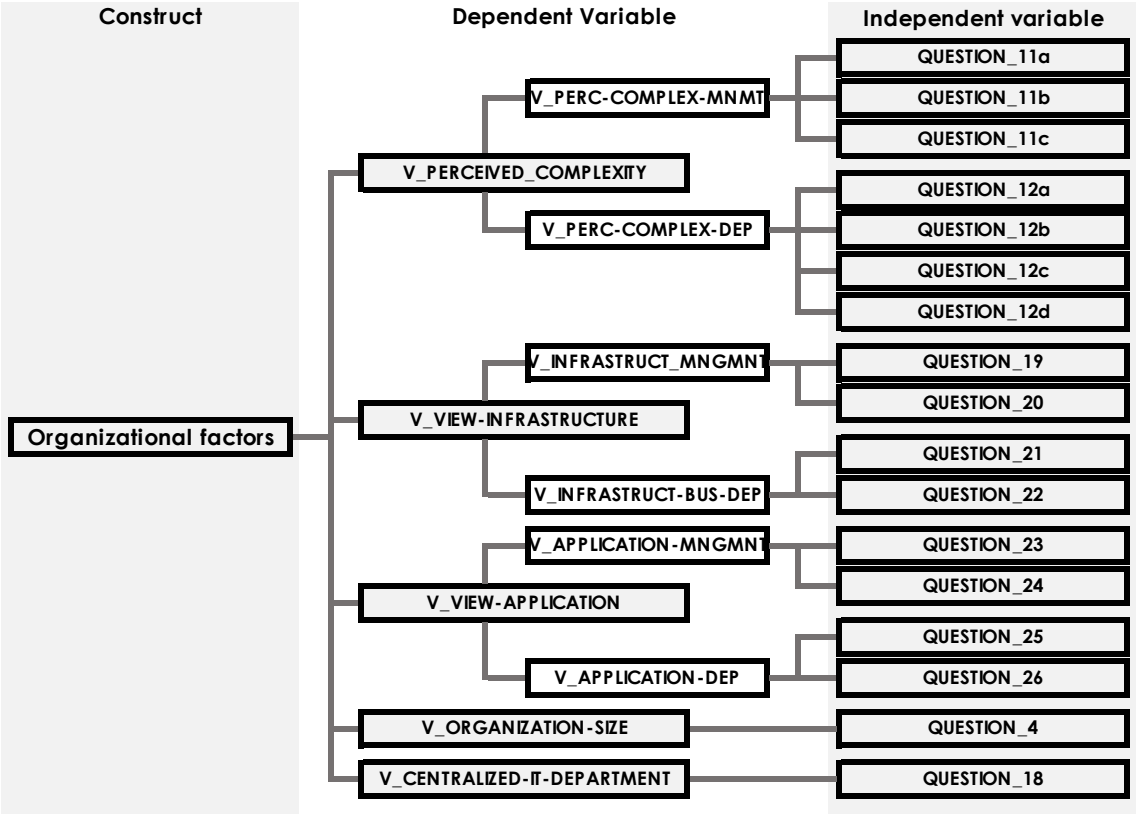

Figure 15 *Conceptual model for organizational factors*

In the next sections, the dependent variables shown in the conceptual model will be discussed and correlated to V_APPROACH-SUCCESS to identify possible organizational factors.

5.5.1 V_PERCEIVED-COMPLEXITY

This variable captures IT Complexity as it is perceived by different levels and departments within the organization. Therefore, it can be debated that it is either part of the construct Organizational Factors or part of the construct IT Complexity. For this research, it was chosen as a part of the construct Organizational factors.

This variable is calculated by computing the mean score from QUESTION_11a, QUESTION_11b, QUESTION_11c, QUESTION_12a, QUESTION_12b, QUESTION_12c and QUESTION_12d.

As these questions capture perceived complexity from the viewpoints management level and business department, also two sub-variables will be used:

- V_MANAGEMENT-LEVEL to capture the perceived complexity at the management levels as a measure for QUESTION_11a, QUESTION_11b, and QUESTION_11c.
  This sub-variable is calculated by computing the mean score from the questions.
- V_BUSINESS-DEPARTMENT to capture the perceived complexity from de business departments as a measure for QUESTION_12a, QUESTION_12b, QUESTION_12c, and QUESTION_12d.
  This sub-variable is calculated by computing the mean score from the questions.

The seven questions used to calculate the variables received the following responses:

V_MANAGEMENT-LEVEL

	De mate van complexiteit van IT Landschap was, hiërarchisch gezien, onderkend door....	Ja	Nee	Weet ik niet	Totaal
11a.	executive / top management	77.11% 64	14.46% 12	8.43% 7	83
11b.	middenmanagement	86.75% 72	8.43% 7	4.82% 4	83
11c.	Werkvloer	68.67% 57	19.28% 16	12.05% 10	83

V_BUSINESS-DEPARTMENT

	De mate van complexiteit van IT Landschap was, organisatorisch gezien, onderkend door....	Ja	Nee	Weet ik niet	Totaal
12a.	bedrijfsvoering / business	67.47% 56	20.48% 17	12.05% 10	83
12b.	beleid en architectuur	78.31% 65	13.25% 11	8.43% 7	83
12c.	financiële afdeling	49.40% 41	21.69% 18	28.92% 24	83
12d	IT Afdeling	91.57% 76	6.02% 5	2.41% 2	83

***Table 23** Responses relating to V_Perceived-Complexity*

Calculating the mean of the two sub-variables above results in the variable V_PERCEIVED-COMPLEXITY. The table below shows the basic statistical information for all three variables.

	_PERCEIVED-COMPLEXITY	V_MANAGEMENT-LEVEL	V_BUSINESS-DEPARTMENT
Mean	0.78082	0.83133	0.83841
Variance	0.17114	0.05555	0.04139
Standard Deviation	0.41369	0.23569	0.20344
Maximal value	1.00000	1.00000	1.00000
Minimal value	0.00000	0.00000	0.16667

***Table 24** Basic statistical information for V_Act-Vision*

5.5.1.1 Correlating V_PERCEIVED-COMPLEXITY

All variables are continuous by nature. So, Spearman's rho is preferred to determine the relationship.

		Perceived complexity (V_PERCEIVED-COMPLEXITY)	Perceived complexity by management level (V_MANAGEMENT-LEVEL)	Perceived Complexity by Business Departments (V_BUSINESS-DEPARTMENT)
Approach Success (V_Approach-success)	Correlation Coefficient	.188	.111	.132
	Sig. (2-tailed)	.092	.350	.233
	N	82	73	83

***Table 25** Correlating V_Perceived complexity*

A Spearman's rho correlation was run to determine the relationship between the approach success rate and the organization's knowledge about the complexity of the IT systems landscape. No statistically significant relationship between the approach success and perceived complexity was found.

5.5.2 V_VIEW-INFRASTRUCTURE

Via this variable organization's view on IT Infrastructure is measured. In his article "IT doesn't matter" Carr [2003] examines the evolution of information technology in business. He introduces a pattern like that of earlier technologies like railroads and electric power in which IT is seen as a utility. In this pattern IT should be available at the lowest, possible cost and IT is not seen as delivering a competitive edge for the organization. On the other side of the spectrum is the pattern where IT is seen as a value creator. In this pattern, IT contributes to the competitive edge of the organization.

Respondents were asked to rate the organization's view on IT-infrastructure via questions 19, 20, 21 and 22. Respondents were offered a 0% to 100% scale with 0% being the utility, low-cost view, and 100% the value creator view. The organization's view is captured from the management level and business department viewpoint. So, two sub-variables will be used:

- V_INFRASTRUCT-MNMNT to capture the executive/top management's (QUESTION_19) and middle management's (QUESTION_20) view on IT Infrastructure.
  This sub-variable is calculated by computing the mean score from the questions.
- V_INFRASTRUCT-BUS-DEP to capture the business' (QUESTION_21) and the financial department's (QUESTION_22) view on IT Infrastructure.
  This sub-variable is calculated by computing the mean score from the questions.

The next table shows basic statistical information about the responses to the four questions.

V_INFRASTRUCT-MNMNT		Total answers	Average Score	Variance	Lowest Highest	Mode Median
19.	Het executive / Top management beschouwde IT-infrastructuur als een…	83	46,99%	8,72	0% 100%	80% 40%
20.	Het midden management beschouwde IT-infrastructuur als een...	83	46,99%	7,95	0 100%	40% 40%
V_INFRASTRUCT-BUS-DEP		Total answers	Average Score	Variance	Lowest Highest	Mode Median
21.	De bedrijfsvoering/business beschouwde IT-infrastructuur als een...	83	47,47%	8,26	0% 100%	40% 40%
22..	De financiële afdeling beschouwde IT-infrastructuur als een...	83	27,83%	4,84	0 100%	40% 20%

***Table 26** Basic statistical information about the responses relating to V_View-Infrastructure*

The variable V_ INFRASTRUCTURE is determined by calculating the mean of the two sub-variables mentioned above. The table below shows the basic statistical information for all three variables.

	V__VIEW-INFRASTRUCTURE	V_INFRASTRUCT-MNMNT	V_INFRASTRUCT-BUS-DEP
Mean	42.319	46.988	37.651
Variance	423.31	659.60	446.59
Standard Deviation	20.575	25.683	21.133
Maximal value	100	100	100
Minimal value	0	0	0

***Table 27** Basic statistical information for V_Infrastructure*

5.5.2.1 Correlating V_ INFRASTRUCTURE

Correlating V_ INFRASTRUCTURE to V_APPROACH_SUCCESS will be done via Spearman's rho as all variables are continuous by nature.

		V_INFRASTRUCTURE	V_INFRASTRUCT-MNMNT	V_INFRASTRUCT-BUS-DEP
Approach Success (V_Approach-success)	Correlation Coefficient	.214	.189	.111
	Sig. (2-tailed)	.052	.087	.316
	N	83	83	83

***Table 28** Correlating V_ Infrastructure*

A Spearman's rho correlation was run to determine the relationship between the approach success rate and the organization's view towards its IT-infrastructure. No statistically significant relationship was found.

5.5.3 V_VIEW-APPLICATION

The variable V_ APPLICATION captures the organization's view on the applications. This variable is a variant of the previously discussed variable V_INFRASTRUCTURE. Respondents were asked to rate the organization's view on applications. They were given a 0% to 100% scale in which 0% corresponded to the utility, low-cost view and 100% corresponded to the value creator view.

This view was captured from the viewpoints management level and business department. So, two sub-variables will be used:

- V_APPLICATION-MNMNT to capture the executive/top management's (QUESTION_23) and middle management's (QUESTION_24) view on applications.
  This sub-variable is calculated by computing the mean score from the questions.
- V_APPLICATION-BUS-DEP to capture the business' (QUESTION_25) and the financial department's (QUESTION_26) view on applications.
  This sub-variable is calculated by computing the mean score from the questions.

The next table shows basic statistical information about the responses to the four questions.

V_APPLICATIONS-MNMNT		Total answers	Average score	Variance	Lowest Highest	Mode Median
23.	Het executive / Top management beschouwde de applicaties / IT-toepassingen als een…	83	55,30%	7,16	0% 100%	80% 60%
24.	Het midden management beschouwde de applicaties / IT-toepassingen als een...	83	55,06%	7,19	0 100%	60% 60%
V_APPLICATIONS-BUS-DEP		**Total answers**	**Average score**	**Variance**	**Lowest Highest**	**Mode Median**
25.	De bedrijfsvoering/business beschouwde de applicaties / IT-toepassingen als een...	83	57,59%	7,53	0% 100%	60% 60%
26..	De financiële afdeling beschouwde de applicaties / IT-toepassingen als een...	83	35,54%	6,32	0 100%	40% 40%

***Table 29** Responses relating to V_ View-Applications*

The variable V_APPLICATION is determined by calculating the mean of the two sub-variables mentioned above. The table below shows the basic statistical information for all three variables.

	V__APPLICATION	V_APPLICATION-MNMNT	V_APPLICATION-BUS-DEP
Mean	50.873	55.181	46.566
Variance	433.50	598.46	422.85
Standard Deviation	20.821	25.683	20.563
Maximal value	100	100	100
Minimal value	0	0	0

***Table 30** Basic statistical information for V_Application*

5.5.3.1 Correlating V_ APPLICATION

The relationship between V_APPLICATION, V_APPLICATION-MNMNT, and V_APPLICATION-BUS-DEP to V_APPROACH_SUCCESS will be investigated via Spearman's rho correlation as all variables are continuous by nature.

		V_APPLICATION	V_APPLICATION -MNMNT	V_APPLICATION -BUS-DEP
Approach Success (V_Approach-success)	Correlation Coefficient	.063	.098	-.061
	Sig. (2-tailed)	.573	.378	.585
	N	83	83	83

***Table 31** Correlating V_ Application*

A Spearman's rho correlation was run to determine the relationship between the approach success rate and the organization's view towards its applications. No statistically significant relationship was found.

5.5.4 V_ORGANIZATION-SIZE

Blau and Scott [1962] stated that organizational size tends to be directly related to complexity. Both Groen [2015] and Ting Liu et al [2006] conclude that complexity creates and potentially overwhelms projects with much uncertainty and risk. Thus, leading to a lower success rate for projects.

The variable V_ORGANIZATION-SIZE will be used to determine the amount of association between the organizational size and the Approach Success rate.

The foundation for V_ORGANIZATION-SIZE is delivered by QUESTION_4. This question received the following responses:

		employees	1-10	11-250	251-1000	1.001-10.000	>10.000
4	Wat was de omvang van de organisatie?		1,20% 1	13,25% 11	9,64% 8	22,89% 19	53,01% 44

***Table 32** Responses relating to V_Organization-size*

5.5.4.1 Correlating V_ORGANIZATION-SIZE

A point biserial correlation will be used to determine the amount of association as the V_ORGANIZATION-SIZE is a categorical variable and V_APPROACH-SUCCESS is a continuous variable.

			V_ORGANZATION-SIZE
Point BiSerial	Approach Success rate (V_Approach-Success)	. Correlation Coefficient	-.026
		Sig. (2-tailed)	.816
		N	83

***Table 33** Correlating V_Organization-Size*

A Point Biserial correlation was run to determine the relationship between the approach success rate and the organization size. No statistically significant relationship was found.

5.5.5 V_CENTRALIZED-IT-DEPARTMENT

Section 3.4.3 concluded that complexity in information systems and specifical redundancy can best be managed via a centralized system where all IT requests are decided upon by one agency [Seifert & McLoughlin, 2007]. Also, a more centralized environment seems to provide for organization-wide, thus more

standardized, services and seems to improve the application landscape. Following this line of thought, the question arose if a centralized system could pose as a success factor for complexity reduction approaches.

The variable V_CENTRALIZED-IT-DEPARTMENT will be used to determine the amount of centralization. The foundation for this variable is delivered by QUESTION_18 which received the following responses:

		Gecentraliseerde IT-organisatie	geDEcentraliseerde IT-organisatie	Hybride IT-organisatie
18	Gedurende het IT complexiteitsverlagings-initiatief / -project had uw organisatie een…	7,23% 6	44,58% 37	48,19% 40

***Table 34** Responses relating to V_Centralized-IT-Department*

5.5.5.1 Correlating V_CENTRALIZED-IT-DEPARTMENT

To determine the amount of association among the success rate of complexity reduction approaches and the centralization of the IT-department a point biserial correlation was used. No statistically significant correlation was found.

			V_ORGANZATION-SIZE
Point BiSerial	Approach Success rate (V_Approach-Success)	. Correlation Coefficient	-.018
		Sig. (2-tailed)	.873
		N	83

***Table 35** Correlating V_Centralized-IT-Department*

5.6 Execution factors

The construct execution factors aim to identify factors relating to the execution of the complexity reduction approach or project. For this, the conceptual model shown below will be used.

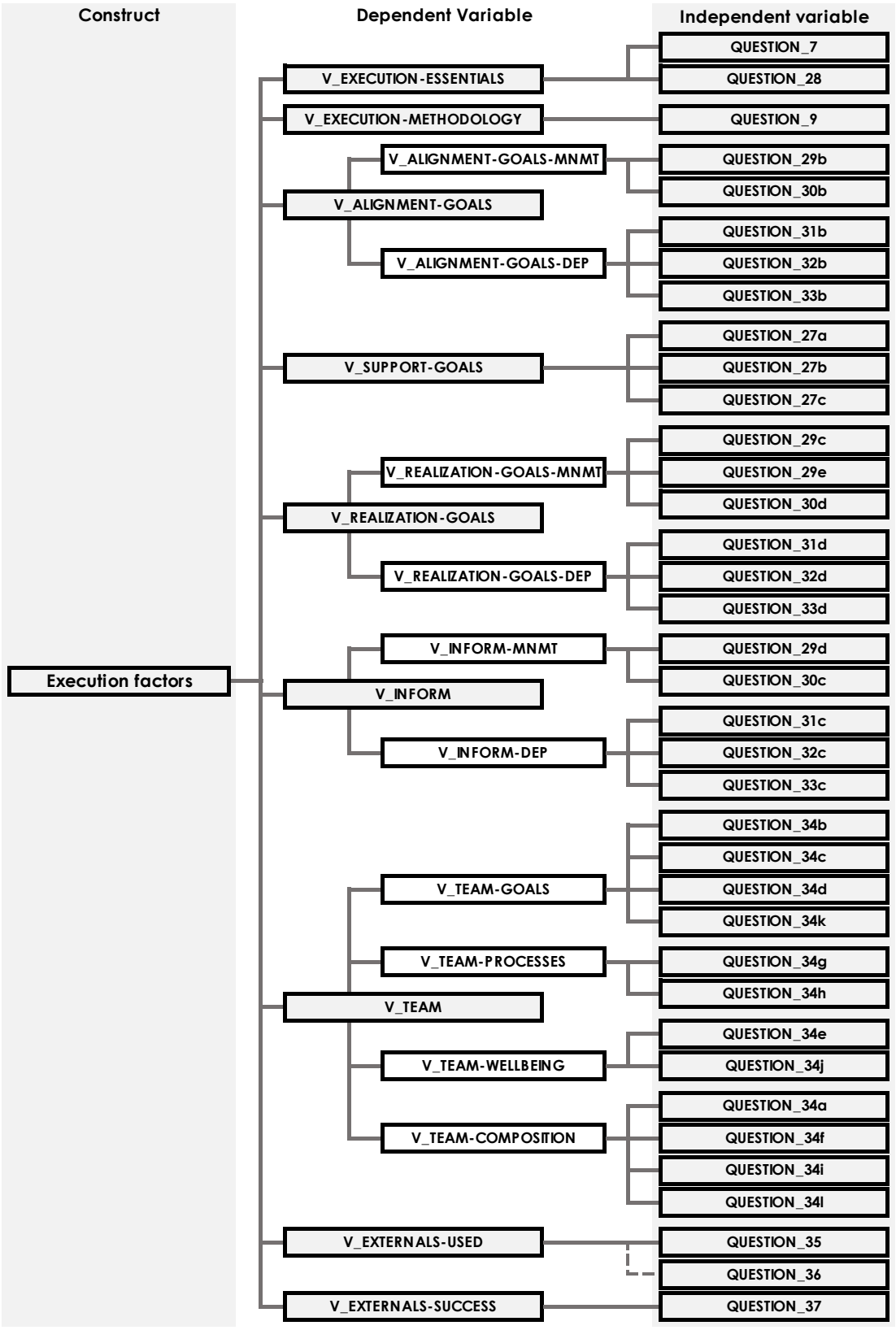

Figure 16 *Conceptual model for execution factors*

In the next sections, the dependent variables shown in the conceptual model will be discussed and correlated to V_APPROACH-SUCCESS to identify possible execution factors.

5.6.1 V_EXECUTION-ESSENTIALS

The variable V_EXECUTION-ESSENTIALS will be used to determine the amount of relationship between the existence of a business case and/or a steering group for the complexity reduction approach and the amount of success in executing this approach. The assumption is that those reduction approaches that have a business case and a steering group are more likely to be successful in their attempts than those who do not.

This variable is based on the answers received for QUESTION_7 and QUESTION_28.

V_EXECUTION-ESSENTIALS		Ja	Nee	Weet ik niet	Totaal
7.	Had uw organisatie een concrete business case voor het IT complexiteitsverlagingsinitiatief / -project?	54 65,06%	24 28,92%	5 6,02%	83
28.	Was er een sponsor- of stuurgroep voor het IT complexiteitsverlagingsinitiatief / -project?	79 95,18%	4 4,82%	0 0%	83

***Table 36** Basic information about the responses relating to V_Execution-Essentials*

The variable V_EXECUTION-ESSENTIALS is determined by calculating the mean of the two questions mentioned above.

5.6.1.1 Correlating V_EXECUTION-ESSENTIALS

To determine the amount of association among the V_EXECUTION-ESSENTIALS and V_APPROACH-SUCCESS a point biserial correlation was used. No statistically significant relationship was found.

			V_Execution-Essentials
Point BiSerial	Approach Success rate (V_Approach-Success)	. Correlation Coefficient	.025
		Sig. (2-tailed)	.824
		N	83

***Table 37** Correlating V_Execution-Essentials*

5.6.2 V_EXECUTION-METHODOLOGY

The variable V_EXECUTION-METHODOLOGY will be used to determine whether the use of a project methodology could pose as a representative for success in reducing IT complexity. This variable is based on the assumption that approaches that use a (project) methodology are more likely to be successful.

The answers received for QUESTION_9 will be used to determine V_EXECUTION-METHODOLOGY.

V_EXECUTION-METHODOLOGY		Ja	Nee	Weet ik niet	Totaal
9.	Het complexiteitsverlagingsinitiatief / -project is volgens een vooraf vastgestelde (project) methodiek uitgevoerd. Hierbij kunt u denken aan Prince2, PMBok, MSP, et cetera.	54 65,06%	19 22,89%	10 12,05%	83

***Table 38** Basic information about the responses relating to V_Execution-Methodology*

When respondents answered "yes" for question 9; they were asked which methodology was used during the complexity reduction approach. The answers were given in a free text format. During the codification phase the free text answers were grouped into categories:

Het complexiteitsverlagingsinitiatief / -project is volgens een vooraf vastgestelde (project) methodiek uitgevoerd. Hierbij kunt u denken aan Prince2, PMBok, MSP, et cetera.		Total
Ja,	namelijk:	54
	1. An Agile methodology	4 7,41%
	2. Accelerated SAP Methodology (ASAP)	1 1,85%
	3. Management of Portfolios (MoP)	1 1,85%
	4. Managing Successful Programmes (MSP)	3 5,56%
	5. Custom, in-house, developed methodology	8 14,81%
	6. Project Management Body of Knowledge (PMBok)	1 1,85%
	7. Projects in Controlled Environments, version 2 (Prince 2)	29 53,70%
	8. A Combination of the above-mentioned methodologies	7 12,96%

***Table 39** Methodologies used during IT complexity reduction approach*

5.6.2.1 Correlating V_EXECUTION-METHODOLOGY

A Point Biserial correlation was run to determine the relationship between the approach success rate and the use of a project methodology. No statistically significant relationship was found.

			V_Execution-Methodology
Point BiSerial	Approach Success rate (V_Approach-Success)	. Correlation Coefficient	0.99
		Sig. (2-tailed)	.404
		N	73

***Table 40** Correlating V_Execution-Methodology*

Also, the Point Biserial correlation was run to check for a relationship between the categories of project methodology and the approach success rate. This also yielded no statistically relevant relationship.

			Project methodology used
Point BiSerial	Approach Success rate (V_Approach-Success)	. Correlation Coefficient	-.223
		Sig. (2-tailed)	.104
		N	54

***Table 41** Correlating the methodology used*

5.6.3 V_ALIGNMENT-GOALS

In section 3.5 was concluded that an IT complexity reduction approach is an IT project that delivers (a change in) an information system leading to improved organizational performance and thus having an impact on business processes. This implies that the approach's goals and actions should (constantly) be aligned with the organization. Bourne adds that "project can only exist with the informed consent of its stakeholder community" [Bourne, 2005].

The variable V_ALIGMENT-GOALS captures the alignment of the approach's goals and actions to the organization. It is based on the assumption that approaches that have their goals aligned with the organization are more likely to be successful. The

variable is measured from both a hierarchical and a departmental viewpoint, so two sub-variables will be used:

- V_ACT-ALIGNMENT-GOALS-MNMNT to capture the alignment at the management levels as a measure for QUESTION_29b and QUESTION_30b.
  This sub-variable is calculated by computing the mean score from the codified responses to the questions.
- V_ACT- ALIGNMENT-GOALS-DEP to capture the alignment at the business department levels as a measure for QUESTION_31b, QUESTION_32b, and QUESTION_33b.
  V_ACT-VISION-DEP will be calculated by computing the mean score from the codified responses to the three questions.

The five questions used to calculate the variables received the following responses:

	Tijdens de looptijd van het complexiteitsverlagingsinitiatief / -project...	Ja	Nee	Weet ik niet	Totaal
29b.	waren de doelstellingen en acties van het initiatief/project afgestemd met het executive / top management	81,93% 68	10,84% 9	7,23% 6	83
30b.	waren de doelstellingen en acties afgestemd van het initiatief/project met het midden management.	67,47% 56	21,69% 18	10,84% 9	83
31b.	waren de doelstellingen en acties van het initiatief/project afgestemd met de bedrijfsvoering / business.	68,67% 57	19,28% 16	12,05% 10	83
32b.	waren de doelstellingen en acties van het initiatief/project afgestemd met de financiële afdeling.	51,81% 43	14,46% 12	33,73% 28	83
33b.	waren de doelstellingen en acties van het initiatief/project afgestemd met de IT afdeling.	85,54% 71	8,43% 7	6,02% 5	83

Table 42 *Responses relating to V_Alignment_Goals*

Calculating the mean of the two sub-variables above results in the variable V_ALIGMENT_GOALS. The table below shows the mean, variance and standard deviation of all three variables.

	V_ALIGNMENT-GOALS	V_ ALIGNMENT-GOALS-MNMNT	V_ ALIGNMENT-GOALS-DEP
Mean	0.82716	0.83333	0.82922
Variance	0.08124	0.08401	0.06188
Standard Deviation	0.28502	0.28985	0.24876
Maximal value	1.00000	1.00000	1.00000
Minimal value	0.00000	0.00000	0.00000

Table 43 *Basic statistical information for V_Alignment-Goals*

5.6.3.1 Correlating V_ALIGNMENT-GOALS

The sub-variables used to calculate V_ALIGNMENT-GOALS are continuous. The variable V_Approach-Success is also continuous. Therefore, Spearman's rho will be used to determine their relationship.

		Alignment of the approach's goals (V_Alignment-Goals)	Alignment of the approach's goals with the management (V_Alignment-Goals-Mnmnt)	Alignment of the approach's goals with the (business) departments (V_Alignment-Goals-Dep)
Approach Success rate (Approach-success)	Correlation Coefficient	.329**	.318*	.291**
	Sig. (2-tailed)	.003	.004	.008
	N	81	81	82

**. Correlation is significant at the 0.01 level (2-tailed).

Table 44 *Correlating V_Alignment-Goals and its sub-variables*

A Spearman's rho correlation was run to determine the relationship between the approach success rate and the alignment of the approach's goals and targets to the organization's goals and targets. A positive relationship, which was statistically significant (r_s =.329, n = 81, p = .003) was found. Both sub-variables also showed a

positive relationship to approach success (r_s =.318, n = 81, p = .004 for V-ALIGNMENT-GOALS-MNMT and r_s =.291, n = 82, p = .008 for V-ALIGNMENT-GOALS-DEP).

5.6.4 V_SUPPORT-GOALS

In the previous section relationship between the approach's alignment and the approach's success rate was measured. Next to aligning the project goals to the organization's goals, the organization should actively support the approach to ensure success. So, the assumption is that approaches that are actively supported by their organizations are more likely to be successful.

The variable V_SUPPORT-GOALS is used to determine if a relationship exists between the project success rate and the amount of support received from the organization. This assumes that a complexity reduction approach is more successful when it receives active support from the organization.

V_SUPPORT-GOALS will be calculated by computing the mean score from the codified responses to questions 27a, 27b, and 27c. These questions received the following responses:

27	Het IT complexiteitsverlagingsinitiatief / -project werd...	Ja	Nee	Weet ik niet	Totaal
a.	actief gesteund door het executive / top management.	73.49% 61	20,48% 17	6,02% 5	83
b.	actief gesteund door het midden management.	62,65% 52	32,53% 27	4,82% 4	83
c.	actief gesteund door de 'werkvloer'.	43,37% 36	51,81% 43	4,82% 4	83

***Table 45** Responses relating to V_Support-Goals*

The table below shows the basic statistical information for V_SUPPORT-GOALS.

	V_Support-Goals
Mean	0.63655
Variance	0.09046
Standard Deviation	0.30076
Maximal value	1.00000
Minimal value	0.00000

***Table 46** Basic statistical information for V_Support-Goals*

5.6.4.1 Correlating V_SUPPORT-GOALS

Both V_SUPPORT-GOALS and V_APPROACH-SUCCESS are continuous in nature. Therefore, Spearman's rho will be used to determine the relationship between these variables.

			V_Support-Goals
Spearman's rho	Approach Success rate (V_Approach-Success)	Correlation Coefficient	.222*
		Sig. (2-tailed)	.044
		N	83

** Correlation is significant at the 0.05 level (2-tailed)*

***Table 47** Correlating V_Support-Goals*

A Spearman's Rho correlation was run to determine the relationship between the approach success rate and the amount of support it received from the organization. A positive relationship was found, that was statistically significant (r_s = .222, n = 83, p = .044)

5.6.5 V_REALIZATION-GOALS

Next to alignment with and support to the goals, also decisions, actions and changes to business processes are often necessary to realize the project goals. The variable V_REALIZATION-GOALS measures to what extent the organization was decisive and actionable to implement the business changes needed for the approach to be successful. The assumption is that an IT complexity reduction approach is more likely to be successful when it operates in an organization that is decisive and actionable to implement the business changes needed.

This variable is calculated based on QUESTION_29c, QUESTION_29e, QUESTION_30d, QUESTION_31d, QUESTION_32d and QUESTION_33d. Via these questions, both the management and business department viewpoints are captured. So, two sub-variables will be used:

- V_REALIZATION-GOALS-MNMT to capture the decisiveness and actionability towards the project goals at the management levels based on QUESTION_29c, QUESTION_29e, and QUESTION_30d.
  This sub-variable is calculated by computing the mean score from the questions.
- V_REALIZATION-GOALS-DEP to capture the decisiveness and actionability from the business department viewpoint based on QUESTION_31d, QUESTION_32d, and QUESTION_33d.
  This sub-variable is calculated by computing the mean score from the questions.

The six questions used to calculate the variables received the following responses:

V_ REALIZATION-GOALS-MNMT	Tijdens de looptijd van het IT complexiteits-verlagingsinitiatief / -project...	Ja	Nee	Weet ik niet	Totaal
29c.	bewaakte het executive / top management tijdige realisatie van de doelstelling van het IT complexiteitsverlagingsinitiatief / -project	43,37% 36	45,78 38	10,84% 9	83
29e.	nam het executive / topmanagement besluiten en acties op het moment dat dat nodig was.	42,17% 35	34,94% 29	22,89% 19	83
30d.	zorgde het midden management voor tijdige realisatie van de doelstelling van het IT complexiteitsverlagingsinitiatief / -project.	46,99% 39	37,35% 31	15,66% 13	83

V_ REALIZATION-GOALS-DEP	Tijdens de looptijd van het IT complexiteits-verlagingsinitiatief / -project...	Ja	Nee	Weet ik niet	Totaal
31d.	zorgde de bedrijfsvoering / business voor tijdige realisatie van de doelstelling van het IT complexiteitsverlagingsinitiatief / -project.	34,94% 29	51,81% 43	12.05% 10	83
32d.	zorgde de financiële afdeling voor tijdige realisatie van de doelstelling van het IT complexiteitsverlagingsinitiatief / -project.	28,92% 24	30,12% 25	40,96% 34	83
33d.	zorgde de IT afdeling voor tijdige realisatie van de doelstelling van het IT complexiteitsverlagingsinitiatief / -project.	62,65% 52	28,92% 24	8,43% 7	83

***Table 48** Responses relating to V_REALIZATION-GOALS*

The table below shows the basic statistical information for V_SUPPORT-GOALS and its sub-variables.

	V_REALIZATION-GOALS	V_REALIZATION-GOALS-MNMNT	V_REALIZATION-GOALS-Dep
Mean	0,54008	0,53049	0,55417
Variance	0,13658	0,17421	0,14845
Standard Deviation	0,36957	0,41738	0,38530
Maximal value	1.00000	1.00000	1.00000
Minimal value	0.16667	0.00000	0.00000

***Table 49** Basic statistical information for V_Realization-Goals*

5.6.5.1 Correlating V_REALIZATION-GOALS

A Spearman's rho correlation was run to determine the relationship between the approach success rate and the organization's decisiveness and actionability towards the approach's goals. A positive relationship, which was statistically significant (r_s =.507, n = 80, p < .001) was found. Both sub-variables also showed a positive relationship to approach success (r_s =.500, n = 79, p < .001 for V-REALIZATION-GOALS-MNMT and r_s =.438, n = 82, p < .001 for V-REALIZATION-GOALS-DEP).

		V_REALIZATION-GOALS	V_REALIZATION-GOALS-Dep	V_REALIZATION-GOALS-MNMNT
Approach Success (V_Approach-success)	Correlation Coefficient	.507**	.500**	.438**
	Sig. (2-tailed)	< .001	< .001	< .001
	N	80	79	82

**. Correlation is significant at the 0.01 level (2-tailed).

***Table 50** Correlating V_Realization-Goals*

5.6.6 V_INFORM

The previous sections captured the organization's decisiveness and actionability towards the approach's goals. But in order to be decisive and actionable, the organization needs to be informed. According to Bourne [2005], a project can only exist with the informed consent of its stakeholder community. So, the variable V_INFORM assumes that those IT complexity reduction approaches who actively inform their stakeholders are more likely to be successful in their endeavor.

The variable is measured from a hierarchical and a departmental viewpoint, so two sub-variables will be used:

- V_INFORM-MNMNT to capture the amount of informing from the approach towards the management levels based on QUESTION_29d and QUESTION_30c.
  This sub-variable is calculated by computing the mean score from the codified responses to the questions.
- V_INFORM-DEP to capture the amount of informing from the approach towards the business departments based on QUESTION_31c, QUESTION_32c, and QUESTION_33c.
  V_INFORM-DEP will be calculated by computing the mean score from the codified responses to the three questions.

The five questions used to calculate the variables received the following responses:

V_ INFORM-MNMT

	Tijdens de looptijd van het IT complexiteits-verlagingsinitiatief / -project...	Ja	Nee	Weet ik niet	Totaal
29d.	informeerde de projectleider het executive / top management met enige regelmaat.	87,95% 73	6,02% 5	6,02% 5	83
30c.	informeerde de projectleider het midden management met enige regelmaat.	72,29% 60	14,46% 12	13,25% 11	83

V_ INFORM-DEP

	Tijdens de looptijd van het IT complexiteits-verlagingsinitiatief / -project...	Ja	Nee	Weet ik niet	Totaal
31c.	informeerde de projectleider de bedrijfsvoering / business met enige regelmaat.	74,70% 62	12,05% 10	13,25% 11	83
32c.	informeerde de projectleider de financiële afdeling met enige regelmaat.	60,24% 50	8,43% 7	31,33% 26	83
33c.	informeerde de projectleider de IT afdeling met enige regelmaat.	89,16% 74	4,82% 4	6,02% 5	83

***Table 51** Responses relating to V_Inform*

Calculating the mean of the two sub-variables above results in the variable V_INFORM. The table below shows the basic statistical information for all three variables.

	V_INFORM	V_INFORM-MNMNT	V_INFORM-DEP
Mean	0,89063	0,87654	0,88889
Variance	0,03899	0,07118	0,06241
Standard Deviation	0,19746	0,26679	0,24983
Maximal value	1.00000	1.00000	1.00000
Minimal value	0.00000	0.00000	0.00000

***Table 52** Basic statistical information for V_Inform*

5.6.6.1 Correlating V_INFORM

A Spearman's rho correlation was run to determine the relationship between the approach success rate and the amount of informing from the approach towards its stakeholders. No statistically significant relationship was found.

		V_INFORM	V_Inform-Mnmnt	V_Inform-Dep
Approach Success rate (Approach-success)	Correlation Coefficient	.054	-.005	.131
	Sig. (2-tailed)	.634	.962	.245
	N	80	81	81

***Table 53** Correlating V_Inform and its sub-variables*

5.6.7 V_TEAM

An old African proverb says, "If you want to go quickly, go alone. If you want to go far, go together." This proverb gives an explanation of why a team is necessary to achieve more complex goals like the reduction of IT complexity.

The variable V_TEAM will be used to determine the relationship between the amount of success of an IT complexity reduction approach and factors relating to the approach's team. A total of five factors will be investigated via the next five sub-variables:

- V_TEAM_GOALS to capture aspects relating to the goals set to achieve. Questions 34b, 34c, 34d and 34k will be used to determine this sub-variable.
  V_TEAM-GOALS will be calculated by computing the mean score from the questions.
- V_TEAM_PROCESSES to capture the team-members awareness and knowledge of the organization's processes and procedures. This assumes that a team delivers its results faster when they are knowledgeable about the processes and procedures they need to adhere to. Questions 34g and 34h will be used to determine this sub-variable.
  This sub-variable is calculated by computing the mean score from the questions.
- V_TEAM_Dedicated to capture whether the team-members had other tasks (next to participating in the approach). This sub-variable assumes that team-members with no other tasks than participating in the project have a better focus on their work and therefore deliver better results. This sub-variable is based on question 34a.
- V_TEAM_Composition to capture information about the composition of the team. This sub-variable is based on the assumption that a more diverse and more knowledgeable team delivers better results. This sub-variable is based on questions 34f, 34i, and 34l and is calculated by computing the mean score from the questions.
- V_TEAM_Wellbeing to capture the joy of working within the team (QUESTION_34e) and the personal growth (QUESTION_34j) of the team members. The assumption behind this sub-variable is that a team with higher wellbeing will deliver better results faster.
  This sub-variable is calculated by computing the mean score from the questions.

The next table shows the responses to the questions mentioned earlier.

V_TEAM-Goals	Het team van het complexiteitsverlagings-initiatief /-project...	Ja	Nee	Weet ik niet	Totaal
34b.	was bekend met de visie en missie van de organisatie.	87,95% 73	6,02% 5	6,02% 5	83
34c.	was bekend met de doelstellingen van het project / initiatief	96,39% 80	2,41% 2	1,20% 1	83
34d.	was gemotiveerd en betrokken bij doelstellingen van het initiatief / project.	80,72% 67	7,23% 6	12,05% 10	83
34k.	wist welke aspecten / factoren belangrijk waren voor bereiken van de doelstellingen.	68,67% 57	14,46% 12	16,87% 14	83

V_TEAM-Processes	Het team van het complexiteitsverlagings-initiatief /-project...	Ja	Nee	Weet ik niet	Totaal
34g.	was bekend met de bedrijfsprocessen.	79,52% 66	16,87% 14	3,61% 3	83
34h.	was bekend met de IT processen.	85,84% 71	10,84% 9	3,61% 3	83

V_TEAM-Dedicated	Het team van het complexiteitsverlagings-initiatief /-project...	Ja	Nee	Weet ik niet	Totaal
34a.	was dedicated en dus voor meer dan 80% van de tijd beschikbaar voor het initiatief / project.	74,70% 62	21,69% 18	3,61% 3	83

V_TEAM-Composition	Het team van het complexiteitsverlagings-initiatief /-project...	Ja	Nee	Weet ik niet	Totaal
34f.	was divers van samenstelling (persoonlijkheden, vakgebied, etc.)	81,93% 68	8,43% 7	9,64% 8	83
34i.	was deskundig en ervaren op hun vakgebieden.	85,54% 71	8,43% 7	6,02% 5	83
34l.	werkte goed samen met de medewerkers van de rest van de organisatie.	75,90% 63	18,07% 15	6,02% 5	83

V_TEAM-Wellbeing	Het team van het complexiteitsverlagings-initiatief /-project...	Ja	Nee	Weet ik niet	Totaal
34e.	ervaarde arbeidsvreugde.	61,45% 51	12,05% 10	26,51% 22	83
34j.	heeft persoonlijke groei ervaren.	60,24% 50	8,43% 7	31,33% 26	83

Table 54 *Basic information about the responses relating to V_Team*

The variable V_ TEAM is determined by calculating the mean of the five sub-variables mentioned above. The table below shows the basic statistical information for all six variables.

	V_TEAM	V_TEAM_ Goals	V_TEAM_Pro cesses	V_TEAM-Dedicated	V_TEAM_Com position	V_TEAM_well being
Mean	0,85954	0,91867	0,86145	0,77500	0,88153	0,84028
Variance	0,03901	0,04300	0,09827	0,17438	0,05056	0,12379
Standard Deviation	0,19752	0,20737	0,31348	0,41758	0,22485	0,35184
Maximal value	1,00000	1,00000	1,00000	1,00000	1,00000	1,00000
Minimal value	0,06667	0,00000	0,00000	0,00000	0,00000	0,00000

Table 55 *Basic statistical information for V_Team*

5.6.7.1 Correlating V_TEAM

As V_TEAM, as well as V_APPROACH-SUCCESS, are continuous variables, a Spearman's rho correlation was run to determine the relationship between the approach success rate and the aspect relating to the approach's team. A positive relationship, which was statistically significant (r_s =.310, n = 72, p = .008) was found between V_APPROACH-SUCCESS and V_TEAM.

		V_TEAM
Approach Success (V_Approach-success)	Correlation Coefficient	.255*
	Sig. (2-tailed)	.020
	N	83

*. Correlation is significant at the 0.05 level (2-tailed).

Table 56 *Correlating V_TEAM*

The sub-variables are categorical in nature. Therefore they will be correlated to V_APPROACH-SUCCESS using point biserial correlation. Sub-variables V_TEAM-Goals (r_s =.360, n = 83, p = .001), V_TEAM-COMPOSITION (r_s =.292 n = 83, p = .007) and V_TEAM-Wellbeing (r_s =.374, n = 72, p = .001) showed a positive relationship to approach success. No statistically significant relationship was found for sub-variables V_TEAM-Processes and V_TEAM-DEDICATED.

		V_TEAM-Goals	V_TEAM-Processes	V_TEAM-Dedicated	V_TEAM-Composition	V_TEAM-Wellbeing
Approach Success (V_Approach-success)	Correlation Coefficient	.360**	.182	.130	.292**	.374**
	Sig. (2-tailed)	.001	.099	.251	.007	.001
	N	83	83	80	83	72

**. Correlation is significant at the 0.01 level (2-tailed).

Table 57 *Correlating the sub-variables for V_TEAM*

5.6.8 V_EXTERNALS-USED

Section 1.3 mentioned that consulting firms have noticed that many organizations have IT complexity reduction on their agendas. Some of these firms have published white papers, papers, and brochures stating their approaches to reducing IT complexity. Organizations can ref this knowledge by buying their methodologies and or hiring their staff. Next to gaining access to knowledge organizations can also choose to hire external staff to gain more manpower/capacity.

The variable V_EXTERNALS-USED will be used to evaluate whether an organization used external staff for their IT complexity reduction approach. This variable assumes that hiring external staff will lead to more success for the IT complexity reduction approach.

V_EXTERNALS-USED will be based on the answers received for QUESTION_35. Next to QUESTION_35, question 36 and 37 were used to capture background information. QUESTION_36 was used to capture background information about "why" the external staff was hired and QUESTION_37 was used to capture whether the external staff delivers what they were hired for. The next table shows the responses to the three questions relating to external staff.

V_ EXTERNALS-USED		Ja	Nee	Weet ik niet	Totaal
35.	Heeft een externe (ingehuurde) partij ondersteuning geleverd bij het complexiteitsverlagingsinitiatief / -project?	77,11% 64	18,07% 15	4,83% 4	83

36.	Met welke reden was de externe partij bij het complexiteitsverlagingsinitiatief / -project betrokken? (Een combinatie is mogelijk)	Ja	Nee	Totaal
	• Als leverancier van capaciteit	49	15	64
	• Als leverancier van een werkwijze en/of methodiek	26	38	64
	• Als leverancier van deskundigheid en/of kennis	51	13	64
	• Ik weet het niet	1	63	64
	• Andere (geef nadere toelichting)	4	60	64

		Ja	Nee	Weet ik niet	Totaal
37.	Heeft de externe partij aan de verwachting voldaan en/of de afgesproken prestatie geleverd?	60,94% 39	18,75% 12	20,31% 13	64

Table 58 *Responses relating to V_Externals-Used*

5.6.8.1 Correlating V_EXTERNALS-USED

A Point Biserial correlation was run to determine the relationship between the continuous variable V_APPROACH-SUCCESS and the categorical variable V_EXTERNALS-USED. A negative relationship, which was statistically significant (r_{pb} =-.347, n = 79, p = .002) was found between these variables. This negative relationship implies that using external staff within the team of the IT complexity reduction approach reduces the likeliness for the approach to be successful.

			V_EXTERNALS-USED
Point BiSerial	Approach Success rate (V_Approach-Success)	. Correlation Coefficient	-.347**
		Sig. (2-tailed)	.002
		N	79

**. Correlation is significant at the 0.01 level (2-tailed).

Table 59 *Correlating V_Externals-Used*

5.7 Mitigation Methods

The construct Mitigation Methods will be analyzed via the dependent variable V_MITIGATION_METHODS and the input provided by QUESTION_17.

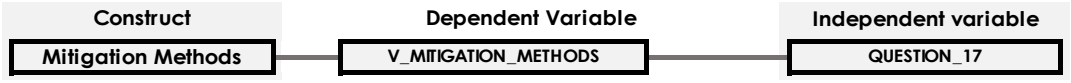

Figure 17 *Conceptual model for Mitigation Methods*

This question was answered by 75 respondents, providing the information below:

17. Heeft het project/initiatief één of meerdere van onderstaande methodes geïmplementeerd en/of gebruikt om IT complexiteit te verlagen? (Een combinatie is mogelijk)		Responses	%
Some form of Portfolio Management		31	19,7%
Service-Oriented Architecture		17	10,8%
Cloud Migration		16	10,2%
Implementing an ERP System		34	21,7%
Implementing an Agile methodology		33	21,0%
We developed our own methodology		19	12,1%
A methodology wasn't used		4	2,6%
Other (please specify)		3	1,9%
	Implementation of a package	*1*	
	Define a standard and optimally work towards this standard. (Don't just isolate/reduce infrastructure)	*1*	
	Reducing hardware/software. Agile was a separate project. Measuring and reducing technical debt.	*1*	

Table 60 *Responses relating to Mitigation-Methods*

The literature review delivered a list with main methods for mitigating IT complexity as the foundation for answering sub-question 3. This question is used to verify this list and therefore this variable will not be statistically analyzed.

5.8 Analysis of statements

Section three of the online survey contained thirteen statements. The statements were answered by 95 respondents. The next table shows these statements and the collected responses.

STATEMENTS Graag uw antwoord op onderstaande stellingen...		Tendency	Agree	Neutral	Dis-agree	I do not know	Total
39a	IT Complexiteit verlaagt de wendbaarheid (agility).	**90,32%**	82 86,32%	4 4,21%	7 7,37%	2 2,11%	95
39b.	IT Complexiteit verhoogt onderhouds-kosten van de IT.	**89,01%**	75 78,95%	12 12,63%	4 4,21%	4 4,21%	95
39c.	IT Complexiteit verlaagt de continuïteit van de IT.	**74,73%**	60 63,16%	19 20,00%	14 14,74%	2 2,11%	95

STATEMENTS	Graag uw antwoord op onderstaande stellingen...	Tendency	Agree	Neutral	Dis-agree	I do not know	Total
39d.	Digitaliseren van (bedrijfs)processen verlaagt IT Complexiteit.	**47,13%**	27 28,42%	28 29,47%	32 33,68%	8 8,42%	95
39e.	Standaardiseren van (bedrijfs)processen verlaagt IT Complexiteit.	**88,71%**	77 81,05%	11 11,58%	5 5,26%	2 2,11%	95
39f.	Standaardiseren van IT infrastructuur (componenten) verlaagt IT Complexiteit.	**93,55%**	81 85,26%	12 12,63%	0 0,00%	2 2,11%	95
39g.	Rationalisatie verlaagt IT Complexiteit.	**94,02%**	84 88,42%	5 5,26%	3 3,16%	3 3,16%	95
39h.	Implementatie van een ERP Systeem verlaagt IT Complexiteit.	**44,94%**	22 23,16%	36 37,89%	31 32,63%	6 6,32%	95
39i.	Migratie naar een Cloud-oplossing verlaagt IT Complexiteit.	**46,02%**	21 22,11%	39 41,05%	28 29,47%	7 7,37%	95
39j.	Makkelijk configureerbare IT-oplossingen / IT-systemen voorkomt IT Complexiteit.	**69,02%**	53 55,79%	21 22,11%	18 18,95%	3 3,16%	95
39k.	Werken onder architectuur voorkomt IT Complexiteit.	**77,17%**	58 61,05%	26 27,37%	8 8,42%	3 3,16%	95
39l.	Gestandaardiseerde IT die beschikbaar is voor de hele organisatie, is een vereiste voor het verlagen van IT Complexiteit.	**79,67%**	66 69,47%	13 13,68%	12 12,63%	4 4,21%	95
39m.	Een gecentraliseerde IT-organisatie is een vereiste voor het verlagen van IT Complexiteit.	**57,69%**	38 40,00%	29 30,53%	24 25,26%	4 4,21%	95

***Table 61** Analyzed Statements*

5.9 Quality indicators for the data-analysis

Bryman [2008] identifies replication, reliability, and validity as quality indicators for research. Bryman [2008] continues that replication can be established by describing all decisions, processes, and actions in detail. These are mentioned in this thesis.

Forza [2002] states that "without assessing reliability and validity of the research, it will be difficult to describe for the effects of measurement errors on theoretical relationships that are being measured."

5.9.1 Reliability of the data-analysis

As discussed in section 2.5.1 the survey's internal consistency, id est the reliability was assessed using a Cronbach's Alpha test in SPSS Statistics. The table below presents the results for this test.

Construct	Reliability (Cronbach's Alpha)
Approach Success	**.622**
Questions: 4 (Q8, Q13, Q15, Q16)	.622
Governance factors	**.788**
Questions: 12 (Q29a, Q30a, Q31a, Q32a, Q33a, Q38a, Q38b, Q38c, Q38d, Q38e, Q38f, Q38g)	.788
Organizational factors	**.752**
Questions: 17 (Q4, Q11a, Q11b, Q11c, Q12a, Q12b, Q12c, Q12d, Q18, Q19, Q20, Q21, Q22, Q23, Q24, Q25, Q26)	.671
Questions: 16 (Cronbach Alpha when Q4 is deleted) (~~Q4,~~ Q11a, Q11b, Q11c, Q12a, Q12b, Q12c, Q12d, Q18, Q19, Q20, Q21, Q22, Q23, Q24, Q25, Q26)	.752
Execution factors	**.900**
Questions: 37 (Q7, Q9, Q27a, Q27b, Q27c, Q28, Q29b, Q29c, Q29d, Q29e, Q30b, Q30c, Q30d, Q31b, Q31c, Q31d, Q32b, Q32c, Q32d, Q33b, Q33c, Q33d, Q34a, Q34b, Q34c, Q34d, Q34e, Q34f, Q34g, Q34h, Q34i, Q34j, Q34k, Q34l, Q35, Q36, Q37)	**.900**

***Table 62** Reliability of the data-analysis*

As stated in section 2.5.1, a reliability value ranging between 0.6 and 0.7 can be regarded as acceptable for exploratory research and a value between 0.7 and 0.9 can be regarded as satisfactory for more advanced research [Nunnally & Bernstein, 1994]. Looking at the table above, it can be concluded that the survey responses are reliable for exploratory research.

It should be noted that the analysis of the 17 questions relating to organizational factors delivered a Cronbach's Alpha score of 0.671. When question 4 is removed the Cronbach's Alpha score is increased to 0.752. Question 4 aims to find the size of the organization in which the IT complexity reduction approach ran. As discussed in section 5.5.4, question 4 relates to the variable V_ORGANIZATION-SIZE for which the statistical analysis did not deliver an indication about a relationship with the approach success rate.

5.9.2 Construct validity of the data-analysis

As discussed in section 2.5.2 validity is about whether the conclusions drawn during data-analysis are correct. Content and construct validity are the most common forms of validity [Hartas, 2015; Brewerton & Millward, 2001; and Litwin, 1995]. Section 4.3 covered how content validation was established; thus leaving construct validity for this section. Stapleton states that "tests are not valid in and of themselves. Rather, test scores may be valid. Although many types of validity have been identified, construct validity has been suggested as encompassing all forms of validity. In addition, construct validity addresses the issue of whether a test does, in fact, measure what it purports to" [Stapleton, 1997].

The construct validity will be established via an exploratory factor analysis. The table on the next page shows the constructs, variables, and relating questions.

Construct	Variable	No. items	Questions
Approach Success			
	V_APPROACH-SUCCESS	4	Q8, Q13, Q15, and Q16
Governance factors			
	1. V_ACT-VISION	5	A29a, Q30a, Q31a, Q32a, and Q33a
	2. V_ALIGNMENT-VISION	2	Q38a, and Q38b
	3. V_ARCHITECTURE	3	Q38c, Q38d, and Q38e
	4. V_ARCHITECTS	2	Q38f, and Q38g
Organizational factors			
	1. V_PERCEIVED-COMPLEXITY	7	Q11a, Q11b, Q11c, Q12a, Q12b, Q12c, and Q12d
	2. V_VIEW-INFRASTRUCTURE	4	Q19, Q20, Q21, and Q22
	3. V_VIEW-APPLICATION	4	Q23, Q24, Q25, and Q26
	4. V_ORGANIZATION-SIZE	1	Q4
	5. V_CENTRALIZED-IT-DEPARTMENT	1	Q18
Execution factors			
	1. V_EXECUTION-ESSENTIALS	2	Q7, and Q28
	2. V_EXECUTION-METHODOLOGY	1	Q9
	3. V_ALIGNMENT-GOALS	5	Q29b, Q30b, Q31b, Q32b, and Q33b
	4. V_SUPPORT-GOALS	3	Q27a, Q27b, and Q27c
	5. V_REALIZATION-GOALS	6	Q29c, Q29e, Q30d, Q31d, Q32d, and Q33d
	6. V_INFORM	5	Q29d, Q30c, Q31c, Q32c, and Q33c
	7. V_TEAM	12	Q34a, Q34b, Q34c, Q34d, Q34e, Q34f, Q34g, Q34h, Q34i, Q34j, Q34k, and Q34l
	8. V_EXTERNALS-USED	3	Q35, Q36, and Q37

***Table 63** Constructs and relating items*

The next sections describe how construct validity was verified using exploratory factor analysis. The analysis was done using IBM SPSS Statistics version 26.

5.9.2.1 Construct validity for governance factors

To determine the construct validity for the governance factors an exploratory factor analysis was conducted using principal component analysis extraction with varimax rotation method. The factor analysis was based on 12 items and 83 cases.

The analysis was started by conducting the Kaiser-Meyer-Olkin measure and Bartlett's Test of Sphericity. Both tests delivered scores that were sufficient to run the factor analysis. The factor analysis yielded that 79.573 percent of the variance can be explained by four factors. This is based on the criterion eigenvalue ≥ 1. Appendix H shows the detailed information about the calculations used for the exploratory factor analysis.

The exploratory factor analysis showed that most of the items were intercorrelated with each other. This provided validity for the subscales and therefore sufficient evidence for construct validation of the governance factors.

5.9.2.2 Construct validity for organizational factors

To determine the construct validity for the organizational factors an exploratory factor analysis was conducted using principal component analysis extraction with varimax rotation method. The factor analysis was initially based on 17 items and 44 cases.

The analysis was started by conducting the Kaiser-Meyer-Olkin measure and Bartlett's Test of Sphericity. Both tests delivered scores that were sufficient to run the factor analysis. Though it should be noted that the KMO score of .521 is below the recommended value of 0.6, but can be considered as barely acceptable as it is above 0.5 [Kaiser, 1974].

Based on the criterion eigenvalue ≥ 1, the exploratory factors analysis showed that 77.208 percent of the variance can be explained by six factors. The rotated factor loadings generally confirm the scales used in the conceptual model as most of the items were intercorrelated to each other. This provided sufficient evidence to assume construct validation of the organizational factors. Detailed information about the calculations used can be found in Appendix H. Construct validity for organizational factors.

5.9.2.3 Construct validity for execution factors

To determine the construct validity for the execution factors an exploratory factor analysis was conducted using principal component analysis extraction with varimax rotation method. The factor analysis was initially based on 37 items. This resulted in a warning in SPSS that "the matrix is not positive definite" and that "the determinant is .000." Therefore SPSS cannot determine KMO and BTS.

Looking at the constructs it was decided to split the validity analysis into three parts. The split is based on execution factors relation to execution and goals (17 items); factors relating to information (5 factors), and factors relating to personnel (15 factors):

Construct	Variable	No. items	Questions
Execution factors – Execution and Goals			
	1. V_EXECUTION-ESSENTIALS	2	Q7, and Q28
	2. V_EXECUTION-METHODOLOGY	1	Q9
	3. V_ALIGNMENT-GOALS	5	Q29b, Q30b, Q31b, Q32b, and Q33b
	4. V_SUPPORT-GOALS	3	Q27a, Q27b, and Q27c
	5. V_REALIZATION-GOALS	6	Q29c, Q29e, Q30d, Q31d, Q32d, and Q33d
	6. V_INFORM	5	Q29d, Q30c, Q31c, Q32c, and Q33c
Execution factors – Information			
	6. V_INFORM	5	Q29d, Q30c, Q31c, Q32c, and Q33c
Execution factors –Personnel			
	7. V_TEAM	12	Q34a, Q34b, Q34c, Q34d, Q34e, Q34f, Q34g, Q34h, Q34i, Q34j, Q34k, and Q34l
	8. V_EXTERNALS-USED	3	Q35, Q36, and Q37

Table 64 *Constructs relating to Execution Factors split up.*

Construct validity for execution and goals related execution factors:
The analysis was started by conducting the Kaiser-Meyer-Olkin measure and Bartlett's Test of Sphericity. Both tests delivered scores that were sufficient to run the factor analysis. Though it should be noted that the KMO score of .534 is below the recommended value of 0.6, but can be considered as barely acceptable as it is above 0.5 [Kaiser, 1974].

To confirm construct validity, an exploratory factor analysis with principal components analysis as extraction method was used. This resulted in 79.596 percent of the variance being explained by six factors. This is based on the criterion eigenvalue ≥ 1. The rotated factor loadings showed most of the items being intercorrelated to each other. This provided sufficient evidence to assume construct validity. Appendix H. contains detailed information about the calculations used.

Construct validity for information related execution factors:
The analysis was started by conducting the Kaiser-Meyer-Olkin measure and Bartlett's Test of Sphericity. For these test to be run successful question Q29d needed to be removed as it invoked the warning: "There are fewer than two cases, at least one of the variables has zero variance, there is only one variable in the analysis, or correlation coefficients could not be computed for all pairs of variables. No further statistics will be computed."

Without question Q29d, both tests delivered scores that were sufficient to run the factor analysis. Though it should be noted that the KMO score of .544 is below the recommended value of 0.6, but can be considered as barely acceptable as it is above 0.5 [Kaiser, 1974].

The exploratory factor analysis resulted in 66.678 percent of the variance is explained by two factors. This result is based on the criterion eigenvalue ≥ 1. The rotated factor loadings showed an intercorrelation among most of the items. Therefore some evidence for construct validity can be assumed. Appendix H. shows the calculations used.

Construct validity for personnel-related execution factors:
The analysis was started by conducting the Kaiser-Meyer-Olkin measure and Bartlett's Test of Sphericity. Both tests delivered scores that were sufficient to run the factor analysis.

The confirm construct validity an exploratory factor analysis, with principal components analysis as extraction method was used. Based on the analysis 64.236 percent of the variance can be explained by three factors, based on the criterion eigenvalue ≥ 1. Most of the items were intercorrelated with each other, thus providing validity for the subscales. Therefore some evidence for construct validity can be assumed. Appendix H. shows the calculations used to draw this conclusion.

5.10 Summarizing the data analysis

In this chapter, the data gathered via the online survey were analyzed and presented. The research methodology indicates that sub-questions S4, S5, S6, and S7 will be evaluated and answered via statistical data analyzed. The methodology also indicates that the data analysis provides a practical foundation for answering sub-questions S3 and S8.

In the next sections, the data analysis will be summarized based on the sub-questions.

5.10.1 S3. Which main methods are used to reduce complexity in the IT-landscape?

During the literature review portfolio management, ERP implementation, using service-oriented architecture, following cloud strategies and agile methodologies were found and discussed.

About 63 percent of the respondents mentioned ERP implementation, agile methodology, and portfolio-management as the main methods used for reducing IT complexity. Service-oriented architecture and cloud migration were mentioned by about 33 percent of the respondents.

Methods for reducing IT complexity	Responses	%
1. Implementing an ERP System	34	21,7%
2. Implementing an Agile methodology	33	21,0%
3. Some form of Portfolio Management	31	19,7%
4. We developed our own methodology	19	12,1%
5. Service-Oriented Architecture	17	10,8%
6. Cloud Migration	16	10,2%
7. A methodology wasn't used	4	2,6%
8. Other (please specify)	3	1,9%

***Table 65** Main methods used for reducing IT complexity*

5.10.2 S4. What are noticeable organizational artifacts relating to the IT complexity reduction approach? and S5. To what extent is management committed to the rationalization approach?

Via this section sub-questions, 4 and 5 will be answered. Both questions aim to deliver a statistical evaluation of organizational factors that can pose as representatives for success in reducing IT complexity.

Section 5.5 investigated five variables and six sub-variables for a possible relationship to the success rate of a complexity reduction approach.

Relationships	**(Sub) Variable**	**Success rate of the complexity reduction initiative/project (V_Approach-Success)**		
IT Complexity as it is perceived by the organization (V_Perceived_Complexity)	Variable	No relationship	Spearman's Rho Significance	0.188 .092
IT Complexity as it is perceived by the management levels within the organization (V_Perc-Complex-mnmnt)	Sub	No relationship	Spearman's Rho Significance	0.111 .360
IT Complexity as it is perceived by the business departments within the organization (V_Perc-Complex-dep)	Sub	No relationship	Spearman's Rho Significance	.132 .233
The organization's view towards its IT infrastructure (V_View_Infrastructure)	Variable	No relationship	Spearman's Rho Significance	.214 .052

Relationships	(Sub) Variable	Success rate of the complexity reduction initiative/project (V_Approach-Success)		
The management's view of the organization's IT infrastructure (V_View_Infrastruct-Mnmnt)	Sub	No relationship	Spearman's Rho	.189
			Significance	.087
The business department's view of the organization's IT infrastructure (V_View_Infrastruct-Bus-Dep)	Sub	No relationship	Spearman's Rho	.111
			Significance	.316
The organization's view towards its applications (V_View_Application)	Variable	No relationship	Spearman's Rho	.063
			Significance	.573
The management's view of the organization's applications (V_View_Application-Mnmnt)	Sub	No relationship	Spearman's Rho	.098
			Significance	.378
The business department's view of the organization's applications (V_View_Application-Bus-Dep)	Sub	No relationship	Spearman's Rho	-.061
			Significance	.585
Size of the organization (V_Organization-Size)	Variable	No relationship	Spearman's Rho	-.026
			Significance	.816
The amount of centralization of the IT department (V_Centralized-IT-Department)	Variable	No relationship	Spearman's Rho	-.018
			Significance	.873

Table 66 *Relationships for Organizational Factors*

The table above shows that **no** statistically relevant relationship was found between any the organizational factors and the success rate of a complexity reduction approach. Therefore, no factors relating to the organization, her stakeholders and her departments that can pose as representatives for success in reducing IT complexity have been found.

5.10.3 S6. What are the governance mechanisms in place relating to the IT complexity reduction approach?

Section 5.5 investigated six governance-related (sub-) variables for a possible relationship to the success rate of a complexity reduction approach.

Relationships	(Sub) Variable	Success rate of the complexity reduction initiative/project (V_Approach-Success)		
Organization's actions in accordance with its vision and mission. (V_Act_Vision)	Variable	**Statistical relationship**	Spearman's Rho	.355**
			Significance	.002
Management's actions in accordance with the organization's vision and mission. (V_Act-Vision-mnmnt)	Sub	**Statistical relationship**	Spearman's Rho	.229*
			Significance	.039
Business Department's actions in accordance with the organization's vision and mission. (V_Act-Vision-Dep	Sub	**Statistical relationship**	Spearman's Rho	.317**
			Significance	.006
The IT department's and IT complexity reduction approach alignment with the organization's mission and vision. (V_Alignment_Vision)	Variable	**Statistical relationship**	Spearman's Rho	.265*
			Significance	.016
Organizations having an IT architecture and acting according to it. (V_Architecture)	Variable	**Statistical relationship**	Spearman's Rho	.265*
			Significance	.017
Organizations having active (enterprise) architects (V_Architects)	Variable	No Relationship	Point Biserial	.063
			Significance	.586

** A relationship is significant at the 0.01 level (2-tailed).
* A relationship is significant at the 0.05 level (2-tailed).

Table 67 *Relationships for Governance Factors*

The table above indicates that those organizations

- That act in accordance to its vision and mission
  and/or
- Whose IT department and/or IT complexity reduction approach act in accordance to the organization's vision and mission
  and/or
- That have an IT architecture and act according to this architecture.

might be more successful in reducing IT complexity than other organizations.

5.10.4 S7. What contributes to a successful execution of an IT complexity reduction approach?

In section 5.6 a total of nine variables and eleven sub-variables relating to the execution of the IT complexity reduction approach were investigated for a possible relationship to the success rate of the IT complexity reduction approach.

Relationships	(Sub) Variable	Success rate of the complexity reduction initiative/project (V_Approach-Success)		
The existence of a business case and a steering group (V_Execution-Essentials)	Variable	No Relationship	Point Biserial Significance	.025 .824
The IT complexity reduction approach was executed via a (project) methodology (V_Execution-Methodology)	Variable	No Relationship	Point Biserial Significance	-.223 .104
The alignment of the approach's goals and actions to the organization. (V_ Alignment-Goals)	Variable	**Statistical relationship**	Spearman's Rho Significance	.329** .003
The alignment of the approach's goals and actions to the management levels. (V_ Alignment-Goals-Mnmnt)	Sub	**Statistical relationship**	Spearman's Rho Significance	.318** .004
The alignment of the approach's goals and actions to the business departments. (V_Alignment-Goals-Dep)	Sub	**Statistical relationship**	Spearman's Rho Significance	.291** .008
The amount of support received from the organization. V_Support-Goals	Variable	**Statistical relationship**	Spearman's Rho Significance	.222* .044
The organization's decisiveness and actionability to implement the business changes needed. (V_Realization-Goals)	Variable	**Statistical relationship**	Spearman's Rho Significance	.507** < .001
The management level's decisiveness and actionability to implement the business changes needed. (V_ Realization -Goals-Mnmnt)	Sub	**Statistical relationship**	Spearman's Rho Significance	.438** < .001
The business department's decisiveness and actionability to implement the business changes needed. (V_Realization -Goals-Dep)	Sub	**Statistical relationship**	Spearman's Rho Significance	.500** < .001
The amount of informing from IT complexity reduction approach towards its stakeholders. (V_Inform)	Variable	No Relationship	Spearman's Rho Significance	.054 .634
The amount of informing from IT complexity reduction approach towards its stakeholders at the management levels. (V_Inform-Mnmnt)	Sub	No Relationship	Spearman's Rho Significance	-.005 .962
The amount of informing from IT complexity reduction approach towards its stakeholders from the business departments. (V_Inform-Dep)	Sub	No Relationship	Spearman's Rho Significance	.131 .245
Factors relating to the team (V_Team)	Variable	**Statistical relationship**	Spearman's Rho Significance	.255* .020
The team members' awareness and willingness to achieve the goals set for the IT complexity reduction approach. (V_Team-Goals)	Sub	**Statistical relationship**	Point Biserial Significance	.360** .001
The team-members' awareness and knowledge of the organization's processes and procedures. (V_Team-Processes)	Sub	No Relationship	Point Biserial Significance	.182 .099

Relationships	(Sub) Variable	Success rate of the complexity reduction initiative/project (V_Approach-Success)		
Team-members' being dedicatedly available for the IT complexity reduction approach, thus having no other tasks than participating in the approach. (V_Team-Dedicated)	Sub	No Relationship	Point Biserial	.130
			Significance	.251
The amount of diversity of team-members and knowledge within the team. (V_Team-Composition)	Sub	**Statistical relationship**	Point Biserial	.291**
			Significance	.007
The amount of wellbeing within the team. (V_Team-Wellbeing)	Sub	**Statistical relationship**	Point Biserial	.374**
			Significance	.001
External staff was hired to aid the IT Complexity reduction approach (V_Externals-Used)	Variable	**Statistical relationship**	Point Biserial	-.347**
			Significance	.002

** A relationship is significant at the 0.01 level (2-tailed).
* A Relationship is significant at the 0.05 level (2-tailed).

Table 68 *Relationships for Execution Factors*

The table above indicates that those IT complexity reduction approaches

- Whose goals and actions are alignment to the organization at the management and/or the business department level *and/or*
- That actively inform their management levels and/or business departments about the progress and/or
- That receive active support from the organization at the management and/or the business department level *and/or*
- Whose management and/or business departments are decisive and actionable to implement the changes needed. and/or
- That have a team that
- are knowledgeable about and motivated towards the goals set *and/or*
- are divers in team-members and knowledge and/or
- experiences personal growth and happiness and/or
- That do not use external staff

might be more successful in reducing IT complexity than other organizations.

5.10.5 S8. What do experts recognize as dominant factors that might positively affect IT complexity in the organization?

Section 5.8 discussed thirteen statements relating to factors that might positively affect IT complexity. These answered by 95 respondents and the respondents agreed for more than 75 percent of the following factors.

- Rationalization
  -> 94,02% of the respondents agreed
- Standardization of IT infrastructure (components)
  -> 93,55% of the respondents agreed
- Digitalization of business processes
  -> 88,71% of the respondents agreed
- Standardized IT shared across the company
  -> 79,67% of the respondents agreed
- Working under architecture
  -> 77,17% of the respondents agreed

It is worth noting that the respondents had diverse opinions about the following three methods as being a method or factor that can positively affect IT complexity:

1. Implementing an ERP system: In the literature review was concluded even though an ERP implementation offers possibilities to address complexity within organizations; it is a risky endeavor potentially leaving organizations with more IT complexity.

This was reflected in the respondent's answers to the statement that implementing an ERP system reduces IT complexity: 23 percent agreed, 33 percent disagreed, and 38 percent was neutral to this statement.

2. Migrating to a cloud-based solution: The literature found that migrating legacy systems to cloud computing environments offers possibilities to reduce IT complexity, but it is a difficult and high-cost process as many legacy applications were developed before the cloud computing era.
   This was reflected in the respondent's answers to the statement that migrating to a cloud-based solution leas to less IT complexity: 22 percent agreed, 30 percent disagreed, and 41 percent was neutral to this statement.
3. Using a service-oriented architecture: In the literature review was concluded that Migrating to SOA can be beneficial in handling IT complexity but it is also potentially expensive, risky and time-consuming as the majority of legacy systems are not SOA enabled.
   The answers given by the respondents reflected this finding. In total 56 percent agreed, 19 percent disagreed, and 22 percent was neutral to the statement that having existing information systems that are readily configurable for new business initiatives leads to less IT complexity.

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6. Conclusions, and directions for further research

6.1 Conclusions

The purpose of this master's thesis is to investigate IT complexity and to identify factors that, if addressed, will increase the chance of success for the IT complexity reduction approach.

IT complexity arises and increases due to the next dimensions:

1. Diversity when a large and various number of (sub) systems exist within the information systems landscape.
2. Ambiguity when organizational goals or missions are unclear and/or when predicting the future situation is impossible and/or when the amount of available information is not complete or invalid.
3. Interdependence when different organizational elements and/or information systems have to transmit information with other organizational elements and/or information systems.
4. Fast flux when information systems landscapes are faced with a high speed of change in the organization and its environment.

For successfully reducing complexity one or more of these dimensions must be addressed. Addressing these dimensions leads to a change in the information system and/or the IT landscape. This change is can best be realized via an IT project. An IT-project delivers (a change in) an information system leading to improved organizational performance and generally impacting business processes.

In order to reduce complexity, it is important that an IT-project is successful. An IT-project is considered successful when it satisfies three factors:

1. compliance with the functionality agreed to in advance,
2. delivery on time and
3. delivery within the agreed budget.

But IT complexity is linked to IT project failure and this failure leads to more technical complexity. A vicious cycle could be noticed in which complexity leads to IT project failure and IT project failure leads to more complexity.

This thesis attempts to break this vicious cycle via the main research question: "*Which factors, when taken into account by an IT complexity reduction approach, will have a positive effect on the outcome of the IT complexity reduction initiative?*"

The factors mentioned above were categorized into three groups: governance-related factors, organization-related factors, and factors relating to the execution of the IT complexity reduction approach.

Factors relating to governance concern leadership, strategy for decision making, and responsibilities for IT developments. When using IT governance to prevent IT complexity, IT architecture should be an integral part of IT governance as it indicates how the design should be realized.

In the conceptual framework, 4 variables and 4 sub-variables were linked to the governance-related factors. The statistical analysis identified 3 variables and 2 sub-variables to have a statistical relationship to the success rate of the IT complexity reduction approach.

So for governance-related factors, can be concluded that IT complexity reduction approaches are more likely to succeed in their endeavor when they operate in organizations that:

- have a clearly defined vision and mission;
- have their management levels, business, and IT departments aligned with and act in accordance with this vision and mission; and
- have an IT architecture and act according to it.

Factors relating to the organization concern IT decision rights and how they are distributed among the organization. They also concern whether the organization perceives its applications and infrastructure as a commodity or as a value creator. Lastly, these factors concern whether the organization acknowledges the IT complexity.

The conceptual framework linked 5 variables and 6 sub-variables to the organizational factors. No statistical relationships for these variables and sub-variables were identified

Factors relating to the execution of the IT complexity reduction approach concern the use of project methodologies, the existence of a business case and steering group. It also concerns that the IT complexity reduction approach's goals and actions are aligned with the organization and that the organization actively supports the approach. Lastly, factors relating to the execution concern the approach's team and the use of external staff.

A total of 9 variables and 10 sub-variables were linked to the execution factors in the conceptual model. During the statistical analysis, 5 variables and 6 sub-variables were identified to have a statistical relationship to the success rate of the approach.

So for factors relating to the execution can be concluded that IT complexity reduction approaches are more likely to succeed in their endeavor when they ensure that they:

- constantly act in accordance with the organization's vision and mission;
- have their project goals and actions aligned to the organization, and
- actively inform their stakeholders about the progress and impediments.

To be more likely to succeed an IT complexity reduction approach should have a team that:

- is knowledgeable about and motivated towards the goals set;
- experiences personal growth and happiness during the approach;
- is diverse in team-members and their knowledge, and;
- does not contain external staff.

This research basically concludes that reducing IT complexity seems to be contingent on the proper alignment of human factors, soft factors and the right frameworks, artifacts, and project methodologies being in place.

6.2 Directions for Further Research

In this research, factors were identified that, if addressed by the IT complexity reduction approach, might increase the chance of success. It is important to note that the factors identified only have a statistical relationship to the success rate of the IT complexity reduction approach. Further investigation is needed to determine the nature and causality of the relationships found. It could also be beneficial to evaluate the factors identified through real cases or projects.

The survey used for this research yielded a considerable dataset based on the responses of 114 respondents for a total of 92 items representing at least 33 organizations. Through future research, this dataset could be examined via cross-tabulation to search for patterns like experience level, age, function, gender, et cetera. These patterns could reveal new and / or better insights regarding reducing complexity in IT landscapes.

Lastly, this study identified a negative relationship between the use of external staff and the success rate of IT complexity reduction approaches. This negative relationship implies that using external staff reduces the likeliness for the approach to be successful. It could be useful to further research this finding.

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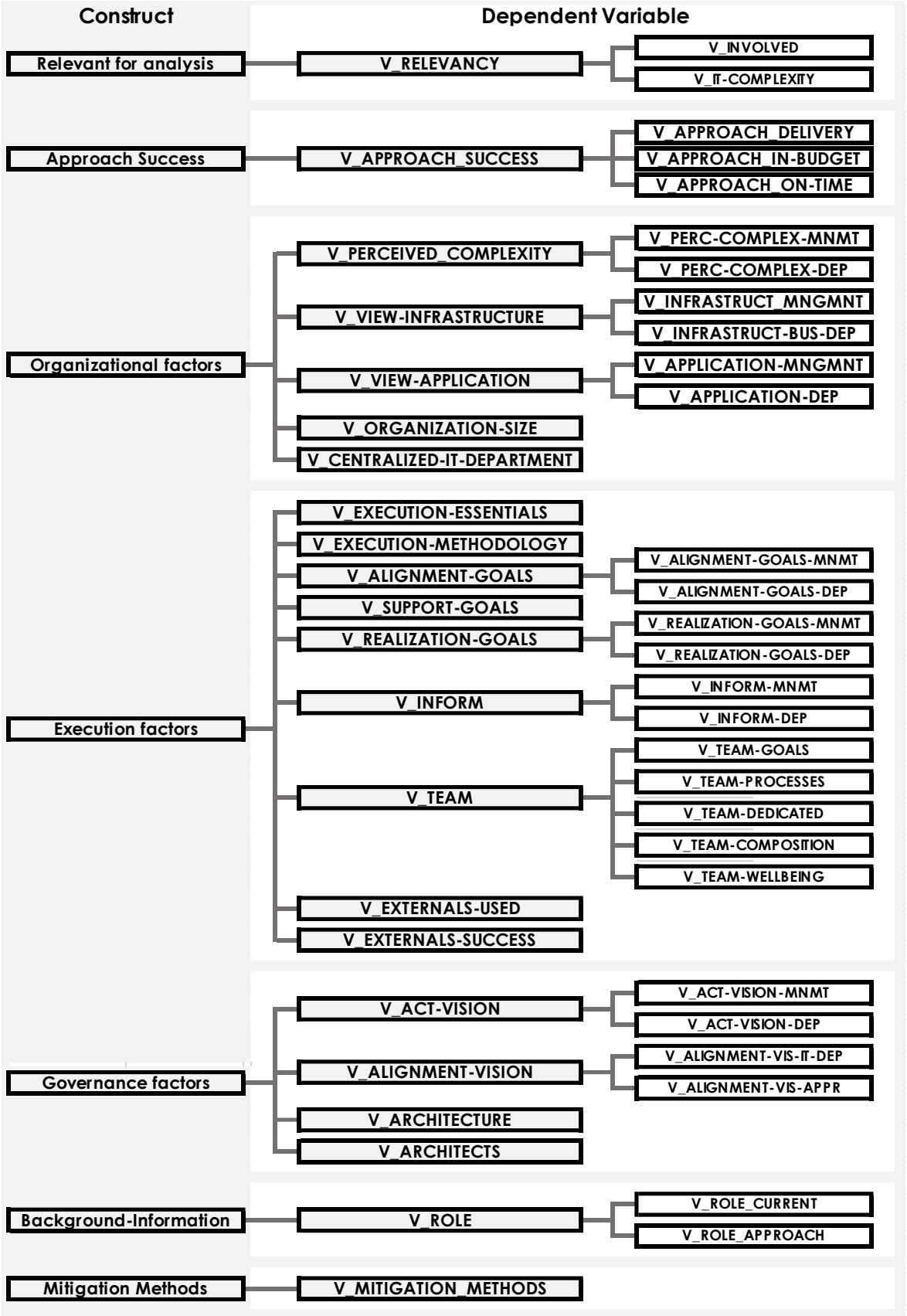
Appendix A: Conceptual Framework



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Appendix B Significance testing

Table 1: Significance for Chi-Square

	Probability less than the critical value				
df	0.90	0.95	0.975	0.99	0.999
2	4.605	5.991	7.378	9.210	13.816
3	6.251	7.815	9.348	11.345	16.266
4	7.779	9.488	11.143	13.277	18.467
5	9.236	11.070	12.833	15.086	20.515
6	10.645	12.592	14.449	16.812	22.458
7	12.017	14.067	16.013	18.475	24.322
8	13.362	15.507	17.535	20.090	26.125
9	14.684	16.919	19.023	21.666	27.877
10	15.987	18.307	20.483	23.209	29.588
11	17.275	19.675	21.920	24.725	31.264
12	18.549	21.026	23.337	26.217	32.910
13	19.812	22.362	24.736	27.688	34.528
14	21.064	23.685	26.119	29.141	36.123
15	22.307	24.996	27.488	30.578	37.697
16	23.542	26.296	28.845	32.000	39.252
17	24.769	27.587	30.191	33.409	40.790
18	25.989	28.869	31.526	34.805	42.312
19	27.204	30.144	32.852	36.191	43.820
20	28.412	31.410	34.170	37.566	45.315
21	29.615	32.671	35.479	38.932	46.797
22	30.813	33.924	36.781	40.289	48.268
23	32.007	35.172	38.076	41.638	49.728
24	33.196	36.415	39.364	42.980	51.179
25	34.382	37.652	40.646	44.314	52.620
26	35.563	38.885	41.923	45.642	54.052
27	36.741	40.113	43.195	46.963	55.476
28	37.916	41.337	44.461	48.278	56.892
29	39.087	42.557	45.722	49.588	58.301
30	40.256	43.773	46.979	50.892	59.703
31	41.422	44.985	48.232	52.191	61.098
32	42.585	46.194	49.480	53.486	62.487
33	43.745	47.400	50.725	54.776	63.870
34	44.903	48.602	51.966	56.061	65.247
35	46.059	49.802	53.203	57.342	66.619
36	47.212	50.998	54.437	58.619	67.985
37	48.363	52.192	55.668	59.893	69.347
38	49.513	53.384	56.896	61.162	70.703
39	50.660	54.572	58.120	62.428	72.055
40	51.805	55.758	59.342	63.691	73.402
41	52.949	56.942	60.561	64.950	74.745
42	54.090	58.124	61.777	66.206	76.084
43	55.230	59.304	62.990	67.459	77.419
44	56.369	60.481	64.201	68.710	78.750
45	57.505	61.656	65.410	69.957	80.077
46	58.641	62.830	66.617	71.201	81.400
47	59.774	64.001	67.821	72.443	82.720
48	60.907	65.171	69.023	73.683	84.037
49	62.038	66.339	70.222	74.919	85.351
50	63.167	67.505	71.420	76.154	86.661

	Probability less than the critical value				
df	0.90	0.95	0.975	0.99	0.999
51	64.295	68.669	72.616	77.386	87.968
52	65.422	69.832	73.810	78.616	89.272
53	66.548	70.993	75.002	79.843	90.573
54	67.673	72.153	76.192	81.069	91.872
55	68.796	73.311	77.380	82.292	93.168
56	69.919	74.468	78.567	83.513	94.461
57	71.040	75.624	79.752	84.733	95.751
58	72.160	76.778	80.936	85.950	97.039
59	73.279	77.931	82.117	87.166	98.324
60	74.397	79.082	83.298	88.379	99.607
61	75.514	80.232	84.476	89.591	100.888
62	76.630	81.381	85.654	90.802	102.166
63	77.745	82.529	86.830	92.010	103.442
64	78.860	83.675	88.004	93.217	104.716
65	79.973	84.821	89.177	94.422	105.988
66	81.085	85.965	90.349	95.626	107.258
67	82.197	87.108	91.519	96.828	108.526
68	83.308	88.250	92.689	98.028	109.791
69	84.418	89.391	93.856	99.228	111.055
70	85.527	90.531	95.023	100.425	112.317
71	86.635	91.670	96.189	101.621	113.577
72	87.743	92.808	97.353	102.816	114.835
73	88.850	93.945	98.516	104.010	116.092
74	89.956	95.081	99.678	105.202	117.346
75	91.061	96.217	100.839	106.393	118.599
76	92.166	97.351	101.999	107.583	119.850
77	93.270	98.484	103.158	108.771	121.100
78	94.374	99.617	104.316	109.958	122.348
79	95.476	100.749	105.473	111.144	123.594
80	96.578	101.879	106.629	112.329	124.839
81	97.680	103.010	107.783	113.512	126.083
82	98.780	104.139	108.937	114.695	127.324
83	99.880	105.267	110.090	115.876	128.565
84	100.980	106.395	111.242	117.057	129.804
85	102.079	107.522	112.393	118.236	131.041
86	103.177	108.648	113.544	119.414	132.277
87	104.275	109.773	114.693	120.591	133.512
88	105.372	110.898	115.841	121.767	134.746
89	106.469	112.022	116.989	122.942	135.978
90	107.565	113.145	118.136	124.116	137.208
91	108.661	114.268	119.282	125.289	138.438
92	109.756	115.390	120.427	126.462	139.666
93	110.850	116.511	121.571	127.633	140.893
94	111.944	117.632	122.715	128.803	142.119
95	113.038	118.752	123.858	129.973	143.344
96	114.131	119.871	125.000	131.141	144.567
97	115.223	120.990	126.141	132.309	145.789
98	116.315	122.108	127.282	133.476	147.010
99	117.407	123.225	128.422	134.642	148.230
100	118.498	124.342	129.561	135.807	149.449

Table 2: Significance of Point Biserial correlation and Spearman Rank Correlation

t Distribution: Critical Values of t

Degrees of freedom	*Two-tailed test:* / *One-tailed test:*	*Significance level* 10% / 5%	5% / 2.5%	2% / 1%	1% / 0.5%	0.2% / 0.1%	0.1% / 0.05%
1		6.314	12.706	31.821	63.657	318.309	636.619
2		2.920	4.303	6.965	9.925	22.327	31.599
3		2.353	3.182	4.541	5.841	10.215	12.924
4		2.132	2.776	3.747	4.604	7.173	8.610
5		2.015	2.571	3.365	4.032	5.893	6.869
6		1.943	2.447	3.143	3.707	5.208	5.959
7		1.894	2.365	2.998	3.499	4.785	5.408
8		1.860	2.306	2.896	3.355	4.501	5.041
9		1.833	2.262	2.821	3.250	4.297	4.781
10		1.812	2.228	2.764	3.169	4.144	4.587
11		1.796	2.201	2.718	3.106	4.025	4.437
12		1.782	2.179	2.681	3.055	3.930	4.318
13		1.771	2.160	2.650	3.012	3.852	4.221
14		1.761	2.145	2.624	2.977	3.787	4.140
15		1.753	2.131	2.602	2.947	3.733	4.073
16		1.746	2.120	2.583	2.921	3.686	4.015
17		1.740	2.110	2.567	2.898	3.646	3.965
18		1.734	2.101	2.552	2.878	3.610	3.922
19		1.729	2.093	2.539	2.861	3.579	3.883
20		1.725	2.086	2.528	2.845	3.552	3.850
21		1.721	2.080	2.518	2.831	3.527	3.819
22		1.717	2.074	2.508	2.819	3.505	3.792
23		1.714	2.069	2.500	2.807	3.485	3.768
24		1.711	2.064	2.492	2.797	3.467	3.745
25		1.708	2.060	2.485	2.787	3.450	3.725
26		1.706	2.056	2.479	2.779	3.435	3.707
27		1.703	2.052	2.473	2.771	3.421	3.690
28		1.701	2.048	2.467	2.763	3.408	3.674
29		1.699	2.045	2.462	2.756	3.396	3.659
30		1.697	2.042	2.457	2.750	3.385	3.646
32		1.694	2.037	2.449	2.738	3.365	3.622
34		1.691	2.032	2.441	2.728	3.348	3.601
36		1.688	2.028	2.434	2.719	3.333	3.582
38		1.686	2.024	2.429	2.712	3.319	3.566
40		1.684	2.021	2.423	2.704	3.307	3.551
42		1.682	2.018	2.418	2.698	3.296	3.538
44		1.680	2.015	2.414	2.692	3.286	3.526
46		1.679	2.013	2.410	2.687	3.277	3.515
48		1.677	2.011	2.407	2.682	3.269	3.505
50		1.676	2.009	2.403	2.678	3.261	3.496
60		1.671	2.000	2.390	2.660	3.232	3.460
70		1.667	1.994	2.381	2.648	3.211	3.435
80		1.664	1.990	2.374	2.639	3.195	3.416
90		1.662	1.987	2.368	2.632	3.183	3.402
100		1.660	1.984	2.364	2.626	3.174	3.390
120		1.658	1.980	2.358	2.617	3.160	3.373
150		1.655	1.976	2.351	2.609	3.145	3.357
200		1.653	1.972	2.345	2.601	3.131	3.340
300		1.650	1.968	2.339	2.592	3.118	3.323
400		1.649	1.966	2.336	2.588	3.111	3.315
500		1.648	1.965	2.334	2.586	3.107	3.310
600		1.647	1.964	2.333	2.584	3.104	3.307
∞		1.645	1.960	2.326	2.576	3.090	3.291

Table 3: Significance for Kendall's Tau Rank Correlation

z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
-3.4	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0002
-3.3	0.0005	0.0005	0.0005	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0003
-3.2	0.0007	0.0007	0.0006	0.0006	0.0006	0.0006	0.0006	0.0005	0.0005	0.0005
-3.1	0.0010	0.0009	0.0009	0.0009	0.0008	0.0008	0.0008	0.0008	0.0007	0.0007
-3.0	0.0013	0.0013	0.0013	0.0012	0.0012	0.0011	0.0011	0.0011	0.0010	0.0010
-2.9	0.0019	0.0018	0.0018	0.0017	0.0016	0.0016	0.0015	0.0015	0.0014	0.0014
-2.8	0.0026	0.0025	0.0024	0.0023	0.0023	0.0022	0.0021	0.0021	0.0020	0.0019
-2.7	0.0035	0.0034	0.0033	0.0032	0.0031	0.0030	0.0029	0.0028	0.0027	0.0026
-2.6	0.0047	0.0045	0.0044	0.0043	0.0041	0.0040	0.0039	0.0038	0.0037	0.0036
-2.5	0.0062	0.0060	0.0059	0.0057	0.0055	0.0054	0.0052	0.0051	0.0049	0.0048
-2.4	0.0082	0.0080	0.0078	0.0075	0.0073	0.0071	0.0069	0.0068	0.0066	0.0064
-2.3	0.0107	0.0104	0.0102	0.0099	0.0096	0.0094	0.0091	0.0089	0.0087	0.0084
-2.2	0.0139	0.0136	0.0132	0.0129	0.0125	0.0122	0.0119	0.0116	0.0113	0.0110
-2.1	0.0179	0.0174	0.0170	0.0166	0.0162	0.0158	0.0154	0.0150	0.0146	0.0143
-2.0	0.0228	0.0222	0.0217	0.0212	0.0207	0.0202	0.0197	0.0192	0.0188	0.0183
-1.9	0.0287	0.0281	0.0274	0.0268	0.0262	0.0256	0.0250	0.0244	0.0239	0.0233
-1.8	0.0359	0.0351	0.0344	0.0336	0.0329	0.0322	0.0314	0.0307	0.0301	0.0294
-1.7	0.0446	0.0436	0.0427	0.0418	0.0409	0.0401	0.0392	0.0384	0.0375	0.0367
-1.6	0.0548	0.0537	0.0526	0.0516	0.0505	0.0495	0.0485	0.0475	0.0465	0.0455
-1.5	0.0668	0.0655	0.0643	0.0630	0.0618	0.0606	0.0594	0.0582	0.0571	0.0559
-1.4	0.0808	0.0793	0.0778	0.0764	0.0749	0.0735	0.0721	0.0708	0.0694	0.0681
-1.3	0.0968	0.0951	0.0934	0.0918	0.0901	0.0885	0.0869	0.0853	0.0838	0.0823
-1.2	0.1151	0.1131	0.1112	0.1093	0.1075	0.1056	0.1038	0.1020	0.1003	0.0985
-1.1	0.1357	0.1335	0.1314	0.1292	0.1271	0.1251	0.1230	0.1210	0.1190	0.1170
-1.0	0.1587	0.1562	0.1539	0.1515	0.1492	0.1469	0.1446	0.1423	0.1401	0.1379
-0.9	0.1841	0.1814	0.1788	0.1762	0.1736	0.1711	0.1685	0.1660	0.1635	0.1611
-0.8	0.2119	0.2090	0.2061	0.2033	0.2005	0.1977	0.1949	0.1922	0.1894	0.1867
-0.7	0.2420	0.2389	0.2358	0.2327	0.2296	0.2266	0.2236	0.2206	0.2177	0.2148
-0.6	0.2743	0.2709	0.2676	0.2643	0.2611	0.2578	0.2546	0.2514	0.2483	0.2451
-0.5	0.3085	0.3050	0.3015	0.2981	0.2946	0.2912	0.2877	0.2843	0.2810	0.2776
-0.4	0.3446	0.3409	0.3372	0.3336	0.3300	0.3264	0.3228	0.3192	0.3156	0.3121
-0.3	0.3821	0.3783	0.3745	0.3707	0.3669	0.3632	0.3594	0.3557	0.3520	0.3483
-0.2	0.4207	0.4168	0.4129	0.4090	0.4052	0.4013	0.3974	0.3936	0.3897	0.3859
-0.1	0.4602	0.4562	0.4522	0.4483	0.4443	0.4404	0.4364	0.4325	0.4286	0.4247
-0.0	0.5000	0.4960	0.4920	0.4880	0.4840	0.4801	0.4761	0.4721	0.4681	0.4641

z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3.0	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990
3.1	0.9990	0.9991	0.9991	0.9991	0.9992	0.9992	0.9992	0.9992	0.9993	0.9993
3.2	0.9993	0.9993	0.9994	0.9994	0.9994	0.9994	0.9994	0.9995	0.9995	0.9995
3.3	0.9995	0.9995	0.9995	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9997
3.4	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9998

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Appendix C: Most popular Agile Methodologies

Girvan and Paul [2017] describe the most popular agile methods as below:

- "**Scrum**: a very popular method that borrows its title from the rugby scrum and uses it as a metaphor for the daily progress update meeting. Scrum has short iterations (sprints) that each focus on delivering working software, a tightly prioritized 'backlog' for both the sprint and the product and specifies a 'Product Owner' role who sets the priorities.
- **XP**: the source of many popular agile practices, and the key founding method. A disciplined approach with high customer involvement, continuous planning, continuous testing and rapid delivery in very short intervals.
- **DSDM**: provides project governance and scaling around XP or RAD approaches. It has three main phases called pre-project, project, and post-project and includes defined formal stages within the project phase. Fitness for Business Purpose is the primary criterion for delivery and acceptance of a system and MoSCoW is used for prioritization.
- **RAD**: both an umbrella term for a range of agile and iterative approaches, and a method described by James Martin (1991) in its own right. RAD takes the analysis, design, build and test phases and repeatedly iterates through them developing prototypes and versions of increasing functionality.
- **Unified Process (UP):** an iterative and incremental framework, with several implementations including the RUP, OpenUP, and AgileUP. A highly tailorable framework that takes a RAD approach that is architecture-centric and risk-focused. The phases of the UP are called Inception, Elaboration, Construction, and Transition, and each has a different focus.
- **Lean**: originating in manufacturing in the 1970s, the principles of Lean were applied to software development by Mary and Tom Poppendieck (2003) in their book, Lean software development. Lean focuses on the delivery of value to the customer and on eliminating waste from the process.
- **Kanban**: an approach that originated in Lean manufacturing and has been further developed by David Anderson (2010). Kanban is based on workflow visualization, typically on a physical board, addressing issues that cause problems, limiting the team's work in progress and balancing the demands on the team. "[Girvan & Paul, 2017]

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Appendix D: Survey

Verzoek participatie onderzoek

Graag verzoek ik u om mee te doen aan mijn onderzoek gericht op complexiteit in IT landschappen. Dit onderzoek is een onderdeel van mijn scriptie ter afronding van mijn studie Business and ICT aan de Universiteit van Leiden. Via deze scriptie verwacht ik factoren te identificeren die representatief zijn voor succes bij het verlagen van complexiteit in IT Landschappen.

Participatie kost u circa 15 minuten. Vanzelfsprekend verwerk ik uw antwoorden anoniem en deel ik mijn resultaten met u na afronding van het onderzoek. Hiermee krijgt u relevante informatie ten aanzien complexiteitsreductie in vergelijking tot uw peers.

Mocht u vragen hebben over dit onderzoek, dan kunt u mij benaderen via:
a.jutte@umail.leidenuniv.nl.

Aanleiding voor dit onderzoek.
Met enige regelmaat lees ik over een duur IT-project dat mislukt. Vaak wordt complexiteit als reden genoemd.

Het IT-landschap is in de loop der jaren uitgegroeid tot een complexe omgeving, gebaseerd op losstaande oplossingen veelal afkomstig van verschillende leveranciers. Ook is de rol van IT de laatste jaren geëvolueerd van een ondersteunende technologie tot een onmisbaar en integraal onderdeel van de primaire en ondersteunende processen van veel organisaties.

De afhankelijkheid van IT neemt dus toe terwijl de complexiteit van de IT aan de andere zijde zorgt voor een toenemend risico op mindere beschikbaarheid van de IT. Ook zorgt de complexiteit van ITlandschap voor veiligheidsrisico's, hogere kosten en maakt het compliant zijn voor wet- en regelgeving, zoals bijvoorbeeld de privacy wetgeving GDPR, lastiger.

Veel organisaties hebben initiatieven en projecten opgestart om direct of indirect complexiteit in het ITlandschap te verlagen. Maar juist de complexiteit van het IT-landschap zorgt voor een grotere kans op falen.

Via dit onderzoek hoop ik factoren te kunnen identificeren die positieve effecten leveren bij het verminderen van complexiteit in IT-landschappen.

Wie ben ik?
Ik ben Arjan Jutte . Ik leid een actief leven met mijn vriendin en 4 (stief)dochters van 14 jaar. Sinds 2006 ben ik als projectleider werkzaam binnen de IT van het ministerie van Defensie. Naast mijn actieve en professionele leven, doe ik ook nog een studie Business and ICT aan de Universiteit van Leiden. Dit onderzoek is de afsluiting van mijn studie.

Hopelijk helpt u mij door mee te doen aan mijn onderzoek en uw ervaringen te delen.

Alvast bedankt!

Arjan Jutte
(www.linkedin.com/in/ajutte/)

1. Wat is uw huidige rol in uw organisatie

- ☐ Chief Executive Officer (Senior)
- ☐ Chief Operating Officer
- ☐ Chief Financial Officer
- ☐ Chief Information Officer
- ☐ Chief Data Officer (CDO)
- ☐ Programma Manager / projectleider
- ☐ (Project) teamlid
- ☐ Business Manager
- ☐ (Senior) Financial Manager
- ☐ (Senior) IT Manager
- ☐ (Senior) Data Manager
- ☐ Consultant
- ☐ Adviseur
- ☐ Anders, namelijk:_____

2. Bent u direct of indirect betrokken geweest bij een initiatief of een project dat verlaging van IT complexiteit tot doel had?

- ☐ Ja
- ☐ Nee

Uw ervaring met complexiteitsreductie

Ik wil u vragen om uw antwoorden op onderstaande vragen zoveel mogelijk te baseren op uw ervaring met één initiatief / project. Het verlagen van complexiteit hoeft hierbij niet de hoofddoelstelling te zijn.

In de volgende vragen refereer ik aan uw project met de term IT complexiteitsverlagingsinitiatief / project.

3. Wat was uw rol in relatie tot het IT complexiteitsverlagingsinitiatief / -project?

- ☐ Lid) Sponsorgroep / (Lid) Stuurgroep
- ☐ Programmamanager / Projectleider
- ☐ Teamlid
- ☐ Adviseur
- ☐ Anders, namelijk:_____

4. Wat was de omvang van de organisatie?

- ☐ 1-10 medewerkers
- ☐ 11-250 medewerkers
- ☐ 251-1000 medewerkers
- ☐ 1.001-10.000 medewerkers
- ☐ > 10.000 medewerkers

5. Waar, hiërarchisch gezien, is het IT complexiteitsverlagingsintitiatief / -project gestart?

- ☐ executive / top management
- ☐ midden management
- ☐ werkvloer

6. Waar, organisatorisch gezien, is het IT complexiteitsverlagingsintitiatief / -project gestart? *(Een combinatie is mogelijk)*

- ☐ bedrijfsvoering / business
- ☐ beleid en architectuur
- ☐ financiële afdeling
- ☐ IT Afdeling
- ☐ Andere (geef nadere toelichting):_____

7. Had uw organisatie een concrete business case voor het IT complexiteitsverlagingsinitiatief / -project?

- ☐ Ja
- ☐ Nee
- ☐ Dat weet ik niet

8. Wat was de doelstelling van de complexiteitsverlagingsinitiatief / -project? *(Een combinatie is mogelijk)*

- ☐ Verlagen van de kosten
- ☐ Verbeteren van de informatiepositie
- ☐ Verbeterde service naar de klanten
- ☐ Voldoen aan wet- en regelgeving
- ☐ Verbeteren van de continuïteit van de IT en/of beveiliging van de informatie
- ☐ Verlagen van de complexiteit van de IT en/of meer standaardisatie in de IT
- ☐ Er was een andere doelstelling, namelijk: _____

9. Het complexiteitsverlagingsinitiatief / -project is volgens een vooraf vastgestelde (project)methodiek uitgevoerd. Hierbij kunt u denken aan Prince2, PMBok, MSP, etcetera.

- ☐ Nee
- ☐ Dat weet ik niet
- ☐ Ja, namelijk_____

10. Voor de beantwoording van deze vraag, kunt u onderstaande passage/stelling gebruiken:
Complex IT-Landschap: *De systemen, tools en processen binnen het IT-Landschap sluiten NIET GOED op elkaar aan. Hierdoor is de informatie NIET naadloos beschikbaar tussen verschillende systemen.*
Simpel IT-Landschap: *De systemen, tools en processen binnen het IT-Landschap sluiten PERFECT op elkaar aan. Hierdoor is de informatie NAADLOOS beschikbaar tussen verschillende systemen.*

Voor het IT complexiteitsverlagingsinitiatief / -project had uw organisatie een....
Simpel IT Landschap <<< ● >>> Complex IT Landschap

11. De mate van complexiteit van IT Landschap was, hiërarchisch gezien, onderkend door....
11a. executive / top management
☐ Eens ☐ Oneens ☐ Dat weet ik niet

11b. midden management
☐ Eens ☐ Oneens ☐ Dat weet ik niet

11c. werkvloer
☐ Eens ☐ Oneens ☐ Dat weet ik niet

12. De mate van complexiteit van IT Landschap was, organisatorisch gezien, onderkend door....
12a. bedrijfsvoering / business
☐ Eens ☐ Oneens ☐ Dat weet ik niet

12b. beleid en architectuur
☐ Eens ☐ Oneens ☐ Dat weet ik niet

12c financiële afdeling
☐ Eens ☐ Oneens ☐ Dat weet ik niet

12d IT afdeling
☐ Eens ☐ Oneens ☐ Dat weet ik niet

13. Het IT complexiteitsverlagingsinitiatief / -project is geëindigd...
☐ Eerder dan gepland ☐ Op tijd ☐ Later dan gepland
☐ Het is nog niet geëindigd ☐ Het is voortijdig stopgezet

14. Wat was de reden waarom het IT complexiteitsverlagingsinitiatief / -project voortijdig is stopgezet? *(Een combinatie is mogelijk)*
☐ Budgetoverschrijding ☐ Leveren van te lage kwaliteit/resultaat
☐ Overschrijding van de looptijd/planning ☐ Anders, namelijk: _____

15. Het IT complexiteitsverlagingsinitiatief / -project is geëindigd....
☐ Onder budget ☐ Op budget ☐ Boven budget ☐ Ik weet het niet

16. Welke van onderstaande elementen zijn gerealiseerd door het IT complexiteitsverlagingsinitiatief / -project?*(Een combinatie is mogelijk)*
☐ Verlaagde kosten ☐ Verbeterde informatiepositie
☐ Verbeterde service naar de klanten ☐ Voldaan aan wet- en regelgeving
☐ Verbeterde continuïteit van de IT en/of beveiliging van de informatie ☐ Verlaagde complexiteit van de IT en/of verhoogde standaardisatie in de IT
☐ Er is niets gerealiseerd ☐ Anders (geef nadere toelichting):_____

17. Heeft het project/initiatief één of meerdere van onderstaande methodes geïmplementeerd en/of gebruikt om IT complexiteit te verlagen? *(Een combinatie is mogelijk)*
☐ Service Oriented Architecture / Service' Georiënteerde Architectuur ☐ Implementatie van een Agile-Methodiek (Scrum, KanBan, DevOps, Lean, SixSigma, et cetera)
☐ Cloud Migratie / Cloud Migratie Strategie ☐ We hebben een methode ontwikkeld en gebruikt
☐ Implementatie van een ERP systeem ☐ Er is geen methode gebruikt
☐ Implementatie van een ERP systeem ☐ Andere (geef nadere toelichting):_____

18. Gedurende het IT complexiteitsverlagingsinitiatief / -project had uw organisatie een...

- ☐ gecentraliseerde IT-organisatie
- ☐ geDEcentraliseerde IT-organisatie
- ☐ combinatie van een gecentraliseerde en gedecentraliseerde IT-Organisatie

19. Het executive / Top management beschouwde IT-infrastructuur als een...

Kostenpost — *(IT dient tegen zo laag mogelijke kosten beschikbaar te zijn)* — Waardecreator — *(IT is vitaal voor het bedrijf en dient zo veel mogelijk toegevoegde waarde te leveren)*

<<< <<< <<< ● >>> >>> >>>

20. Het midden management beschouwde IT-infrastructuur als een...

Kostenpost — *(IT dient tegen zo laag mogelijke kosten beschikbaar te zijn)* — Waardecreator — *(IT is vitaal voor het bedrijf en dient zo veel mogelijk toegevoegde waarde te leveren)*

<<< <<< <<< ● >>> >>> >>>

21. De bedrijfsvoering/business beschouwde IT-infrastructuur als een...

Kostenpost — *(IT dient tegen zo laag mogelijke kosten beschikbaar te zijn)* — Waardecreator — *(IT is vitaal voor het bedrijf en dient zo veel mogelijk toegevoegde waarde te leveren)*

<<< <<< <<< ● >>> >>> >>>

22. De financiële afdeling beschouwde IT-infrastructuur als een...

Kostenpost — *(IT dient tegen zo laag mogelijke kosten beschikbaar te zijn)* — Waardecreator — *(IT is vitaal voor het bedrijf en dient zo veel mogelijk toegevoegde waarde te leveren)*

<<< <<< <<< ● >>> >>> >>>

23. Het executive / Top management beschouwde de applicaties / IT-toepassingen als een...

Kostenpost — *(IT dient tegen zo laag mogelijke kosten beschikbaar te zijn)* — Waardecreator — *(IT is vitaal voor het bedrijf en dient zo veel mogelijk toegevoegde waarde te leveren)*

<<< <<< <<< ● >>> >>> >>>

24. Het midden management beschouwde de applicaties / IT-toepassingen als een...

Kostenpost — *(IT dient tegen zo laag mogelijke kosten beschikbaar te zijn)* — Waardecreator — *(IT is vitaal voor het bedrijf en dient zo veel mogelijk toegevoegde waarde te leveren)*

<<< <<< <<< ● >>> >>> >>>

25. De bedrijfsvoering/business beschouwde de applicaties / IT-toepassingen als een...

Kostenpost — *(IT dient tegen zo laag mogelijke kosten beschikbaar te zijn)* — Waardecreator — *(IT is vitaal voor het bedrijf en dient zo veel mogelijk toegevoegde waarde te leveren)*

<<< <<< <<< ● >>> >>> >>>

26. De financiële afdeling beschouwde de applicaties / IT-toepassingen als een...

Kostenpost — *(IT dient tegen zo laag mogelijke kosten beschikbaar te zijn)* — Waardecreator — *(IT is vitaal voor het bedrijf en dient zo veel mogelijk toegevoegde waarde te leveren)*

<<< <<< <<< ● >>> >>> >>>

27. Het IT complexiteitsverlagingsinitiatief / -project werd....

27a. actief gesteund door het executive / top management.

☐ Ja ☐ Nee ☐ Dat weet ik niet

27b. actief gesteund door het midden management.

☐ Ja ☐ Nee ☐ Dat weet ik niet

27c. actief gesteund door de 'werkvloer'.

☐ Ja ☐ Nee ☐ Dat weet ik niet

28. Was er een sponsor- of stuurgroep voor het IT complexiteitsverlagingsintiatief / -project?

☐ Ja ☐ Nee ☐ Dat weet ik niet

29. Tijdens de looptijd van het IT complexiteitsverlagingsinitiatief / -project...

29a. handelde het executive / top management in lijn met de missie en doelstellingen van de organisatie.

☐ Ja ☐ Nee ☐ Dat weet ik niet

29b. waren de doelstellingen en acties van het initiatief/project afgestemd met het executive / top management.

☐ Ja ☐ Nee ☐ Dat weet ik niet

29c. bewaakte het executive / top management tijdige realisatie van de doelstelling van het IT complexiteitsverlagingsinitiatief / -project

☐ Ja ☐ Nee ☐ Dat weet ik niet

29d. informeerde de projectleider het executive / top management met enige regelmaat.

☐ Ja ☐ Nee ☐ Dat weet ik niet

29e. nam het executive / top management besluiten en acties op het moment dat dat nodig was.

☐ Ja ☐ Nee ☐ Dat weet ik niet

30. Tijdens de looptijd van het IT complexiteitsverlagingsinitiatief / -project...

30a. handelde het midden management in lijn met de missie en doelstellingen van de organisatie.

☐ Ja ☐ Nee ☐ Dat weet ik niet

30b. waren de doelstellingen en acties afgestemd van het initiatief/project met het midden management.

☐ Ja ☐ Nee ☐ Dat weet ik niet

30c. informeerde de projectleider het midden management met enige regelmaat.

☐ Ja ☐ Nee ☐ Dat weet ik niet

30d. zorgde het midden management voor tijdige realisatie van de doelstelling van het IT complexiteitsverlagingsinitiatief / -project.

☐ Ja ☐ Nee ☐ Dat weet ik niet

31. Tijdens de looptijd van het IT complexiteitsverlagingsinitiatief / -project...

31a. handelde de bedrijfsvoering / business in lijn met de missie en doelstellingen van de organisatie.

☐ Ja ☐ Nee ☐ Dat weet ik niet

31b. waren de doelstellingen en acties van het initiatief/project afgestemd met de bedrijfsvoering / business.

☐ Ja ☐ Nee ☐ Dat weet ik niet

31c. informeerde de projectleider de bedrijfsvoering / business met enige regelmaat.
☐ Ja ☐ Nee ☐ Dat weet ik niet

31d. zorgde de bedrijfsvoering / business voor tijdige realisatie van de doelstelling van het IT complexiteitsverlagingsinitiatief / -project.
☐ Ja ☐ Nee ☐ Dat weet ik niet

32. Tijdens de looptijd van het IT complexiteitsverlagingsinitiatief / -project...

32a. handelde de financiële afdeling in lijn met de missie en doelstellingen van de organisatie.
☐ Ja ☐ Nee ☐ Dat weet ik niet

32b. waren de doelstellingen en acties van het initiatief/project afgestemd met de financiële afdeling.
☐ Ja ☐ Nee ☐ Dat weet ik niet

32c. informeerde de projectleider de financiële afdeling met enige regelmaat.
☐ Ja ☐ Nee ☐ Dat weet ik niet

32d. zorgde de financiële afdeling voor tijdige realisatie van de doelstelling van het IT complexiteitsverlagingsinitiatief / -project.
☐ Ja ☐ Nee ☐ Dat weet ik niet

33. Tijdens de looptijd van het IT complexiteitsverlagingsinitiatief / -project...

33a. handelde de IT afdeling in lijn met de missie en doelstellingen van de organisatie.
☐ Ja ☐ Nee ☐ Dat weet ik niet

33b. waren de doelstellingen en acties van het initiatief/project afgestemd met de IT afdeling.
☐ Ja ☐ Nee ☐ Dat weet ik niet

33c. informeerde de projectleider de IT afdeling met enige regelmaat.
☐ Ja ☐ Nee ☐ Dat weet ik niet

33d. zorgde de IT afdeling voor tijdige realisatie van de doelstelling van het IT complexiteitsverlagingsinitiatief / -project.
☐ Ja ☐ Nee ☐ Dat weet ik niet

34. Het team van het complexiteitsverlagingsinitiatief /-project...

34a. was dedicated en dus voor meer dan 80% van de tijd beschikbaar voor het initiatief / project.
☐ Ja ☐ Nee ☐ Dat weet ik niet

34b. was bekend met de visie en missie van de organisatie.
☐ Ja ☐ Nee ☐ Dat weet ik niet

34c. was bekend met de doelstellingen van het project / initiatief
☐ Ja ☐ Nee ☐ Dat weet ik niet

34d. was gemotiveerd en betrokken bij doelstellingen van het initiatief / project.
☐ Ja ☐ Nee ☐ Dat weet ik niet

34e. ervaarde arbeidsvreugde.
☐ Ja ☐ Nee ☐ Dat weet ik niet

34f. was divers van samenstelling (persoonlijkheden, vakgebied, etc.)
☐ Ja ☐ Nee ☐ Dat weet ik niet

34g. was bekend met de bedrijfsprocessen.
☐ Ja ☐ Nee ☐ Dat weet ik niet

34h. was bekend met de IT processen.
☐ Ja ☐ Nee ☐ Dat weet ik niet

34i. was deskundig en ervaren op hun vakgebieden.
☐ Ja ☐ Nee ☐ Dat weet ik niet

34j. heeft persoonlijke groei ervaren.
☐ Ja ☐ Nee ☐ Dat weet ik niet

34k. wist welke aspecten / factoren belangrijk waren voor bereiken van de doelstellingen.
☐ Ja ☐ Nee ☐ Dat weet ik niet

34l. werkte goed samen met de medewerkers van de rest van de organisatie.
☐ Ja ☐ Nee ☐ Dat weet ik niet

35. Heeft een externe (ingehuurde) partij ondersteuning geleverd bij het complexiteitsverlagingsinitiatief / -project?
☐ Ja ☐ Nee ☐ Dat weet ik niet

36. Met welke reden was de externe partij bij het complexiteitsverlagingsinitiatief / -project betrokken?(Een combinatie is mogelijk)
☐ Als leverancier van een werkwijze en/of methodiek ☐ Als leverancier van capaciteit
☐ Als leverancier van deskundigheid en/of kennis ☐ Ik weet het niet
☐ Andere (geef nadere toelichting): _____

37. Heeft de externe partij aan de verwachting voldaan en/of de afgesproken prestatie geleverd?
☐ Ja ☐ Nee ☐ Dat weet ik niet

38. Tijdens de looptijd van het complexiteitsverlagingsinitiatief / -project....
38a. sloot de visie en het beleid van de IT aan op de visie en het beleid van de organisatie.
☐ Ja ☐ Nee ☐ Dat weet ik niet

38b. was de doelstelling van het intitiatief / project in overeenstemming met de IT strategie en IT architectuur.
☐ Ja ☐ Nee ☐ Dat weet ik niet

38c. was er een (informatie-)architectuur die richting gaf aan de realisatie van nieuwe IT (applicaties en infrastructuur).
☐ Ja ☐ Nee ☐ Dat weet ik niet

38d. was er een (informatie-)architectuur die richting gaf aan het onderhoud van bestaande IT (applicaties en infrastructuur).
☐ Ja ☐ Nee ☐ Dat weet ik niet

38e. werkte de organisatie "onder architectuur".
☐ Ja ☐ Nee ☐ Dat weet ik niet

38f. zijn (enterprise) architecten actief betrokken bij het initiatief / project.
☐ Ja ☐ Nee ☐ Dat weet ik niet

38g. zijn (enterprise) architecten actief betrokken binnen de organisatie.
☐ Ja ☐ Nee ☐ Dat weet ik niet

Stellingen

39. Graag uw antwoord op onderstaande stellingen...

39a. IT Complexiteit verlaagt de wendbaarheid (agility).

☐ Mee eens ☐ Neutraal ☐ Oneens ☐ Weet ik niet

39b. IT Complexiteit verhoogt onderhoudskosten van de IT.

☐ Mee eens ☐ Neutraal ☐ Oneens ☐ Weet ik niet

39c. IT Complexiteit verlaagt de continuïteit van de IT.

☐ Mee eens ☐ Neutraal ☐ Oneens ☐ Weet ik niet

39d. Digitaliseren van (bedrijfs)processen verlaagt IT Complexiteit.

☐ Mee eens ☐ Neutraal ☐ Oneens ☐ Weet ik niet

39e. Standaardiseren van (bedrijfs)processen verlaagt IT Complexiteit.

☐ Mee eens ☐ Neutraal ☐ Oneens ☐ Weet ik niet

39f. Standaardiseren van IT infrastructuur(componenten) verlaagt IT Complexiteit.

☐ Mee eens ☐ Neutraal ☐ Oneens ☐ Weet ik niet

39g. Rationalisatie verlaagt IT Complexiteit.

☐ Mee eens ☐ Neutraal ☐ Oneens ☐ Weet ik niet

39h. Implementatie van een ERP Systeem verlaagt IT Complexiteit.

☐ Mee eens ☐ Neutraal ☐ Oneens ☐ Weet ik niet

39i. Migratie naar een Cloud-oplossing verlaagt IT Complexiteit.

☐ Mee eens ☐ Neutraal ☐ Oneens ☐ Weet ik niet

39j. Makkelijk configureerbare IT-oplossingen / IT-systemen voorkomt IT Complexiteit.

☐ Mee eens ☐ Neutraal ☐ Oneens ☐ Weet ik niet

39k. Werken onder architectuur voorkomt IT Complexiteit.

☐ Mee eens ☐ Neutraal ☐ Oneens ☐ Weet ik niet

39l Gestandaardiseerde IT die beschikbaar is voor de hele organisatie, is een vereiste voor het verlagen van IT Complexiteit.

☐ Mee eens ☐ Neutraal ☐ Oneens ☐ Weet ik niet

39m. Een gecentraliseerde IT-organisatie is een vereiste voor het verlagen van IT Complexiteit.

☐ Mee eens ☐ Neutraal ☐ Oneens ☐ Weet ik niet

Hartelijk bedankt voor uw participatie!

Ik wil u bedanken voor uw tijd en de antwoorden die u gegeven heeft. De komende periode zal ik uw antwoorden anoniem verwerken.
Eventuele vragen en/of opmerkingen over dit onderzoek hoor ik graag. U kunt mij benaderen via a.jutte@umail.leidenuniv.nl.

40. Wilt u de resultaten van dit onderzoek ontvangen?

☐ Nee ☐ Ja(mijn e-mail adres is:)_____

Appendix E: Survey questions linked to constructs

Question	Background Information	Relevancy	Approach success	Governance factors	Organizational Factors:	Execution factors	Mitigation Methods	Statements	
Q1 Wat is uw huidige rol in uw organisatie	✓								
Q2 Bent u direct of indirect betrokken geweest bij een initiatief of een project dat verlaging van IT complexiteit tot doel had?		✓							
Q3 Wat was uw rol in relatie tot het IT complexiteitsverlagingsinitiatief / -project?	✓								
Q4 Wat was de omvang van de organisatie?					✓				
Q5 Waar, hiërarchisch gezien, is het IT complexiteitsverlagingsintitiatief / -project gestart?					✓				
Q6 Waar, organisatorisch gezien, is het IT complexiteitsverlagingsintitiatief / -project gestart?(Een combinatie is mogelijk)					✓				
Q7 Had uw organisatie een concrete business case voor het IT complexiteitsverlagingsinitiatief / -project?						✓			
Q8 Wat was de doelstelling van de complexiteitsverlagingsinitiatief / -project?			✓						
Q9 Het complexiteitsverlagingsinitiatief / -project is volgens een vooraf vastgestelde (project)methodiek uitgevoerd.						✓			
Q10 Voor het IT complexiteitsverlagingsinitiatief had uw organisatie een Complex IT Landschap of Simpel IT landschap		✓							
Q11 De mate van complexiteit van IT Landschap was, hiërarchisch gezien, onderkend door....									
a executive Top management					✓				
b midden management					✓				
c werkvloer					✓				
Q12 De mate van complexiteit van IT Landschap was, organisatorisch gezien, onderkend door....									
a bedrijfsvoering / business					✓				
b beleid en architectuur					✓				
c financiele afdeling					✓				
d IT afdeling					✓				
Q13 Het IT complexiteitsverlagingsinitiatief / -project is geëindigd...			✓						
Q14 Wat was de reden waarom het IT complexiteitsverlagingsinitiatief / -project voortijdig is stopgezet?			✓						
Q15 Het IT complexiteitsverlagingsinitiatief / -project is geëindigd....			✓						
Q16 Welke van onderstaande elementen zijn gerealiseerd door het IT complexiteitsverlagingsinitiatief / -project?			✓						
Q17 Heeft het project/initiatief één of meerdere van onderstaande methodes geïmplementeerd en/of gebruikt?								✓	
Q18 Gedurende het IT complexiteitsverlagingsinitiatief / -project had uw organisatie een...					✓				
Q19 Het executive / Top management beschouwde IT-infrastructuur als een...					✓				
Q20 Het midden management beschouwde IT-infrastructuur als een...					✓				
Q21 De bedrijfsvoering/business beschouwde IT-infrastructuur als een...					✓				
Q22 De financiële afdeling beschouwde IT-infrastructuur als een...					✓				
Q23 Het executive / Top management beschouwde de applicaties / IT-toepassingen als een...					✓				
Q24 Het midden management beschouwde de applicaties / IT-toepassingen als een...					✓				
Q25 De bedrijfsvoering/business beschouwde de applicaties / IT-toepassingen als een...					✓				
Q26 De financiële afdeling beschouwde de applicaties / IT-toepassingen als een...					✓				
Q27 Het IT complexiteitsverlagingsinitiatief / -project werd....									
a Actief gesteund door het executive top management				✓					
b Actief gesteund door het midden management				✓					
c actief gesteund door de werkvloer				✓					
Q28 Was er een sponsor- of stuurgroep voor het IT complexiteitsverlagingsintiatief / -project?						✓			
Q29 Tijdens de looptijd van het IT complexiteitsverlagingsinitiatief / -project...									
a handelde het executive / top management in lijn met de missie en doelstelling van de organisatie				✓					
b waren de doelstellingen en acties van het initiatief/project afgestemd met het executive/top management						✓			
c bewaakte het executive / top management tijdige realisatie van de doelstelling van het initiatief / project						✓			
d informeerde de projectleider het executive top management met enige regelmaat						✓			
e nam het executive / top management besluiten en acties op het moment dat dat nodig was.						✓			
Q30 Tijdens de looptijd van het IT complexiteitsverlagingsinitiatief / -project...									
a handelde het midden management in lijn met de missie en doelstellingen van de organisatie.				✓					
b waren de doelstellingen en acties afgestemd van het initiatief/project met het midden management.						✓			
c informeerde de projectleider het midden management met enige regelmaat.						✓			
d zorgde het midden management voor tijdige realisatie van de doelstellingen						✓			
Q31 Tijdens de looptijd van het IT complexiteitsverlagingsinitiatief / -project...									
a handelde de bedrijfsvoering / business in lijn met de missie en doelstellingen van de organisatie.				✓					
b waren de doelstellingen en acties van het initiatief/project afgestemd met de bedrijfsvoering / business.						✓			
c informeerde de projectleider de bedrijfsvoering / business met enige regelmaat.						✓			
d zorgde de bedrijfsvoering / business voor tijdige realisatie van de doelstelling						✓			
Q32 Tijdens de looptijd van het IT complexiteitsverlagingsinitiatief / -project...									
a handelde de financiële afdeling in lijn met de missie en doelstellingen van de organisatie.				✓					
b waren de doelstellingen en acties van het initiatief/project afgestemd met de financiële afdeling.						✓			
c informeerde de projectleider de financiële afdeling met enige regelmaat.						✓			
d zorgde de financiële afdeling voor tijdige realisatie van de doelstelling						✓			
Q33 Tijdens de looptijd van het IT complexiteitsverlagingsinitiatief / -project...									
a handelde de IT afdeling in lijn met de missie en doelstellingen van de organisatie.				✓					
b waren de doelstellingen en acties van het initiatief/project afgestemd met de IT afdeling.						✓			
c informeerde de projectleider de IT afdeling met enige regelmaat.						✓			
d zorgde de IT afdeling voor tijdige realisatie van de doelstelling van het IT complexiteitsverlagingsinitiatief / -project.						✓			
Q34 Het team van het complexiteitsverlagingsinitiatief /-project...									
a was dedicated en dus voor meer dan 80% van de tijd beschikbaar voor het initiatief / project.						✓			
b was bekend met de visie en missie van de organisatie.						✓			
c was bekend met de doelstellingen van het project / initiatief						✓			
d was gemotiveerd en betrokken bij doelstellingen van het initiatief / project.						✓			
e ervaarde arbeidsvreugde.						✓			
f was divers van samenstelling (persoonlijkheden, vakgebied, etc.)						✓			
g was bekend met de bedrijfsprocessen.						✓			
h was bekend met de IT processen.						✓			
i was deskundig en ervaren op hun vakgebieden.						✓			
j heeft persoonlijke groei ervaren.						✓			
k wist welke aspecten / factoren belangrijk waren voor bereiken van de doelstellingen.						✓			
l werkte goed samen met de medewerkers van de rest van de organisatie.						✓			
Q35 Heeft een externe (ingehuurde) partij ondersteuning geleverd bij het complexiteitsverlagingsinitiatief / -project?						✓			
Q36 Met welke reden was de externe partij bij het complexiteitsverlagingsinitiatief / -project betrokken?						✓			
Q37 Heeft de externe partij aan de verwachting voldaan en/of de afgesproken prestatie geleverd?						✓			
Q38 Tijdens de looptijd van het complexiteitsverlagingsinitiatief / -project....									
a sloot de visie en het beleid van de IT aan op de visie en het beleid van de organisatie.				✓					
b was de doelstelling van het intitiatief / project in overeenstemming met de IT strategie en IT architectuur.				✓					
c was er een (informatie-)architectuur die richting gaf aan de realisatie van nieuwe IT (applicaties en infrastructuur).				✓					
d was er een (informatie-)architectuur die richting gaf aan het onderhoud van bestaande IT (applicaties en infrastructuur).				✓					
e werkte de organisatie "onder architectuur".				✓					
f zijn (enterprise) architecten actief betrokken bij het initiatief / project.				✓					
g zijn (enterprise) architecten actief betrokken binnen de organisatie.				✓					
Q39 Graag uw antwoord op onderstaande stellingen...									
a IT Complexiteit verlaagt de wendbaarheid (agility).									✓
b IT Complexiteit verhoogt onderhoudskosten van de IT.									✓
c IT Complexiteit verlaagt de continuïteit van de IT.									✓
d Digitaliseren van (bedrijfs)processen verlaagt IT Complexiteit.									✓
e Standaardiseren van (bedrijfs)processen verlaagt IT Complexiteit.									✓
f Standaardiseren van IT infrastructuur(componenten) verlaagt IT Complexiteit.									✓
g Rationalisatie verlaagt IT Complexiteit.									✓
h Implementatie van een ERP Systeem verlaagt IT Complexiteit.									✓
i Migratie naar een Cloud-oplossing verlaagt IT Complexiteit.									✓
j Makkelijk configureerbare IT-oplossingen / IT-systemen voorkomt IT Complexiteit.									✓
k Werken onder architectuur voorkomt IT Complexiteit.									✓
l Gestandaardiseerde IT die beschikbaar is voor de hele organisatie, is een vereiste voor het verlagen van IT Complexiteit.									✓
m Een gecentraliseerde IT-organisatie is een vereiste voor het verlagen van IT Complexiteit.									✓

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Appendix F: Survey Coding

Header		Response option		Codification
respondent_id		Automatically generated		No Codification
date_created		Automatically generated		No Codification
date_modified		Automatically generated		No Codification
Q1	Wat is uw huidige rol in uw organisatie	Chief Data Officer		1
		Chief Executive Officer		2
		Chief Financial Officer		3
		Chief Information officer		4
		Chief Operating Officer		5
		(Senior) Business Manager		6
		(Senior) Data Manager		7
		(Senior) Financial Manager		8
		(Senior) IT Manager		9
		Programma Manager / projectleider		10
		(Project) teamlid		11
		Adviseur		12
		Consultant		13
		Anders, namelijk:		14
		namelijk:		No Codification
Q2	Bent u direct of indirect betrokken geweest bij een initiatief of een project dat verlaging van IT complexiteit tot doel had?	Ja		1
		Nee		0
Q3	Wat was uw rol in relatie tot het IT complexiteitsverlagingsinitiatief / -project?	(Lid) Sponsorgroep / (Lid) Stuurgroep		1
		Programmamanager / Projectleider		2
		Teamlid		3
		Adviseur		4
		Anders, namelijk:		5
Q4	Wat was de omvang van de organisatie?	1-10 medewerkers		1
		11-250 medewerkers		2
		251-1000 medewerkers		3
		1.001-10.000 medewerkers		4
		> 10.000 medewerkers		5
Q5	Waar, hiërarchisch gezien, is het IT complexiteitsverlagingsinitiatief / -project gestart?	executive / top management		3
		midden management		2
		werkvloer		1
Q6	Waar, organisatorisch gezien, is het IT complexiteitsverlagingsinitiatief / -project gestart?(Een combinatie is mogelijk)	bedrijfsvoering / business	Checked	1
			Not Checked	0
		beleid en architectuur	Checked	1
			Not Checked	0
		financiële afdeling	Checked	1
			Not Checked	0
		IT Afdeling	Checked	1
			Not Checked	0
		Andere (geef nadere toelichting)	Checked	No Codification
			Not Checked	0
Q7	Had uw organisatie een concrete business case voor het IT complexiteitsverlagingsinitiatief / -project?	Response	Ja	1
			Nee	0
			Weet ik niet	-
Q8	Wat was de doelstelling van de complexiteitsverlagingsinitiatief / -project?(Een combinatie is mogelijk)	Verlagen van de kosten	Checked	1
			Not Checked	0
		Verbeteren van de van de service naar de klanten	Checked	1
			Not Checked	0
		Verbeteren van de continuïteit van de IT en/of beveiliging van de	Checked	1
			Not Checked	0
		Verbeteren van de informatiepositie	Checked	1
			Not Checked	0
		Verlagen van de complexiteit van de IT en/of meer standaardisatie in	Checked	1
			Not Checked	0
		Voldoen aan wet- en regelgeving	Checked	1
			Not Checked	0
Q9	Het complexiteitsverlagingsinitiatief / -project is volgens een vooraf vastgestelde (project)methodiek uitgevoerd. Hierbij kunt u denken aan Prince2, PMBok, MSP, etcetera.	Ja		1
		Namelijk		No codification
		Nee		0
		Weet ik niet		-
Q10	Voor het IT complexiteitsverlagingsinitiatief / -project had uw organisatie een....	Simpel <<●>>Complexiteit landschap		Decimal value
Q11a	De mate van complexiteit van IT Landschap was, hiërarchisch gezien, onderkend door....	executive / top management	Eens	1
			Oneens	0
			Weet ik niet	-
Q11b	De mate van complexiteit van IT Landschap was, hiërarchisch gezien, onderkend door....	midden management	Eens	1
			Oneens	0
			Weet ik niet	-

Header		Response option		Codification
Q17	Heeft het project/initiatief één of meerdere van onderstaande methodes geïmplementeerd en/of gebruikt om IT complexiteit te verlagen? (Een combinatie is mogelijk)	Implementatie van Portfolio Management (bijv oorbeeld IT	Checked	1
			Not Checked	0
		Service Oriented Architecture / Service Georiënteerde Architectuur	Checked	1
			Not Checked	0
		Cloud Migratie / Cloud Migratie Strategie	Checked	1
			Not Checked	0
		Implementatie van een ERP systeem	Checked	1
			Not Checked	0
		Implementatie van een Agile-Methodiek (Scrum, KanBan,	Checked	1
			Not Checked	0
		We hebben zelf een methode ontwikkeld en gebruikt	Checked	1
			Not Checked	0
		Er is geen methode gebruikt	Checked	1
			Not Checked	0
		Andere (geef nadere toelichting)	Checked	1
			Not Checked	0
			Toelichting	No codification
Q18	Gedurende het IT complexiteitsverlagingsinitiatief / -project had uw organisatie een...	gecentraliseerde IT-organisatie		1
		combinatie		0
		geDEcentraliseerde IT-organisatie		-1
Q19	Het executive / Top management beschouwde IT-infrastructuur als een...	No input given		-
		Kostenpost <<●>> Waardecreator		Decimal value
Q20	Het midden management beschouwde IT-infrastructuur als een...	No input given		-
		Kostenpost <<●>> Waardecreator		Decimal value
Q21	De bedrijfsvoering/business beschouwde IT-infrastructuur als een...	No input given		-
		Kostenpost <<●>> Waardecreator		Decimal value
Q22	De financiële afdeling beschouwde IT-infrastructuur als een...	No input given		-
		Kostenpost <<●>> Waardecreator		Decimal value
Q23	Het executive / Top management beschouwde de applicaties / IT-toepassingen als een...	No input given		-
		Kostenpost <<●>> Waardecreator		Decimal value
Q24	Het midden management beschouwde de applicaties / IT-toepassingen als een...	No input given		-
		Kostenpost <<●>> Waardecreator		Decimal value
Q25	De bedrijfsvoering/business beschouwde de applicaties / IT-toepassingen als een...	No input given		-
		Kostenpost <<●>> Waardecreator		Decimal value
Q26	De financiële afdeling beschouwde de applicaties / IT-toepassingen als een...	No input given		-
		Kostenpost <<●>> Waardecreator		Decimal value
Q27a	Het IT complexiteitsverlagingsinitiatief / -project werd actief gesteund door het executive / top management.	Ja		1
		Nee		0
		Weet ik niet		-
Q27b	Het IT complexiteitsverlagingsinitiatief / -project werd actief gesteund door het midden management.	Ja		1
		Nee		0
		Weet ik niet		-
Q27c	Het IT complexiteitsverlagingsinitiatief / -project werd actief gesteund door de 'werkvloer'.	Ja		1
		Nee		0
		Weet ik niet		-
Q28	Was er een sponsor- of stuurgroep voor het IT complexiteitsverlagingsintiatief / -project?	Ja		1
		Nee		0
		Weet ik niet		-
Q29a	Tijdens de looptijd van het IT complexiteitsverlagingsinitiatief / -project handelde het executive / top management in lijn met de missie en doelstellingen van de organisatie.	Ja		1
		Nee		0
		Weet ik niet		-
Q29b	Tijdens de looptijd van het IT complexiteitsverlagingsinitiatief / -project waren de doelstellingen en acties van het initiatief/project afgestemd met het executive / top management.	Ja		1
		Nee		0
		Weet ik niet		-
Q29c	Tijdens de looptijd van het IT complexiteitsverlagingsinitiatief / -project bewaakte het executive / top management tijdige realisatie van de doelstelling van het IT	Ja		1
		Nee		0
		Weet ik niet		-
Q29d	Tijdens de looptijd van het IT complexiteitsverlagingsinitiatief / -project informeerde de projectleider het executive / top management met enige regelmaat.	Ja		1
		Nee		0
		Weet ik niet		-
Q29e	Tijdens de looptijd van het IT complexiteitsverlagingsinitiatief / -project nam het executive / top management besluiten en acties op het moment dat dat nodig was.	Ja		1
		Nee		0
		Weet ik niet		-
Q30a	Tijdens de looptijd van het IT complexiteitsverlagingsinitiatief / -project handelde het midden management in lijn met de missie en doelstellingen van de organisatie.	Ja		1
		Nee		0
		Weet ik niet		-
Q30b	Tijdens de looptijd van het IT	Ja		1
		Nee		0
		Weet ik niet		-

Header		Response option		Codification
Q34d	Het team van het complexiteitsverlagingsinitiatief / -project was gemotiveerd en betrokken bij doelstellingen van het initiatief / project.	Ja		1
		Nee		0
		Weet ik niet		-
Q34e	Het team van het complexiteitsverlagingsinitiatief / -project ervaarde arbeidsvreugde.	Ja		1
		Nee		0
		Weet ik niet		-
Q34f	Het team van het complexiteitsverlagingsinitiatief / -project was divers van samenstelling (persoonlijkheden, vakgebied, etc.)	Ja		1
		Nee		0
		Weet ik niet		-
Q34g	Het team van het complexiteitsverlagingsinitiatief / -project was bekend met de bedrijfsprocessen.	Ja		1
		Nee		0
		Weet ik niet		-
Q34h	Het team van het complexiteitsverlagingsinitiatief / -project was bekend met de IT processen.	Ja		1
		Nee		0
		Weet ik niet		-
Q34i	Het team van het complexiteitsverlagingsinitiatief / -project was deskundig en ervaren op hun vakgebieden.	Ja		1
		Nee		0
		Weet ik niet		-
Q34j	Het team van het complexiteitsverlagingsinitiatief / -project heeft persoonlijke groei ervaren.	Ja		1
		Nee		0
		Weet ik niet		-
Q34K	Het team van het complexiteitsverlagingsinitiatief / -project wist welke aspecten / factoren belangrijk waren voor bereiken van de doelstellingen.	Ja		1
		Nee		0
		Weet ik niet		-
Q34l	Het team van het complexiteitsverlagingsinitiatief / -project werkte goed samen met de medewerkers van de rest van de organisatie.	Ja		1
		Nee		0
		Weet ik niet		-
Q35	Heeft een externe (ingehuurde) partij ondersteuning geleverd bij het complexiteitsverlagingsinitiatief / -project?	Ja		1
		Nee		0
		Weet ik niet		-
Q36	Met welke reden was de externe partij bij het complexiteitsverlagingsinitiatief / -project betrokken?(Een combinatie is mogelijk)	Als leverancier van capaciteit	Checked	1
			Not Checked	0
		Als leverancier van een werkwijze en/of methodiek	Checked	1
			Not Checked	0
		Als leverancier van deskundigheid en/of kennis	Checked	1
			Not Checked	0
		Ik weet het niet	Checked	1
			Not Checked	0
		Andere (geef nadere toelichting)	Checked	1
			Not Checked	0
			Toelichting	No codification
Q37	Heeft de externe partij aan de verwachting voldaan en/of de afgesproken prestatie geleverd?	Ja		1
		Nee		0
		Weet ik niet		-
Q38a	Tijdens de looptijd van het complexiteitsverlagingsinitiatief / -project sloot de visie en het beleid van de IT aan op de visie en het beleid van de organisatie.	Ja		1
		Nee		0
		Weet ik niet		-
Q38b	Tijdens de looptijd van het complexiteitsverlagingsinitiatief / -project was de doelstelling van het initiatief / project in overeenstemming met de IT strategie en IT architectuur	Ja		1
		Nee		0
		Weet ik niet		-
Q38c	Tijdens de looptijd van het complexiteitsverlagingsinitiatief / -project was er een (informatie-)architectuur die richting gaf aan de realisatie van nieuwe IT (applicaties en infrastructuur).	Ja		1
		Nee		0
		Weet ik niet		-
Q38d	Tijdens de looptijd van het complexiteitsverlagingsinitiatief / -project was er een (informatie-)architectuur die richting gaf aan het onderhoud van bestaande IT (applicaties en	Ja		1
		Nee		0
		Weet ik niet		-
Q38e	Tijdens de looptijd van het complexiteitsverlagingsinitiatief / -project werkte de organisatie "onder architectuur".	Ja		1
		Nee		0
		Weet ik niet		-
Q38f	Tijdens de looptijd van het complexiteitsverlagingsinitiatief / -project zijn (enterprise) architecten actief betrokken bij het initiatief / project.	Ja		1
		Nee		0
		Weet ik niet		-
Q38g	Tijdens de looptijd van het complexiteitsverlagingsinitiatief / -project zijn (enterprise) architecten actief betrokken binnen de organisatie.	Ja		1
		Nee		0
		Weet ik niet		-
Q39a	Stelling: IT Complexiteit verlaagt de wendbaarheid (agility).	Eens		1
		Neutraal		0
		Oneens		-1
		Weet ik niet		-

Header		Response option		Codification
Q11c	De mate van complexiteit van IT Landschap was, hiërarchisch gezien, onderkend door....	werkv loer	Eens	1
			Oneens	0
			Weet ik niet	-
Q12a	De mate van complexiteit van IT Landschap was, organisatorisch gezien, onderkend door....	bedrijfsv oering / business	Eens	1
			Oneens	0
			Weet ik niet	-
Q12b	De mate van complexiteit van IT Landschap was, organisatorisch gezien, onderkend door....	beleid en architectuur	Eens	1
			Oneens	0
			Weet ik niet	-
Q12c	De mate van complexiteit van IT Landschap was, organisatorisch gezien, onderkend door....	financiële afdeling	Eens	1
			Oneens	0
			Weet ik niet	-
Q12d	De mate van complexiteit van IT Landschap was, organisatorisch gezien, onderkend door....	IT Afdeling	Eens	1
			Oneens	0
			Weet ik niet	-
Q13	Het IT complexiteitsverlagingsinitiatief / -project is geëindigd...	Later dan gepland		0
		Het is v oortijdig stopgezet		0.25
		Op tijd		0.75
		Eerder dan gepland		1
		Het is nog niet geëindigd		-
Q14	Wat was de reden waarom het IT complexiteitsverlagingsinitiatief / -project voortijdig is stopgezet?(Een combinatie is mogelijk)	IF Q13 < > "Het is v oortijdig		[QUESTION_LOGIC_SKIPPED]
		Budgetov erschrijding	Checked	1
			Not Checked	0
		Lev eren v an te lage kwaliteit/resultaat	Checked	1
			Not Checked	0
		Ov erschrijding v an de looptijd/planning	Checked	1
			Not Checked	0
		Anders, namelijk	Checked	1
			Not Checked	0
			Namelijk	No codification
Q15	Het IT complexiteitsverlagingsinitiatief / -project is geëindigd....	IF Q13 = "Het is nog niet geëindigd"		[QUESTION_LOGIC_SKIPPED]
		Bov en budget		0
		Op budget		0.75
		Onder budget		1
		Ik weet het niet		-
Q16	Welke van onderstaande elementen zijn gerealiseerd door het IT complexiteitsverlagingsinitiatief / -project?(Een combinatie is mogelijk)	Verlaagde kosten	Checked	1
			Not Checked	0
		Verbeterde serv ice naar de klanten	Checked	1
			Not Checked	0
		Verbeterde continuïteit v an de IT en/of bev eiliging v an de informatie	Checked	1
			Not Checked	0
		Verbeterde informatiepositie	Checked	1
			Not Checked	0
		Verlaagde complexiteit v an de IT en/of v erhoogde standaardisatie in	Checked	1
			Not Checked	0
		Voldaan aan wet- en regelgev ing	Checked	1
			Not Checked	0
		Er is niets gerealiseerd	Checked	1
			Not Checked	0
		Anders (geef nadere toelichting)	Checked	1
			Not Checked	0
			Toelichting	No codification

Header		Response option	Codification
Q30c	Tijdens de looptijd van het IT complexiteitsverlagingsinitiatief / -project informeerde de projectleider het midden management met enige regelmat	Ja	1
		Nee	0
		Weet ik niet	-
Q30d	Tijdens de looptijd van het IT complexiteitsverlagingsinitiatief / -project zorgde het midden management voor tijdige realisatie van de doelstelling van het IT complexiteitsverlagingsinitiatief /	Ja	1
		Nee	0
		Weet ik niet	-
Q31a	Tijdens de looptijd van het IT complexiteitsverlagingsinitiatief / -project handelde de bedrijfsv oering / business in lijn met de missie en doelstellingen van de organisatie.	Ja	1
		Nee	0
		Weet ik niet	-
Q31b	Tijdens de looptijd van het IT complexiteitsverlagingsinitiatief / -project waren de doelstellingen en acties van het initiatief/project afgestemd met de bedrijfsv oering / business.	Ja	1
		Nee	0
		Weet ik niet	-
Q31c	Tijdens de looptijd van het IT complexiteitsverlagingsinitiatief / -project informeerde de projectleider de bedrijfsv oering / business met enige regelmat	Ja	1
		Nee	0
		Weet ik niet	-
Q31d	Tijdens de looptijd van het IT complexiteitsverlagingsinitiatief / -project zorgde de bedrijfsv oering / business voor tijdige realisatie van de doelstelling van het IT complexiteitsverlagingsinitiatief /	Ja	1
		Nee	0
		Weet ik niet	-
Q32a	Tijdens de looptijd van het IT complexiteitsverlagingsinitiatief / -project handelde de financiële afdeling in lijn met de missie en doelstellingen van de organisatie	Ja	1
		Nee	0
		Weet ik niet	-
Q32b	Tijdens de looptijd van het IT complexiteitsverlagingsinitiatief / -project waren de doelstellingen en acties van het initiatief/project afgestemd met de financiële afdeling	Ja	1
		Nee	0
		Weet ik niet	-
Q32c	Tijdens de looptijd van het IT complexiteitsverlagingsinitiatief / -project informeerde de projectleider de financiële afdeling met enige regelmat	Ja	1
		Nee	0
		Weet ik niet	-
Q32d	Tijdens de looptijd van het IT complexiteitsverlagingsinitiatief / -project zorgde de financiële afdeling voor tijdige realisatie van de doelstelling van het IT complexiteitsverlagingsinitiatief /	Ja	1
		Nee	0
		Weet ik niet	-
Q33a	Tijdens de looptijd van het IT complexiteitsverlagingsinitiatief / -project handelde de IT afdeling in lijn met de missie en doelstellingen van de organisatie.	Ja	1
		Nee	0
		Weet ik niet	-
Q33b	Tijdens de looptijd van het IT complexiteitsverlagingsinitiatief / -project waren de doelstellingen en acties van het initiatief/project afgestemd met de IT afdeling.	Ja	1
		Nee	0
		Weet ik niet	-
Q33c	Tijdens de looptijd van het IT complexiteitsverlagingsinitiatief / -project informeerde de projectleider de IT afdeling met enige regelmaat.	Ja	1
		Nee	0
		Weet ik niet	-
Q33d	Tijdens de looptijd van het IT complexiteitsverlagingsinitiatief / -project zorgde de IT afdeling voor tijdige realisatie van de doelstelling van het IT complexiteitsverlagingsinitiatief / -project	Ja	1
		Nee	0
		Weet ik niet	-
Q34a	Het team van het complexiteitsverlagingsinitiatief /-project was dedicated en dus meer dan 80% van de tijd beschikbaar	Ja	1
		Nee	0
		Weet ik niet	-
Q34b	Het team van het complexiteitsverlagingsinitiatief /-project was bekend met de visie en missie van de organisatie.	Ja	1
		Nee	0
		Weet ik niet	-
Q34c	Het team van het complexiteitsverlagingsinitiatief /-project was bekend met de doelstellingen van het project / initiatief	Ja	1
		Nee	0
		Weet ik niet	-

Header		Response option	Codification
Q39b	Stelling: IT Complexiteit verhoogt onderhoudskosten van de IT.	Eens	1
		Neutraal	0
		Oneens	-1
		Weet ik niet	-
Q39c	Stelling: IT Complexiteit verlaagt de continuïteit van de IT.	Eens	1
		Neutraal	0
		Oneens	-1
		Weet ik niet	-
Q39d	Stelling: Digitaliseren van (bedrijfs)processen verlaagt IT Complexiteit.	Eens	1
		Neutraal	0
		Oneens	-1
		Weet ik niet	-
Q39e	Stelling: Standaardiseren van (bedrijfs)processen verlaagt IT Complexiteit.	Eens	1
		Neutraal	0
		Oneens	-1
		Weet ik niet	-
Q39f	Stelling: Standaardiseren van IT infrastructuur(componenten) verlaagt IT Complexiteit.	Eens	1
		Neutraal	0
		Oneens	-1
		Weet ik niet	-
Q39g	Stelling: Rationalisatie verlaagt IT Complexiteit.	Eens	1
		Neutraal	0
		Oneens	-1
		Weet ik niet	-
Q39h	Stelling: Implementatie van een ERP Systeem verlaagt IT Complexiteit.	Eens	1
		Neutraal	0
		Oneens	-1
		Weet ik niet	-
Q39i	Stelling: Migratie naar een Cloud-oplossing verlaagt IT Complexiteit.	Eens	1
		Neutraal	0
		Oneens	-1
		Weet ik niet	-
Q39j	Stelling: Makkelijk configureerbare IT-oplossingen / IT-systemen voorkomt IT Complexiteit.	Eens	1
		Neutraal	0
		Oneens	-1
		Weet ik niet	-
Q39k	Stelling: Werken onder architectuur voorkomt IT Complexiteit.	Eens	1
		Neutraal	0
		Oneens	-1
		Weet ik niet	-
Q39l	Stelling: Gestandaardiseerde IT die beschikbaar is voor de hele organisatie, is een vereiste voor het verlagen van IT Complexiteit.	Eens	1
		Neutraal	0
		Oneens	-1
		Weet ik niet	-
Q39m	Stelling: Een gecentraliseerde IT-organisatie is een vereiste voor het verlagen van IT Complexiteit.	Eens	1
		Neutraal	0
		Oneens	-1
		Weet ik niet	-
Q40	Wilt u de resultaten van dit onderzoek ontvangen?	Nee	0
		Ja	1
		(mijn e-mail adres is:)	anonymized

Appendix G coded survey results per interviewee

respondent_id	date_created	date_modified	Q1		Q2	Q3		Q4	Q5	Q6					Q7	Q8						Q9		Q10	Q11a	Q11b	Q11c	Q12a	Q12b	Q12c	Q12d	Q13
				Background			Background			bedrijfsvoering / business	beleid en architectuur	financiële afdeling	IT Afdeling	nadere toelichting)		Verlagen van de kosten	Verbeteren van de van de service	Verbeteren van de continuïteit van de	Verbeteren van de informatie-	Verlagen van de complexiteit van	wet- en regelgeving		Namelijk	Complexiteit landschap	top management	midden management	werkvloer	bedrijfsvoering / business	en architect	financiële afdeling	IT Afdeling	Res- ponse
10281220478	2018-10-15 22:39:07	2018-10-15 23:25:01	10		1	2		5	3	0	0	0	1	0	1	1	0	1	0	1	0	1	Prince2 en ms	1	1	0	0	0	1	1	1	0
10285075894	2018-10-17 11:47:34	2018-10-17 12:03:51	12		1	2		5	3	0	1	0	0	0	1	1	1	1	0	1	1	1	prince2	0.8	1	1	1	1	1	1	1	0
10290384301	2018-10-19 11:52:48	2018-10-19 12:04:11	10		1	3		5	3	0	0	0	1	0	0	1	0	0	0	0	0	1	Prince2	0.8	1	1	0	0	1	1	1	0
10290408097	2018-10-19 12:09:53	2018-10-19 12:27:32	11		1	3		5	3	1	0	0	0	0	1	0	1	1	1	1	0	1	Een Defensier	1	1	1	1	1	1	1	1	-
10290441293	2018-10-19 12:31:37	2018-10-19 12:44:44	13		1	4		5	3	1	0	0	0	0	0	0	1	1	1	1	0	0		1	0	-	1	1	-	-	1	0.25
10290527610	2018-10-19 13:20:07	2018-10-19 13:37:54	9		1	1		3	3	1	0	0	1	0	1	1	1	1	1	1	0	1	Prince2/Agile	0.8	0	1	1	1	0	0	1	0
10290528143	2018-10-19 13:20:16	2018-10-19 13:43:07	11		1	3		4	3	0	0	0	1	0	1	1	1	0	1	1	0	1	Agile	0.6	0	1	1	1	1	0	1	0
10290605152	2018-10-19 13:49:08	2018-10-19 14:17:22	10		1	2		5	3	0	0	0	1	0	0	0	0	0	0	1	0	0		0.8	1	1	1	-	1	-	1	-
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Appendix H: Construct validity

Construct validity for governance factors

To determine the construct validity for the governance factors an exploratory factor analysis was conducted using principal component analysis extraction with varimax rotation method. The factor analysis was initially based on 12 items and 83 cases. The next tables show information about the exploratory factor analysis.

KMO, BTS, and communalities for Governance Factors:

Test	Score
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	
KMO score	.672
Bartlett's Test of Sphericity	
Approx. Chi-Square	156.023
Df	66
Sig.	<.001
Communalities	
Range	0.507 - 0.888

Total variance explained for Governance Factors:

Component	Initial Eigenvalues			Extraction sums of squared loadings			Rotation sums of squared loadings		
	Total	% of variance	Cumulative%	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	3.717	30.972	30.972	3.717	30.972	30.972	2.582	21.515	21.515
2	2.733	22.777	53.749	2.733	22.777	53.749	2.271	18.922	40.437
3	1.278	10.650	64.399	1.278	10.650	64.399	2.069	17.241	57.678
4	1.078	8.984	79.573	1.078	8.984	73.384	1.885	15.705	73.384

Extraction Method: Principal Component Analysis

Rotated factor loadings for Governance Factors:

	Component			
Item	**1**	**2**	**3**	**4**
Q38e	.845			
Q38d	.774			
Q38c	.764			*.510*
Q38b	.676		*.499*	
Q38a		.789		
Q33a		.761		
Q30a		.623	*.557*	
Q29a		.593	*.542*	
Q31a			.878	
Q32a			.582	
Q38f				.858
Q38g				.737

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 8 iterations.

Comparison of rotated factor loadings to constructs:

Item	Relating construct	Component			
		1	2	3	4
Q38e	V_ARCHITECTURE	.845			
Q38d	V_ARCHITECTURE	.774			
Q38c	V_ARCHITECTURE	.764			
Q38b	V_ALIGNMENT-VISION	.676		*.499*	
Q38a	V_ALIGNMENT-VISION		.789		
Q33a	V_ACT-VISION		.761		
Q30a	V_ACT-VISION		.623	*.557*	
Q29a	V_ACT-VISION		.593	*.542*	
Q31a	V_ACT-VISION			.878	
Q32a	V_ACT-VISION			.582	
Q38f	V_ARCHITECTS				.858
Q38g	V_ARCHITECTS				.737

Based on the table above it can be concluded the construct validity generally is in order. Questions 33a and 38b delivered some noise as their rotated factor score did not relate to the expected construct

Construct validity for organizational factors

To determine the construct validity for the organizational factors an exploratory factor analysis was conducted using principal component analysis extraction with varimax rotation method. The factor analysis was initially based on 17 items and 44 cases. The next tables show information about the exploratory factor analysis.

KMO, BTS, and communalities for Organizational Factors:

Test	Score
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	
KMO score	.521
Bartlett's Test of Sphericity	
Approx. Chi-Square	436.371
Df	136
Sig.	<.001
Communalities	
Range	0.611 - 0.868

Total variance explained for Organizational Factors:

Com-ponent	Initial Eigenvalues			Extraction sums of squared loadings			Rotation sums of squared loadings		
	Total	% of vari-ance	Cumu-lative%	Total	% of vari-ance	Cumu-lative %	Total	% of vari-ance	Cumu-lative %
1	4.943	29.074	29.074	4.943	29.074	29.074	4.559	26.820	26.820
2	2.731	16.063	45.137	2.731	16.063	45.137	2.275	13.384	40.204
3	1.895	11.146	56.283	1.895	11.146	56.283	1.908	11.225	51.429
4	1.316	7.739	64.022	1.316	7.739	64.022	1.615	9.499	60.928
5	1.205	7.089	71.111	1.205	7.089	71.111	1.481	8.714	69.642
6	1.036	6.097	77.208	1.036	6.097	77.208	1.286	7.566	77.208

Extraction Method: Principal Component Analysis

Rotated factor loadings for Organizational Factors:

Item	Component					
	1	2	3	4	5	6
Q24	.904					
Q23	.857					
Q25	.809					
Q20	.779			*.385*		
Q21	.774				*.361*	
Q19	.737					
Q11a		.883				
Q12b		.837				
Q12c		.637		*.488*		
Q11b			.836			
Q11c			.809			
Q22	*.385*			.786		
Q26	*.600*			.621		
Q18					.885	
Q4		*.366*			.458	
Q12a					.457	
Q12d						.900

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 8 iterations.

Comparison of rotated factor loadings to constructs:

Item	Relating construct	Component					
		1	2	3	4	5	6
Q24	V_VIEW-APPLICATION	.904					
Q23	V_VIEW-APPLICATION	.857					
Q25	V_VIEW-APPLICATION	.809					
Q20	V_VIEW-INFRASTRUCTURE	.779			*.385*		
Q21	V_VIEW-INFRASTRUCTURE	.774				*.361*	
Q19	V_VIEW-INFRASTRUCTURE	.737					
Q11a	V_PERCEIVED-COMPLEXITY		.883				
Q12b	V_PERCEIVED-COMPLEXITY		.837				
Q12c	V_PERCEIVED-COMPLEXITY		.637		*.488*		
Q11b	V_PERCEIVED-COMPLEXITY			.836			
Q11c	V_PERCEIVED-COMPLEXITY			.809			
Q22	V_VIEW-INFRASTRUCTURE	*.385*			.786		
Q26	V_VIEW-APPLICATION	*.600*			.621		
Q18	V_ORGANIZATION-SIZE					.885	
Q4	V_CENTRALIZED-DEPARTMENT		*.366*			.458	
Q12a	V_PERCEIVED-COMPLEXITY					.457	
Q12d	V_PERCEIVED-COMPLEXITY						.900

Construct validity for execution factors

To determine the construct validity for the execution factors an exploratory factor analysis was conducted using principal component analysis extraction with varimax rotation method. The factor analysis was initially based on 37 items. This resulted in a warning in SPSS that "the matrix is not positive definite" and that "the determinant is .000." Therefore SPSS cannot determine KMO and BTS.

Looking at the constructs it was decided to split the validity analysis into three parts. The split is based on execution factors relation to execution and goals (17 items); factors relating to information (5 factors), and factors relating to personnel (15 factors):

Construct	Variable	No. items	Questions
Execution factors – Execution and Goals			
	1. V_EXECUTION-ESSENTIALS	2	Q7, and Q28
	2. V_EXECUTION-METHODOLOGY	1	Q9
	3. V_ALIGNMENT-GOALS	5	Q29b, Q30b, Q31b, Q32b, and Q33b
	4. V_SUPPORT-GOALS	3	Q27a, Q27b, and Q27c
	5. V_REALIZATION-GOALS	6	Q29c, Q29e, Q30d, Q31d, Q32d, and Q33d
	6. V_INFORM	5	Q29d, Q30c, Q31c, Q32c, and Q33c
Execution factors – Information			
	6. V_INFORM	5	Q29d, Q30c, Q31c, Q32c, and Q33c
Execution factors –Personnel			
	7. V_TEAM	12	Q34a, Q34b, Q34c, Q34d, Q34e, Q34f, Q34g, Q34h, Q34i, Q34j, Q34k, and Q34l
	8. V_EXTERNALS-USED	3	Q35, Q36, and Q37

Construct validity for execution and goals related execution factors:

KMO, BTS, and communalities for execution and goals related Execution Factors:

Test	Score
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	
KMO score	.534
Bartlett's Test of Sphericity	
Approx. Chi-Square	273.229
Df	136
Sig.	<.001
Communalities	
Range	0.591 - 0.922

Total variance explained for execution and goal-related Execution Factors:

Com-ponent	Initial Eigenvalues			Extraction sums of squared loadings			Rotation sums of squared loadings		
	Total	% of vari-ance	Cumu-lative%	Total	% of vari-ance	Cumu-lative %	Total	% of vari-ance	Cumu-lative %
1	5.186	30.507	30.507	5.186	30.507	30.507	4.180	24.587	24.587
2	2.532	14.896	45.403	2.532	14.896	45.403	2.467	14.514	39.101
3	1.996	11.741	57.145	1.996	11.741	57.145	2.026	11.918	51.020
4	1.541	9.063	66.208	1.541	9.063	66.208	1.717	10.099	61.119
5	1.140	6.704	72.912	1.140	6.704	72.912	1.692	9.956	71.075
6	1.136	6.684	79.596	1.136	6.684	79.596	1.449	8.521	79.596

Extraction Method: Principal Component Analysis

Rotated Factor loadings for execution and goal-related Execution Factors:

		Component				
Item	**1**	**2**	**3**	**4**	**5**	**6**
Q29e	.826					*.449*
Q30d	.805				*.343*	
Q29c	.776		*.360*			
Q33d	.774					
Q31d	.665				*.475*	
Q27b	.625	*.488*				
Q27a	.395					
Q33b		.726				
Q27c	*.352*	.647				
Q30b	*.609*	.643				
Q32b			.872			
Q32d			.779			
Q7				.857		
Q9		*.368*		796		
Q29b					.890	
Q31b		*.362*	*.403*		.503	*.490*
Q28						.894

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 7 iterations.

Comparison of rotated factor loadings to constructs:

Item	Relating construct	Component					
		1	2	3	4	5	6
Q29e	V_REALIZATION-GOALS	.826					*.449*
Q30d	V_REALIZATION-GOALS	.805				*.343*	
Q29c	V_REALIZATION-GOALS	.776		*.360*			
Q33d	V_REALIZATION-GOALS	.774					
Q31d	V_REALIZATION-GOALS	.665				*.475*	
Q27b	V_SUPPORT-GOALS	.625	*.488*				
Q27a	V_SUPPORT-GOALS	.395					
Q33b	V_ALIGNMENT-GOALS		.726				
Q27c	V_SUPPORT-GOALS	*.352*	.647				
Q30b	V_ALIGNMENT-GOALS	*.609*	.643				
Q32b	V_ALIGNMENT-GOALS			.872			
Q32d	V_REALIZATION-GOALS			.779			
Q7	V_EXECUTION-ESSENTIALS				.857		
Q9	V_EXECUTION-METHODOLOGY		*.368*		796		
Q29b	V_ALIGNMENT-GOALS					.890	
Q31b	V_ALIGNMENT-GOALS		*.362*	*.403*		.503	*.490*
Q28	V_EXECUTION-ESSENTIALS						.894

Construct validity for information related execution factors:

The analysis was started by conducting the Kaiser-Meyer-Olkin measure and Bartlett's Test of Sphericity. For these test to be run successful question Q29d needed to be removed as it invoked the warning: "There are fewer than two cases, at least one of the variables has zero variance, there is only one variable in the analysis, or correlation coefficients could not be computed for all pairs of variables. No further statistics will be computed."

Without Q29d, both tests delivered scores that were sufficient to run the factor analysis. Though it should be noted that the KMO score of .544 is below the recommended value of 0.6, but can be considered as barely acceptable as it is above 0.5 [Kaiser, 1974].

KMO, BTS, and communalities for information related Execution Factors:

Test	Score
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	
KMO score	.544
Bartlett's Test of Sphericity	
Approx. Chi-Square	14.647
Df	6
Sig.	<.023
Communalities	
Range	0.516 - 0.857

Total variance explained for information related Execution Factors:

Component	Initial Eigenvalues			Extraction sums of squared loadings			Rotation sums of squared loadings		
	Total	% of variance	Cumulative%	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	1.596	39.906	39.906	1.596	39.906	39.906	1.578	39.444	39.444
2	1.071	26.772	66.678	1.071	26.772	66.678	1.089	27.234	66.678

Extraction Method: Principal Component Analysis

Rotated factor loadings for information related Execution Factors:

Item	Component 1	Component 2
Q33c	.828	
Q32c	.711	
Q31c	.612	*.482*
Q30c		.919

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 3 iterations.

Comparison of rotated factor loadings to constructs:

Item	Relating construct	Component 1	Component 2
Q33c	V_INFORM (DEP)	.828	
Q32c	V_INFORM (DEP)	.711	
Q31c	V_INFORM (DEP)	.612	*.482*
Q30c	V_INFORM (MNMT)		.919

Construct validity for personnel-related execution factors:

KMO, BTS, and communalities for personnel-related Execution Factors:

Test	Score
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	
KMO score	.706
Bartlett's Test of Sphericity	
Approx. Chi-Square	266.154
Df	78
Sig.	<.001
Communalities	
Range	0.454 - 0.842

Total variance explained for personnel-related Execution Factors:

Component	Initial Eigenvalues			Extraction sums of squared loadings			Rotation sums of squared loadings		
	Total	% of variance	Cumulative%	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	5.499	42.298	42.298	5.499	42.298	42.298	3.449	26.529	26.529
2	1.579	12.144	54.441	1.579	12.144	54.441	3.344	25.720	52.249
3	1.273	9.795	64.236	1.273	9.795	64.236	1.558	11.987	64.236

Extraction Method: Principal Component Analysis

Rotated factor loadings for personnel-related Execution Factors:

Item	Component		
	1	2	3
Q34j	.812	.336	
Q34a	.741		
Q34e	.731	.399	
Q34b	.709	.533	
Q34d	.703	.358	
Q34l	.378		
Q34h		.754	
Q34g		.724	
Q34c	.588	.716	
Q34i		.689	
Q34k	.367	.536	
Q34f		.522	.460
Q35			.657

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 5 iterations

Comparison of rotated factor loadings to constructs:

Item	Relating construct	Component		
		1	2	3
Q34j	V_TEAM	.812	.336	
Q34a	V_TEAM	.741		
Q34e	V_TEAM	.731	.399	
Q34b	V_TEAM	.709	.533	
Q34d	V_TEAM	.703	.358	
Q34l	V_TEAM	.378		
Q34h	V_TEAM		.754	
Q34g	V_TEAM		.724	
Q34c	V_TEAM	.588	.716	
Q34i	V_TEAM		.689	
Q34k	V_TEAM	.367	.536	
Q34f	V_TEAM		.522	.460
Q35	V_EXTERNALS-USED			.657