

Rotterdam School of Management
Erasmus University

Influence of Standardization

**Tracking the influence of business process standardization on
process cycle time, costs and quality**

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Preface

Research topic

In the summer of 2012 Dutch Railways (NS) were audited in a benchmark regarding their finance, Human Resources (HR), purchasing and IT function. The recruitment process is an important process within the HR function. One of the conclusions of the benchmark was that although NS' recruitment process performance was higher than the world class peer group, it was also about four times more expensive. NS' management reaction to this conclusion was rather interesting: apparently unanimously the management team decided that process standardization was the solution to this 'problem'. To cut back process costs one could think of several other solutions, but the immediate choice for standardization triggered my curiosity regarding this subject. Apparently standardization is a universal truth regarding cost reduction in the minds of NS' management. I decided to read more about business process standardization, which led to the subject of my thesis.

Although my interest for this subject was initiated by the HR processes discussed before, the data used for this study are from procurement processes, more specifically order processes. Hence, HR processes are not subject of this study. In chapter 2 I will start with a practical exploration of the purchasing process at NS, before I discuss the theoretical exploration of both standardization and purchasing in the same chapter. However, I cannot start this study without shortly discussing my own background.

Researcher's background

I joined NS in November 2007 as an e-Procurement specialist, working for the procurement department of NS Holding. During the three years I worked there, I developed a fascination for processes and their (mostly hidden) costs. My preference for procurement processes has helped me to choose processes for my empirical research which will be discussed in chapter 3. In 2010 I joined the 'Regie- en Controlorganisatie' (RCO), an HR department at NS which concerns the standardization of HR. One could state that I have an above average affinity with processes, especially regarding procurement and HR processes. The reason for giving this brief background is quite simple: my experience at NS might make me biased because of my work experience and employer relation. It would not be appropriate not to report this in advance.

Acknowledgement

I am both proud of and thankful for the completion of this report. I would like to express special thanks to my coach Prof. Dr. Ir. Jan Dul and my co-reader Prof. Dr. Finn Wynstra. Both their input and frequently tested patience regarding my willfulness have helped me through what I sometimes perceived as tough times. I want to thank Erick Haag for his time and effort in order to come up with the measure for process costs.

Furthermore I would like to thank my father and friend Paul Lucassen for supporting me along the process and helping me with my English. Last but not least I would like to thank Richard de Jong, with whom I became close friends during the past two years. I will probably never forget our epic thesis weekend! He helped me through my study along the way and his pep talks were both needed and very much appreciated. I can only hope that my support was appreciated likewise.

Saturday, 11th of May 2013,

Jean-Paul Lucassen

Duiven, Netherlands

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Executive Summary

As a response to a benchmark in 2012, NS' management imposed cost savings in order to meet the performance of the benchmark's world class peer group. These savings should be realized through process standardization. Business process standardization has therefore been the subject of my master thesis.

The definition of a business process is *a set of logically-related tasks, at least partially executed by humans and performed to achieve a defined business outcome*. Such processes are the objects to standardize. "*Standardization of business processes means defining exactly how a process will be executed regardless of who is performing the process or where it is completed*" (Ross et al.: 2006).

Prior research has focused on process performance. Mostly process performance was an accumulation of process cycle time, process costs and process quality. This study approached these three concepts as separate variables. Another distinguishing element of this study is the fact that 'real' process data was used, whereas prior research used interviews or Likert scale surveys instead. This could therefore be one of the first studies focusing on measured process output data. Theoretical testing was applied to the order process, specifically the order process at Dutch Railways.

Literature shows that process standardization has a positive effect, hence standardization decreases cycle times, decreases costs and increases quality. Three propositions were tested:

H1: A high level of business process standardization is likely to decrease process cycle time.

H2: A high level of business process standardization is likely to decrease process costs.

H3: A high level of business process standardization is likely to increase process quality.

This study found support for all hypotheses.

It is, however, important to note that this study has its limitations, for which generalizability could be limited.

1

Introduction

1.1 Process standardization

This study concerns the standardization of business processes. Business processes consist of tasks which are executed to achieve a certain outcome. Standardizing these processes means that a process is exactly defined regarding how the tasks are executed, regardless by whom or what.

Davenport & Short (1990) defined a business process as "a set of logically-related tasks performed to achieve a defined business outcome". Various variants of this definition have been used in literature, but the general character of the definitions is that a business process is a collection of various tasks that produce an outcome (Bititci & Muir: 1997). The definition which will be used in this study will be: *a set of logically-related tasks, at least partially executed by humans and performed to achieve a defined business outcome*. The human element of this definition has been added because I assume that the people who initiate or influence a process, influence the process outcomes. For example, their experience within the process might have an influence on the outcome.

Although some researchers have complained about the lack of literature regarding standardization (Lyytinen & King: 2006; von Stetten et al.: 2008), I was able to find sufficient theories regarding this study. Münstermann et al. (2010) have stated that "an important management question is how to enhance the performance of a company's business process" and that "one possible level to increase the performance of a given business process is process standardization". De Vries (2006) defines a business standard as "the result of the standardization by a company or other organization for its own needs". Shaw et al. (2007) have defined process standardization as a means to change business processes, which might refer to the management's standardization approach. The definition that will be used in this study is the definition of Ross et al. (2006): "*standardization of business processes means defining exactly how a process will be executed regardless of who is performing the process or where it is completed*". Standardization is linked to automation. Porter (2001) states that "IT has been a force for standardization activities and competitive convergence".

Münstermann et al. (2010) have conducted research on the impact of process standardization on process performance because in "practitioner communities" the proposition has been stated that standardized processes show better process performance. There is some empirical indication that process standardization can lead to an increased readiness to outsource processes (Wüllenweber et al.: 2008). Although outsourcing has been the subject of several articles, it is not part of this study. The reason for this is that I assume that outsourcing does not affect the process on its own; it concerns where a company decides to execute the process which I assume does not affect its performance. Wagner (2006) and Mooney et al. (1996) divide process performance into process cycle time, process costs and process quality. The same distinction was used by Münstermann et al. (2010) in their research.

Several former researchers have used process performance as one dependent variable. I assume, however, that it might be possible that for instance cycle time decreases, but the process costs may not have changed. This may also apply to process quality. Hence I have chosen not to use performance as a dependent variable, but to use cycle time, costs and quality as separate dependent variables. Literature shows that the effect of standardization on the separate variables is positive. Therefore the assumption is that standardization has a positive effect on cycle times, costs and quality. Prior research has not made a distinction in the level of standardization, which would mean that a process is either standardized or not. I assume that not every process has the same level of standardization, and should therefore be researched in that manner.

1.2 Research objective

This study is a theory-oriented research. "Theory-oriented research is research where the objective is to contribute to theory development. Ultimately the theory may be useful for practice in general" (Dul & Hak: 2008). Since I have had limited time for this study, such a contribution can only be produced to a limited extent. I have chosen for a theory-oriented research, because this kind of research has a bigger range in terms of generalizability than practice-oriented research.

The general research objective of this study is to contribute to the knowledge of process standardization.

Exploration 2

2.1 Process standardization theory

Prior research has combined three aspects being cycle time, costs and quality as process performance and studied the relation between standardization and process performance. Their research suggests a positive effect of process standardization on cycle time, process costs and process quality. These studies were using Likert scale surveys for their empirical research. I have chosen not to use this method and to use a data set of 'real' process outcome data.

2.1.1 Process cycle time

A standardized process is easier to execute than a non-standardized process and can therefore be executed faster. Standardization makes it easier to execute a process by decreasing diversity and variance and increasing the presence of both implicit and explicit process knowledge (Hesser et al.: 2006; Lillrank & Liukko: 2004). Process standardization simplifies the activities and sub-activities of a process through which reduced cycle times are immediately realized (Jayaram & Vickery: 1998). They also state that standardization creates an expertise regarding materials and processes through which it becomes easier to identify delays and unnecessary process steps. Ungan (2006) and Siha & Saad (2008) define "standardization through documentation". Ungan (2006) assumes that process documentation has to be created in order to standardize a process. Siha & Saad (2008) state that extensive documentation leads to significant cycle time reductions. From my theoretical exploration regarding cycle time I derived the following probabilistic proposition:

H1: A high level of business process standardization is likely to decrease process cycle time.

2.1.2 Process costs

Process standardization can improve operational performance and through the elimination of errors, process costs can be reduced (Beimborn et al.: 2009). Wüllenweber et al. (2008) state that standardization can cut back process costs by, among others, decreasing process errors and profiting from expert knowledge. Research by Van Wessel et al. (2006) and Manrodt & Vitasek (2004) shows that process standardization can also lead to cost reduction by reducing the number of employees

within the process. Besides cost savings, standardization can offer further value because operative process performance improves through business process standardization (Swaminathan: 2001), while Ramakumar & Cooper (2004) have stated that "process standardization proves profitable". Hammer & Stanton (1999) state that IBM has standardized its processes around the world with "dramatic benefits": an average reduction of 75% in time to market for new products, cost savings in excess of nine billion dollars and a sharp upswing in on-time deliveries and customer satisfaction. From my theoretical exploration regarding process costs I derived the following probabilistic proposition:

H2: A high level of business process standardization is likely to decrease process costs.

2.1.3 Process quality

Process quality can be measured by the number of defect products or wrongfully executed services. Lillrank & Liukko (2004) state that standardization leads to operational excellence or improved operational performance and less errors which directly leads to higher process quality. Ramakumar & Cooper (2004) have even stated that process standardization is critical to achieve operational excellence in a global value chain. Crosby (1984) states that cost of quality is a measure of quality, better said the costs of not doing something right at first. After all it is not quality, "but the lack of quality that costs money" (Crosby: 1984). Most of these costs are invisible, lots of companies are not aware what the lack of quality costs them. To make these costs transparent, three quality costs can be distinguished (Van Weele: 1992):

- Prevention costs, made to prevent quality deviations;
- Reviewing costs, made to decrease the effect of errors;
- Correction costs, made as a consequence of (the correction of) errors;

From my theoretical exploration regarding process quality I derived the following probabilistic proposition:

H3: A high level of business process standardization is likely to increase process quality.

2.2 Hypotheses and conceptual model

The objects of study are business processes. The domain consists of all business processes in the world.

The objective of this study is to contribute to the knowledge of business process standardization by testing the following propositions:

- H1: *A high level of business process standardization is likely to decrease process cycle time.*
- H2: *A high level of business process standardization is likely to decrease process costs.*
- H3: *A high level of business process standardization is likely to increase process quality.*

These hypotheses lead to the following conceptual model.

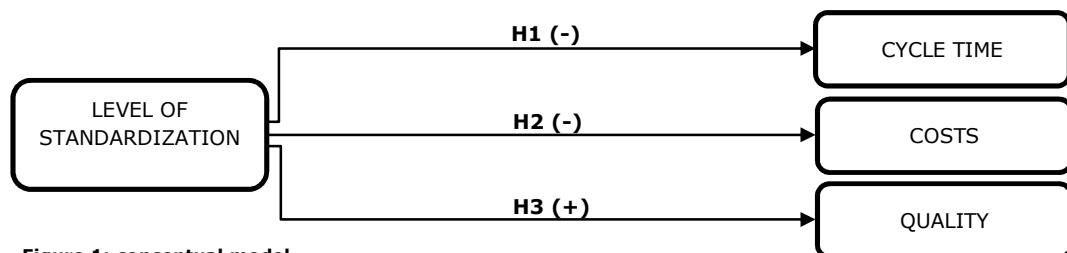


Figure 1: conceptual model

For the present there is no reason to assume that this theory would be influenced by geography, time, type of organization or level of complexity.

2.3 Effect Sizes

I have defined effect sizes in advance which I will consider as support for the hypotheses. Should the outcome of my study be lower than the pre-defined effect size, the hypotheses will be rejected. There is support for my hypothesis regarding cycle time when a business process with a high level of standardization on average has a cycle time that is 14.3% shorter than the cycle time of a business process with a low level of standardization. Since cycle time is measured in weekdays, the difference of one day will be used as a standard, hence 14.3%. Münstermann et al. (2010), who studied the differences costs before and after standardization of the recruitment process at one specific organization. They found a difference in costs of 30%. There is support for my hypothesis regarding costs when the costs of a business process with a high level of

standardization on average are 30% lower than the costs of a business process with a low level of business process standardization. I have no reference to establish an effect size regarding quality, therefore no effect size is defined in advance.

2.4 Parsimony

The conceptual model I used could be perceived as rather simple. This so-called simplicity is deliberate. From my point of view, many scientists tend to overdo the complexity of their models. I feel much more comfortable with 'Ockham's razor', also known as the law of parsimony (Forster: 1998), which is the principle that the explanation of facts should not be more complicated than necessary (Jefferys & Berger: 1998). McDonald & Marsh (1990) state that "it could be claimed that parsimony is not good in itself, but is only good insofar as it facilitates interpretation of results". They explain this by stating that very complex models might be interpretable, while some simple models might not be (McDonald & Marsh: 1990). Jefferys & Berger (1998) have stated that "hypotheses that have fewer adjustable parameters will automatically have an enhanced posterior probability because the predictions are sharper". Popper (1959) has linked this to his well-known falsification: the preference for simpler theories is because simple theories are testable. Especially the claim of testability is why I prefer 'simple' models when it comes to research.

The development of parsimonious models has been pursued by theorists from psychiatry, sociology and psychology (Benjamin: 1974). Researchers are concerned that inclusion of additional parameters may provide an imaginary improvement in fit because of the possibility of not contributing to valid interpretations of the data (Marsh & Hau: 1996).

2.5 Procurement

Considering that purchased goods and services represent between 50 and 70 percent of a company's revenue, the importance of the procurement function can easily be understood (Spekman et al.: 1999). Therefore procurement decisions have a potentially great impact on the overall business performance of a company (Sánchez-Rodríguez et al.: 2006). Baron et al. (2000) have defined procurement as the process that is utilized in supplying each link in the supply chain, and historically it has had an internal focus and has become an automated business process in many companies. Sánchez-Rodríguez et al. (2006) have asserted the significant effect that standardization of procurement procedures can have on the performance of both procurement and business processes. Literature on standardization of procurement procedures and its impact on purchasing performance is minimal (Sánchez-Rodríguez et al.: 2006).

Van Weele (1992) has introduced a purchasing process model with six separate 'activities'. He defined the order function as *within agreed conditions, ordering of required goods including order handling and monitoring*. He furthermore states that the procurement function's task regarding ordering is taking care of the order, including the aspect of designing order routines which will result in a document, an order receipt. This study will focus on the order activity.



Figure 2: Purchasing process by Van Weele (1992)

Purchasers have a role regarding several procurement activities. For this study supplier selection, contracting and ordering are relevant activities (Van Weele: 1992). Another important subject Van Weele has introduced is 'action fields' of procurement. One of these action fields is standardization, which he defines as identifying standardization possibilities in order to estimate cost savings and risks. Another task of the purchaser is to verify internal Purchase Requests (PR).

The administrative complexity of procurement can be very large. A good administrative organization is therefore a prerequisite for a good procurement organization (Van Weele: 1992). Van Weele (1992) introduced a procurement system and part of that system are 'purchasing requisitions'. Internal users make a request for goods or services they require. The procurement department will complement the request with product and supplier data. After verification the PR is converted into a purchasing order (PO).

A measure used by procurement departments to measure their results are the number of orders, procedure backlogs and authorization. Purchasers have a role in optimizing internal order procedures and communicating regarding this subject with internal requesters. Purchasing logistics is focused on optimizing both the order process and incoming supply of goods (Van Weele: 1992). Van Weele (1992) has introduced some measures of purchasing logistics regarding order policies. Among others they are:

- Administrative cycle time of the procurement department;
- Number of PR's per time unit;
- Number of PO's per time unit.

Several studies show evidence of the fact that automation of procurement mostly focuses on improving efficiency in operational, administrative and repetitive purchasing activities. Standard procurement software mainly focuses on the purchase of production

related goods. Logistics focused software focuses on supporting the order process, not on activities like supplier selection and contract management (Van Stekelenborg: 1994).

Procurement cycle time, sometimes referred to as lead time, is an important dimension of time-based performance, "even though it has received little attention in time-based literature" (Jayaram & Vickery: 1998). The supply-based strategies of electronic data interchange (EDI) and standardization have been discussed as "strongly influencing lead time performance" in literature regarding time-based competition (Jayaram & Vickery: 1998). Jayaram & Vickery (1998) state that standardization, in combination with empowerment, "offers the 'biggest bang for the buck' in improving procurement lead times."

Johnston & Lewin (1996) describe organizational buying behavior (OBB) as an often "multiphase, multiperson, multidepartmental and multiobjective process". The view that OBB is a process is important and has been the subject of previously proposed models. Webster & Wind (1996) added that OBB usually involves many people in the process together with complex interactions between them. The integrated model of OBB by Johnston & Lewin (1996) contain several characteristics which influence OBB:

- Environmental characteristics, like political context;
- Organizational characteristics, like organization structure;
- Purchase or product characteristics, like buy task and prior experience;
- Seller characteristics, like product quality and delivery time;
- Group characteristics, like expectations and leadership;
- Informational characteristics, like the active search for information;
- Conflict negotiation characteristics, like when it comes to joint-decision making.

2.5.1 e-Procurement

Supply chains in procurement are traditionally supported by information technology (Leenders & Fearon: 1997, Monczka et al.: 1997). The idea of e-procurement is to include the requester in the procurement process via an electronic multi-vendor catalog and, for instance, prevent re-entry of data (Neef: 2001). A benchmark study by Puschmann & Alt (2005) highlights 'preparation of catalogs offering the right amount of good-quality content' as a factor of the implementation of e-procurement in large organizations. Porter (2001) speaks of digital marketplaces, which automate corporate procurement by linking buyers and suppliers electronically. "The benefits to buyers include low transaction costs, easier access to price and product information, convenient purchase of associated services and, sometimes, the ability to pool volume." He also describes the link of marketplaces and standardization, since much of the economic

value created on those marketplaces is derived from the standards they establish. Porter (2001) also mentioned prominent applications of the internet in the value chain, specifically for procurement, being automated “requisitions to pay” and direct and indirect procurement via marketplaces, auctions, etc. e-Procurement is about bringing important simplifications of the procurement process and reducing operational workload. Presutti Jr. (2003) has defined e-procurement as “a technology solution that facilitates corporate buying using the Internet”. “If the procurement process is to be faster and more convenient, the number of authorization stages must be radically reduced” (Puschmann & Alt: 2005).

Most studies on e-procurement show large efficiencies regarding process costs (Gebauer and Segev: 1998). Puschmann & Alt (2005) state that identifying the right e-procurement strategy for a commodity is crucial to the success of e-procurement and is ranked as one of the major challenges. “The use of standards plays a critical role in e-procurement. Objects to be standardized are catalogs, data and processes. If the catalog data were not organized according to an ordered structure, they would be virtually unusable” (Puschmann & Alt: 2005). According to Puschmann & Alt (2005) e-procurement provides an opportunity for dramatic cost savings. These cost savings are one of the most important motivations for e-procurement. Benefits of e-procurement fall into two categories, efficiency and effectiveness. Efficiency includes process savings, effectiveness includes proactive management of key data and higher-quality procurement decisions within organizations (Kalakota & Robinson: 2001). e-Procurement enables decentralization of procurement processes within organizations as a result of a higher supply chain transparency provided by e-procurement systems (Aberdeen Group: 2001; Eyholzer and Hunziker: 2000; Arthur Andersen Business Consulting: 2001).

Prior to e-procurement, purchasers were confronted with individual transactions. Because of the labor-intensity, strategic aspects were neglected. The negotiation power of purchasers was limited because requesters made the purchasing decision (Puschmann & Alt: 2005). The use of internet technologies in procurement aims at realizing faster and more efficient operational processes which bypass the purchasing department (Giunipero & Sawchuk: 2000).

2.5.2 Catalogs

“At the heart of every procurement system is a catalog. Even in an environment lacking automation, requisitioners consult a hard copy” (Ariba: 2000). Requesters directly search products in electronic catalogs which are authorized and negotiated by the procurement department in advance. The former alternative, paper-based procedures, are labor-intensive and prone to harbor considerable error potential and many

transactions bypass the procurement department and are carried out directly with local suppliers. e-Catalogs add additional cost savings as well as cycle time reductions, which produces content users and thereby giving procurement more internal influence (Ariba: 2010). The benefits of e-catalogs include reduced processing cost (Baron et al. 2000). However, e-catalogs also constitute considerable costs (Doyon et al.: 2001). Baron et al. (2000) have identified five tangible factors associated with benefits in web-based business-to-business procurement systems, including cycle time, transaction costs and error rate. Ariba distinguishes three types of catalogs: Catalog Interchange Format (CIF), punchout and Level 2 punchout. A CIF is a catalog that is maintained by the customer and in some cases by the catalog vendor. The primary benefits of this type of catalog are control, preferred product guidance and pricing. It is, however, more resource-intensive and it might not be as up to date as other catalog types. A punchout catalog 'punches' the requester out of his own procurement solution to a supplier-hosted catalog. There the customer can search and select a product or service. The requester then returns to his own procurement solution in order to complete the PR. Level 2 punchout is a combination of the best of both worlds. This type of catalog enables buying organizations to search for punchout items in their own procurement solution, instead of searching each suppliers' site separately (Ariba 2000).

For my theoretical testing I used data from procurement processes, specifically order processes from NS. Therefore I will now discuss procurement at NS.

2.6 Procurement at NS

For its procurement activities NS uses e-procurement software, Ariba. The order process is automated and thoroughly documented. A complicating factor at NS is that not all business units are using the same tooling and data from these systems are not consolidated in a manner which makes the data comparable.

For ordering the Ariba Buyer module (Ariba) is used by NS Reizigers (the largest business unit of NS), NS Holding (including Shared Service Center ICT) and HiSpeed (which deploys the international passenger activities of NS). NedTrain and NS Stations, both considerably large business units, are using a separate order system.

Ariba is used by several staff members. They have separate roles in the order process. First there is a requester or preparer, who initiates the order process with a PR. Second there is a purchaser: depending on the commodity chosen by the requester, the PR has to be approved by a purchaser. A commodity comprises goods or services. The purchaser checks whether the right commodity has been selected. If yes, the purchaser will verify whether the right supplier has been selected and if there is a contract to which

the PR should be linked. After approval by a purchaser, the next step is approval by a controller. The controller will check the account used by the requester and purchaser. This account is important for financial reporting activities. Another staff member with a role in the process is a manager, since he or she is the budget owner and more importantly: he or she has the relevant level of authority. Since not every manager has the same level of authorization, the number of managers in the approval flow depends on the economic value of the PR and the level of authorization a manager has. A final role is the role of reviewer. Any prior mentioned approver can add someone to the approval flow in the role of reviewer, asking him or her to approve the request before or after approving the request themselves. Ariba does not limit the number of approvers in an approval flow. When all approvers have approved the request, this directly leads to a PO which is sent electronically to the supplier.

Order processes exist at NS in several levels of standardization. A form of ordering with a low standardization level is a *free format PR*. A requester is free to choose a supplier, a product or service, number of items, amount and account, for which a purchaser is added to the approval flow to verify whether all information is filled in correctly. After the purchaser, a controller, manager and optionally a reviewer have to approve the request. This will also result in a PO.

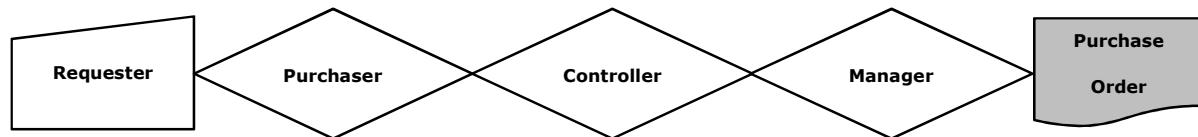


Figure 3: Pre-defined order approval flow of a free format purchase request

The order process with the highest level of standardization is the *catalog item PR*. A catalog is the result of a previously negotiated contract with a supplier. The Ariba architecture at NS makes it impossible to bypass procurement. Catalogs only exist because procurement was involved in both contracting and catalog creation. All products in the catalog are fixed and therefore do not have to be approved by a purchaser: the very existence of the catalog item by definition means that the purchasing department agrees with the terms of the PR.

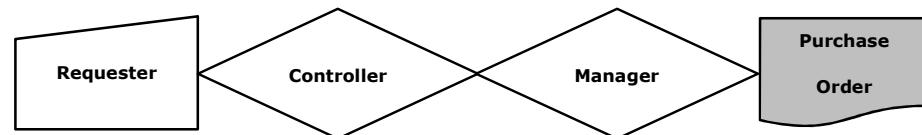


Figure 4: Pre-defined order approval flow of a catalog purchase request

The final form of ordering at NS is quite similar to the free format PR: a *blanket order*. This type of order has the same form and approval flow as the free format PR, but is

always linked to a contract and the amount in the order is not shared with the supplier. Most blanket orders are used for orders valid for a particular year with an uncertainty regarding the actual amount that will be spent.

In this study only a catalog request and a free format request will be used. A free format PR will be referred to as a non-catalog PR. The blanket order process at NS is 'fabricated', since in most cases the controller initiates the blanket order on behalf of the requester. This means that approval by the controller, which is part of the approval flow, is somewhat distorting the process. Therefore this type of ordering is not considered to be appropriate to use as an indication of any use for this study.

2.7 Further discussion

Regardless the outcomes of this study, there does not seem to be a universal level of standardization. The level of standardization is influenced by human beings. A human being, in this case someone from the procurement department, chooses to provide NS with a catalog order option or not. What I find interesting is that intuitively one could imagine the benefits of standardization and catalogs. But if so, why is it not used for every order? I realize that this thought is somewhat simple and I have discussed that not all commodities and products or services are applicable regarding catalog ordering (Porter: 2001). Catalogs also have implementation costs (Doyon et al.: 2001).

The number of catalogs at NS is relatively low. That is why this study contains a discussion on the possible reasons for the current number of catalogs at NS.

3 Methodology

This chapter will discuss the research strategy and selection of instances. After that the measurement of variables will be discussed, followed by the data analysis methods used.

3.1 Research strategy

The preferred strategy for testing a probabilistic relation is an experiment (Dul & Hak: 2008). In an experiment one would like to influence the independent variable in such a way that changes in the values of the independent variables can be measured. For this study it has not been possible to conduct an experiment, since in the given period of time it was not feasible to design the right conditions. Dul & Hak (2008) state that "if such an experiment is not feasible, the survey is the next best strategy for testing a probabilistic relation. In a survey, the co-variation between the values of two or more concepts is observed in a group of real life (non-experimental) instances". Therefore the research strategy of this study is a survey. To verify a relation with a survey strategy, a large N would be required (Dul & Hak: 2008).

3.2 Selection of instances

For this study I assumed every order as a separate process. Every order process starts with a request and ends with the order being sent to the supplier. The exact specifications of the order processes were described in chapter 2. I have chosen a convenience sample with data from NS. The main reason for this is the combination of wanting to test with 'real' process data instead of surveys. The second reason is the accessibility of the data. I work at NS, used to work for the procurement department and I have constant access to data through Ariba Analysis (Analysis), the reporting module of Ariba.

In 2012 over 16,000 orders were processed via Ariba. Data from other procurement systems were not used for this study, hence only data from Ariba were used. I have used a commodity filter because products and services with a very high degree of coordination effort of the supplier and a very low order frequency are certainly not candidates for e-procurement (Porter: 2001). Orders were sorted per commodity. Not every commodity is suitable for the use of catalogs, for instance for the reason mentioned above: the number of times these specific products or services are required

are very small. Therefore this study has only used commodities with enough orders to draw conclusions from and at the same time sufficient catalog and non-catalog orders to make a comparison. The commodities used were Communication & Print, General & Technical services and HR services.

With the aforesaid commodity 'filter', 7,862 orders remained. 23 of them have not been fully registered, which results in insufficient data regarding requester data for those particular orders. However, cycle time and order amount of these orders were available, so these orders have not been excluded from the data analysis. All population data has been used for analysis, without taking a random sample from the data. Therefore I have approached the data analysis as a census analysis: if data are collected in relation to all units of a population rather than to a sample of units of a population, data can be treated as a census (Bryman & Bell: 2011).

To summarize, my selection of instances contains all NS' orders from 2012 that were ordered using Ariba Buyer and have Communication & Print, General & Technical services or HR services as a commodity.

3.3 Measurement

The data for this study have been retrieved with Analysis, the reporting module of Ariba. I wanted to use the data of completed order processes because this explicitly means the whole process has been finalized. Therefore I used all PO's with an order date in 2012. The order date is the date the order has been finalized and sent to the supplier. All PR numbers linked to these PO's were used for analysis. For specific PR information I needed another report from Analysis, for which I used request dates between the 1st of December 2011 and the 31st of December 2012, because it is possible that orders that were completed in 2012 were initiated in 2011. These two data sets made it possible to match the PR with the corresponding PO.

3.3.1 Independent variable: Level of Standardization

In this study I used two levels of standardization, being Non Catalog Items (free format orders) and Catalog Items (orders via a catalog). These types of standardization were discussed in chapter 2. The standardization level of an order could be reported directly from Analysis.

3.3.2 Dependent variable: Cycle Time

The cycle time of a process comes directly from an Analysis report and is measured in days. Weekdays are not taken into account. Besides the fact that this is a pre-defined Analysis field, I have not corrected the data for weekend days. Correction would not do

justice to how the outcome of the process is experienced by both NS and supplier. For example: when a PR is initiated on Monday and finalized on the next Monday, the cycle time is seven days. Correcting for the weekend results in only five days, which suggests the supplier would have had the order before the weekend. However, the supplier has received the order after the weekend, which might lead to delay in the process.

3.3.3 *Dependent variable: Costs*

Prior research has used surveys in order to determine whether standardization has any effect on process costs. Since I have a data set available without costs indicators, I had to find another way to determine costs. To do so, I spoke to Erick Haag, Lecturer Procurement & Supply Management at Rotterdam School of Management and Leader Procurement Transformation Netherlands at Cap Gemini Consulting, about which methodology to use to determine the process costs. From the experience of his consulting practice, the costs are assumed to be directly related to the time spent in the process. Hence, measuring the amount of time in the process would result in process costs. Timing the process proved to be a problem, because I would need all the names of requesters and approvers of every specific order. I had all the names of the preparers, but not of the specific approvers involved in the PR's in my data set. To cope with this problem, I tried to take a convenience sample of purchasers, controllers and managers and a random sample of fifty from the list of preparers from the data set. This was a convenience sample in the sense that all approvers I approached were from my own network and not randomly sampled. Then an additional problem occurred: only 40 valid requester email addresses came up in Microsoft Outlook, meaning 10 people already left the organization. When I approached the remaining 40 people, the bigger part replied that in the meantime they changed jobs and that they were no longer ordering in Ariba. Most of them gave me a name of the person who was now ordering, but the sample that would remain would not be better than a convenience sample. This made me reconsider the methodology of determining process costs, since the convenience sample might not have given valid results.

Ordering takes time which costs money, and the preparers of catalog orders are the same persons who order non catalog. The results from a small sample showed that the amount of time spent on approving a PR is relatively equal for purchasers, controllers and managers. Although Analysis cannot report who the approvers were, it can report the number of approvers in the approval flow of every PR. As discussed in chapter 2, a non-catalog PR has three approvers by default, while a catalog PR has two approvers by default. The process costs were measured by the number of approvers within a PR, which I have done because of Manrodt & Vitasek's (2004) claim that cost reduction is

realized by reducing the number of employees in the process. I have corrected the number of approvers with the number of approvers by default, to make it possible and justified to compare the difference between the levels of standardization. For a non-catalog PR with seven approvers this would mean that the value of the process costs is $7 - 3 = 4$.

3.3.4 Dependent variable: Quality

Process quality can be measured by the number of defect products or wrongfully executed services, as discussed in the chapter before. Lillrank & Liukko (2004) state that standardization leads to operational excellence or improved operational performance and less errors. During the order process, approvers can adjust information within the order. I have considered an adjustment that was made, as a process error indicator. Analysis does not report whether the process has been changed. Therefore a data request has been sent to NS' data center in Slovakia. All the PR numbers from the data set have been sent to them with the request to indicate which orders have been adjusted during the approval flow. A column was added to the data, containing the number of adjustments during a specific PR. A single adjustment could trigger several simultaneous changes. This means that for instance changing the contract by a purchaser could result in three changes: the contract, order amount and commodity code. This data was extracted from the data provided from NS' data center in Slovakia.

3.3.5 Control Variables

I have added some control variables to my study, partly because "perception of risk varies depending on the product, the shopping solution and the customer's individual characteristics" (Kwon et al.: 1991). These control variables were added because from my theoretical exploration I derived that not every commodity or product is candidate for catalogs (Porter: 2001). The control variables for order size and order amount were added for this reason. Hence, my control variables regard both human and order characteristics.

3.3.5.1 Requester Experience

Widely accepted models regarding OBB contain individual participant's characteristics, for example education, perceptions and prior experience (Johnston & Lewin: 1996). The influence of experience is confirmed by Spekman (1979) and Thomas (1982), while Kohli (1989) has stated that 'expert power' is important regarding the procurement process. From a practitioners point of view one could also state that a requester's experience within an organization, with ordering and specifically ordering in Ariba might have an effect on the quality of the process. Any lack of experience with both the system

or specific administrative processes may cause the need for changes that have to be made by approvers. This would mean that approvers need more time during the process, resulting in higher process costs. One could say that with experience comes self-confidence regarding ordering and that consumers who are self-confident are more likely to order through a catalog than consumers who are not (Dash et al.: 1976; DeKorte: 1977; Gillett: 1976). When it comes to experience, Webster & Wind (1996) added that "organizational factors cause decision makers to act differently than they would if they were functioning alone or in a different organization". I have interpreted their claim as an indicator that an individual might influence the process and its outcome based on his or her experience. Webster & Wind (1996) state that in the previous experience of the individual, cultural, organizational and social factors are reflected.

As stated, a requester's experience with ordering might have an effect on the quality of the process. This would mean that inexperienced approvers need more time during the process, resulting in higher process costs. I have added the personnel numbers of preparers to the data from analysis. The preparer data field is different from the requester data field in Analysis. Since it is possible for a requester to order on behalf of someone else, these names appear in different data fields. The 'preparer' is the person who takes care of the data input, the 'requester' is the person on whose behalf the request is put in the system. For this reason the data field 'preparer' is used. The personnel number of the preparer allows to cross reference with data from the SAP HR system to the data from Analysis. The HR information used is the date of the commencement of employment. The reference date for the HR information was the 31st of December 2012. In Microsoft Excel (Excel) I have calculated the difference between the reference date and the date of commencement of employment, giving the number of days of employment. This number was divided by 365 and rounded to a full year, resulting in the number of years of employment. A second measure I used to measure requester experience is the number of purchase orders a preparer has initiated in 2012. The number of orders can be derived directly from Analysis.

3.3.5.2 Order Amount

Regarding OBB, Robinson et al. (1967) introduced 'buy phases', which represent the sequence of activities performed in organization buying. Among others, these activities have my special interest regarding this study:

- Determination of characteristics and quantity;
- Description of characteristics and quantity;
- Select an order routine;

The order routine could be the choice for free format or catalog ordering. The other subjects could be important for order characteristics.

Because of their economic value, Prasad (1975) classified certain products as being perceived to represent a high level of economic risk. Therefore the order amount, the economic value of the order, might be of influence on the process. A higher order amount might trigger a higher level of awareness or focus, resulting in higher quality, leading to shorter cycle times and lower process costs.

I discussed the possibility that an order amount, in terms of economic value, might influence the process. I assumed that a higher order amount triggers a higher level of awareness or focus, resulting in higher quality, leading to shorter cycle times and lower costs. The economic value of the PO could determine whether a higher ranked manager is added to the approval flow, based on the manager's authorization regarding amount approval at NS. The order amount was reported directly from Analysis

3.3.5.3 Order Size

The order size is measured by the number of line items of each order. The number of line items has a direct impact on the time a requester needs to fill in all the data of the order. An approver could need more time to approve an order with more line items. I assume a significant difference between the free format request and the catalog request when more line items are part of the order. The number of line items was derived directly from Analysis.

I have added order size to this study, since it has impact on the amount of time one needs for data input and reviewing during approval. In a free format order the requester has to type in all the data, as in a catalog order one selects different catalog items by a 'simple mouse click'.

3.4 Data Analysis

Since data of the whole population is available, inferential statistic testing is not needed and the statistic measures of the population can be calculated (De Vocht: 2010). Nonetheless, (descriptive) statistical tests were executed in order to analyze the data. The following paragraphs describe which data analyses have been used. Data analysis has been conducted using SPSS following the descriptions by De Vocht (2010) and Van Dalen & De Leede (2009). SPSS 21 was used for the analysis. Even when statistic testing has to be done, it is important to *explore the data* before the tests. The data was therefore first presented in a compare means report.

Correlation

To analyze the strength and direction of a relation between variables, I used a *correlation coefficient*. The coefficient I used is the Pearson's r . Although the conceptual model does not suggest correlation between the dependent variables, correlation coefficients have been calculated for both the control variables and between the dependent variables itself. Every combination of two variables is presented in a *correlation matrix*.

Regression

To establish the influence of the control variables, a linear regression test was used to analyze the effect of the control variables on the separate dependent variables. Another regression test was applied to establish the influence of the independent variable on the dependent variables.

3.5 Interviews

In addition to my data analysis I have conducted several interviews. In most literature the advantages of standardization are underlined, and intuitively one could expect that standardization of a process has its benefits. I found it surprising that NS only has a few catalogs in use. Simply said: when it has benefits, one would expect more catalogs and when catalogs have no benefits, one would expect no catalogs at all. However, in my theoretical exploration I have discussed that not all commodities and products or services are applicable regarding catalog ordering. Catalogs also have implementation costs. These are not in scope for this study, but might come up during the interviews.

In order to determine why a purchaser initiates a catalog or not, I conducted open interviews with purchasers of NS. The interviews took place *after* the data analysis. Any findings from that analysis could therefore be taken into account during the interview. This links with the emergent character Guba & Lincoln (1989) describe, which regards the possibility to use information one retrieves that was not available in advance. The interviews were unstructured, meaning that I had a list of topics, an interview guide (Bryman & Bell: 2011). This guide was partly extracted from the findings of the data analysis and of course partly based on my theoretical exploration. The style of questioning was informal, since all interviewees were colleagues. This made the interviews very similar to conversations, and they were therefore studied as such (Rapley: 2001). The phrasing and sequencing of the questions varied from interview to interview. The interviews were in Dutch, since all purchasers and the researcher are Dutch. Interviews have the advantage that they generally can generate a large amount of information, and information that comes out of the interview at hand can be discussed

further. Taking the above into account, one could speak of grounded theory, which Bryman & Bell (2011) define as 'theory that was derived from data, systematically gathered and analyzed through the research process'. The outcome of the interviews will not be analyzed as data, but will be used as input for further discussion in chapter 5.

4

Results

This chapter will discuss the outcomes of the data analysis and preliminary findings regarding the outcomes. It will be reported according to the data analysis described in chapter 3. Regarding costs I found a limitation regarding this measure. Therefore I have reviewed this limitation in chapter 5.

Before I start with 'technical' tests, I will first discuss some high level findings regarding the data analysis. The final paragraph will discuss hypotheses testing. It is important to report that all outcomes are significant.

The total population contains 7,838 cases. There were no missing cases, hence all cases were valid. These cases, being the order processes, are divided into 3,325 (42.4%) catalog orders and 4,513 (57.6%) non-catalog orders.

The mean cycle time is 5.59 days. The mean process costs is 0.37. This means that on average 0.37 approvers are added to the approval flow, on top of the pre-defined number of approvers. Finally the mean quality is 1.27, meaning that the average number of adjustments to a PO is 1.27.

However, when I compare the means of both catalog and non-catalog orders there are some remarkable differences. As table 1 shows, the mean cycle time for catalog orders is 4.92 and for non-catalog orders the mean is 6.09: a difference of 1.17 days, hence 19.2%. The mean process costs for catalog orders are 0.21 and for non-catalog orders they are 0.48: a difference of 0.27, hence 56.3%. Finally, the mean quality for catalog orders is 0.69 and 1.69 for non-catalog orders: a difference of 1.0, hence 59.2%.

	Cycle Time	Costs	Quality	Order Amount	Order Size
<i>Mean</i>					
Std. Level: Non Catalog orders	6.09	0.48	1.69	7,214.7	1.27
Std. Level: Catalog orders	4.92	0.21	0.69	217.63	2.82
	1.17	0.27	1.00	6,997.07	-1.55
	19.2%	56.3%	59.2%	97.0%	-122%
Skewness	4.03	4.49	8.50	21.87	3.73

Table 1: compare means & skewness

4.1 Correlation

Because I derived an expected direction of the relation between my independent variable and dependent variables from my theoretical exploration, I could use a one-tailed test. However, since my control variables might have an effect which I cannot derive from theory I have chosen to use a two-tailed test regarding the correlation tests. With SPSS I have reported a correlation matrix. The correlation coefficients are relatively low, with (.346) being the highest for the relation Standardization*Order Size.

	Correlation Matrix							
	1	2	3	4	5	6	7	8
1 Standardization								
2 Experience yrs		.041						
3 Experience PR		-.293	.325					
4 Order Amount		-.109	.020	.115				
5 Order Size		.346	-.017	-.161	-.010			
6 Cycle Time		-.095	-.061	-.011	.084	-.021		
7 Costs		-.159	-.095	.111	.165	-.086	.210	
8 Quality		-.114	.000	.010	.003	.123	-.017	.100

Table 2: correlation matrix

I will discuss the highest correlations:

- As expected, the independent variable correlates negatively with the dependent variables, meaning that an increase in the standardization level will result in a decrease of cycle time, process costs and an increase of process quality. These results could be support for the hypotheses;
- The negative correlation between Standardization*Experience PR (-.293) could be explained by the fact that people who initiate relatively many PR's while there are only few catalogs, requesters are to choose more non-catalog PR's;
- The negative correlation between Standardization*Order Amount (-.109) can be explained by the fact that catalogs on average contain relatively low priced products or services, whereas non-catalog PR's can be valued over one million euros. Therefore one could expect the order amount to be lower when standardization level increases;
- The correlation between Standardization*Order Size (.346) is rather surprising. To explain this outcome I had to use my interviews with purchasers. The results of these interviews will be discussed in chapter 5;
- Costs correlate with both types of experience, but in opposite directions: Costs*Experience yrs correlates negatively (-.095), while Costs*Experience PR correlates positively (.111). The latter can be explained by the fact that experienced requesters, based on the number of PR's, seem to have more higher valued PR's, resulting in extra approvers, which are interpreted as costs. The negative correlation can be explained by the fact that experience could lead to higher requester knowledge, resulting in less additional approvers since people rely on the requester's knowledge;
- The two types of experience also correlate (.325). People working a prolonged period for NS gained higher seniority, and when seniority is higher I know from experience that those people are mostly responsible for ordering. This would mean that people with more years of experience might make more PR's in a year;
- The correlation between Costs*Order Amount (.165) makes sense: The higher the order amount, the more managers are added to the approval flow, depending on their authorization;
- The correlation between Costs*Cycle time (.210) also makes sense: since costs are measured in the number of additional approvers, one should expect the approval time to last longer;
- The correlation between Quality*Order Size (.123) can be explained by the fact that an adjustment by any approver could change data in every line item. When a purchaser for instance changes a contract of a PR with three line items, this will lead to three adjustments, while the same change would lead to one adjustment when the PR would have one line item.

4.2 Control variable influence

To analyze the influence of the control variables on the dependent variables I have done a linear regression test. I have tested the relation between all control variables and every single dependent variable. The results are shown in table 3.

	Cycle Time	Costs	Quality
<i>Control Variables (Model 1)</i>			
Standardized Coefficients (Beta)			
Experience yrs	-.059	-.139	-.007
Experience PR	-.013	.122	.029
Order Amount	.091	.156	-.001
Order Size	-.037	-.057	.124
Adjusted R Squares			
Model 1	.013	.056	.014
Model 2	.024	.064	.043

Table 3: control variable influence

Cycle Time

The adjusted R square value of .013 means that only 1.3% of the variance of 'Cycle Time' is explained by the control variables. The model as a whole is significant. The coefficients table shows the influence of every single control variable on the cycle time. Experience measured in both number of PR's and years only have little effect on process cycle time. Surprisingly, the order size has a negative relation towards the cycle time, meaning that an increase in order size leads to a smaller cycle time. Intuitively one would expect that an order size increase might lead to longer cycle times.

Costs

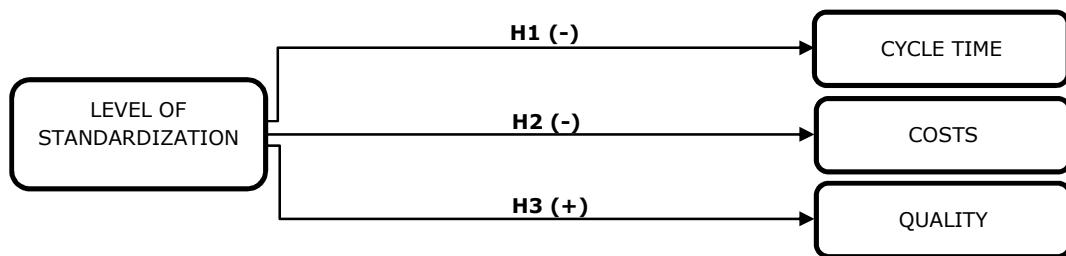
The adjusted R square value of .056 means that only 5.6% of the variance of 'Costs' is explained by the control variables. The coefficients table shows the influence of every single control variable on the process costs. None of the control variables have a notable effect on the dependent variable 'Costs'.

Quality

The adjusted R square value of .014 means that only 1.4% of the variance of 'Quality' is explained by the control variables. All control variables have a negligible influence on the quality.

4.3 Regression

I have discussed the influence of the control variables, and will now test the regression of the whole model. The outcomes of the regression test are shown in table 3. I will do this using two 'blocks' in SPSS, which makes it possible to report the regression of both control variables and the model as a whole. For clarification, this is the model I am testing:



Cycle Time

The variance of the dependent variable Cycle Time is only explained by 2.4% by the whole model, standardization only adds 1.1% to the variance explanation. This is surprisingly low, especially regarding the differences of means between the levels of standardization in this relation.

Costs

The variance of the dependent variable Costs is only explained by 6.5% by the whole model, standardization only adds 0.8% to the variance explanation. This is also surprisingly low when it comes to the differences of means between the levels of standardization in this relation.

Quality

The variance of the dependent variable Quality is only explained by 4.3% by the whole model, standardization only adds 2.9% to the variance explanation. This is surprisingly low again, in comparison to the differences of means between the levels of standardization in this relation.

Low regression coefficients

I was very much surprised by the low regression coefficients from my data analysis. My theoretical exploration did not suggest such little influence of just standardization on the tested variances. The regression test might, however, have been comparing incomparable variances. The variances of for instance the control variables are completely different regarding standardization level.

	Non-Catalog	Catalog
Order Amount		
Minimum	0	0
Maximum	1,298,535	14,577
Mean	7,214.7	217.63
Order Size		
Minimum	1	1
Maximum	12	23
Mean	1.27	2.82

Table 4: examples of incomparable variances

An explanation could be the distribution of the data, since all dependent variables have a very high skewness (table 1). Regression tests assume a normal distribution, which in this data set is not applicable. Distributions with skewness ≤ 1 can be assumed symmetric (De Vocht: 2010). In this case, skewness is very high, meaning that symmetry is not applicable. Table 1 shows skewness regarding the separate dependent variables. The additional interviews have given insight in possible other and possibly more relevant variables that affect process cycle time, process costs and process quality. I find these findings rather interesting and I will discuss them in chapter 5, where theoretical implications and future research are discussed.

4.4 Conclusion

Although regression coefficients were relatively low, the proven differences between the means of catalog and non-catalog orders are spectacular. I do not want to disregard these results because of low regression coefficients. Since the outcomes of this study show high skewness, I have also taken the medians into account when it comes to hypothesis testing (as shown in table 5). This was not part of my initial data analysis described in chapter 3.

	Cycle Time	Costs	Quality
<i>Median</i>			
Std. Level: Non Catalog orders	5.00	.00	.00
Std. Level: Catalog orders	3.00	.00	.00
	2.00	.00	.00
	40%	-	-

Table 5: medians of dependent variables

I will discuss the tested hypotheses shortly:

H1: A high level of process standardization is likely to decrease process cycle time.

Catalog orders have a mean cycle time that is 19.2% shorter than non-catalog orders' cycle time (as shown in table 1). This percentage is higher than the pre-defined effect size of 14.3%. Additionally, the difference between medians is 40% (as shown in table 5). The correlation coefficients indicate the relation between the independent variable and this dependent variable. Therefore there is support for hypothesis H1.

H2: A high level of process standardization is likely to decrease process costs.

Catalog orders have mean costs that are 56.3% lower than non-catalog orders' costs (as shown in table 1). This percentage is higher than the pre-defined effect size of 25%. There is no difference between medians. The correlation coefficients indicate the relation between the independent variable and this dependent variable. Since the difference between the actual mean and the pre-defined effect size is substantial, there is support for hypothesis H2. In chapter 5 the hypothesis regarding costs is retested in the limitations section. This does not have any effect on the ultimate conclusion regarding this hypothesis.

H3: A high level of process standardization is likely to increase process quality.

Catalog orders have a mean quality that is 59.2% higher than non-catalog orders' quality (as shown in table 1). I consider this percentage to be very high. There is no difference between medians. The correlation coefficients also indicate the relation between the independent variable and this dependent variable. Since the difference between the actual mean and the pre-defined effect size is substantial, there is support for hypothesis H3.

5

Discussion

5.1 *Theoretical implications*

This study implicates that theory regarding the effect of business process standardization on process cycle time, process costs and process quality is also valid when using 'real' data in the empirical research. A contribution might be the exact differences between processes with a different standardization level. My study could be the first step towards more extensive research on this particular subject using 'real' data. The only research which came close to comparing outcomes was research by Münstermann et al. (2010) who studied the differences in cycle time and costs before and after standardization of the recruitment process at one specific organization. They found a difference in cycle time of 25% and a difference in costs of 30%. They used interviews for data collection, hence no 'real' data was used.

The regression coefficients are very low. Possible explanations were discussed in chapter 4. One of the possible reasons for the low regression coefficients was high skewness. It is possible to reduce skewness with logistical transformation. Since I was not able to find this transformation myself, I consulted a data scientists at iNostix. iNostix is an analysis consulting company that works with NS regarding HR Analytics. The data scientist verified whether transformation would affect the regression outcomes. All dependent variable data were increased with 1 in order to make it possible to use all data with a value of zero. Table 6 shows that although skewness was reduced considerably, only the regression coefficient regarding costs has changed. Therefore I see no reason to change my prior conclusions.

	Cycle Time	Costs	Quality	
<i>Skewness</i>				
Before transformation	4.026	4.485	8.502	
After transformation	-.076	1.720	2.229	
<i>Adjusted R Squares</i>				
Before transformation	.013	.056	.014	
After transformation	.013	.067	.014	

Table 6: skewness and adjusted R squares after logistical transformation

In 2010, Münstermann et al. conducted another research on the influence of process standardization on the performance of the recruitment process. Their regression test outcomes regarding cycle time (39%), costs (31%) and quality (63%) are much higher than the outcomes of this study. I have two explanations regarding these differences. The first explanation has been stated before: Münstermann et al. (2010) used seven point Likert scale questionnaires for their data collection. My data collection has a continuous scale, which makes the possibility of a normal distribution smaller than data between seven values. Since regression tests imply a normal distribution, regression test values might differ. Finally, I do not want to ignore the possibility that the Likert scale may have measured perception and contain a social desirability bias. This makes comparison between data outcomes probably impossible and certainly irrelevant.

A more important reason might be the difference in processes. The recruitment processes were probably less standardized than the internal order process I used in my study. I have compared two types of order process, but the free format process already has a relatively high level of standardization, since it already is an automated process. This automation makes the improvement potential smaller than for instance a more manually executed process like the recruitment process. Münstermann et al. (2010) also point out that the recruitment process is the “most time and cost consuming process among all HR processes”. They also state that this process has numerous different tasks, while the order process I studied only has a few different tasks. This implies a higher improvement potential for the recruitment process. Therefore a theoretical implication could be that a higher standardization level might lead to other aspects to be of influence on process outcomes like cycle time, costs and quality.

5.2 Limitations

As discussed, I have no illusions regarding the generalizability of this study: the generalizability could be very limited. It is important to note that only one specific process within one specific part of one specific organization has been studied. I have chosen this process carefully. It might, however, represent a single example of business processes. The results might therefore not be directly transferrable to any other organization or process. They might be transferrable to orders at NS within the same commodity in other years than 2012, for which 2012 is representative.

The measuring of process costs proved to be difficult and I would rather have found actual cost data. I used a derivative of the actual costs. During the review of my results I realized that I only might have measured the additional costs, because I have corrected for the pre-defined approvers. These pre-defined approvers also represent costs and should therefore have been part of my analysis when measuring actual costs. For verifying purposes, I have run an additional SPSS test with costs without correction for the pre-defined number of approvers. Table 7 shows that the difference regarding costs is lower than discussed in chapter 4, but the effect size is still higher than the percentage I have defined in advance regarding the support for the hypothesis. Additionally comparing medians also results in finding support for the hypothesis. Therefore the conclusion regarding this hypothesis in chapter 4 stands.

	Cycle Time	Costs	Quality	Order Amount	Order Size
<i>Mean</i>					
Std. Level: Non Catalog orders	6.09	3.48	1.69	7,214.7	1.27
Std. Level: Catalog orders	4.92	2.21	0.69	217.63	2.82
	1.17	1.27	1.00	6,997.07	-1.55
	19.2%	36.5%	59.2%	97.0%	-122%
Skewness	4.03	2.70	8.50	21.87	3.73
<i>Median</i>					
Std. Level: Non Catalog orders	5.00	3.00	.00		
Std. Level: Catalog orders	3.00	2.00	.00		
	2.00	1.00	.00		
	40%	33%	-		

Table 7: additional testing regarding costs

Process quality was measured by the number of adjustments during the process, since literature states that the process errors express process quality. I was able to report the number of adjustment, but there is still chance that errors are not noticed and adjusted. These 'missing values' suggest that not all process errors are analyzed.

Although it was ambitious trying to be innovative regarding the usage of real data, it might have caused problems regarding statistical testing. I have measured the level of standardization using two values, which basically does not differ from a process being standardized or not. I have been critical concerning prior research measuring standardization by two values.

Since regression coefficients are low, I cannot conclude otherwise than that I have not been able to propose a generic theoretical research model or a generic empirical operationalization to analyze the impact of business process standardization.

5.3 Further discussion

In addition to the data analysis, I have conducted interviews with employees of NS' procurement department. These employees have different levels of seniority, ranging from operational buyer to senior buyer II, one of them is a procurement analyst. We discussed the effects of catalogs in general and the outcomes of my empirical research. The main goal of these interviews was to understand the outcomes of this study and to try and understand the presence of catalogs at NS.

General benefits of catalogs

Without exception all purchasers point out that a major benefit of catalogs is up to date pricing and the right product or service offering. This is according to the literature I discussed in my theoretical exploration. Sometimes product specifications are mandatory by law, which can be enforced by the use of a catalog. This will ensure product specification compliance with legislation. A catalog can be applied to keep the product assortment small, which has benefits regarding chance of failure or wrong products. This could have effect on the success of changing suppliers or products. Catalogs are also important to reduce the number of rejected invoices and invoice approval adjustments. Efficiency is often mentioned as a benefit of catalogs: the process should be faster than the 'normal' process. Non-catalog requests have more actions, where catalog requests take less time regarding data input. Another efficiency benefit of standardization is that one can spend more time on strategic issues given the time reduction on operational issues. A smaller, but relatively often mentioned benefit is procurement's reduced workload regarding approval with catalog PR's. The internal use of catalogs further relieves the procurement organization of time intensive 'sorting out related activities'. An

important mentioned benefit is the possibility to analyze the procurement spend, since currently management information depends on information provided by the supplier. This supplier dependence is experienced as undesirable. Finally the benefit of a catalog is the user friendly character of the concept: simply adding pre-defined products or services to your chart has its benefits in comparison to the data input of a free format order.

Procurement role

Not all purchasers agree on the role of procurement when it comes to catalogs. Although the bigger part of the purchasers sees a role for procurement, only a few purchasers assume the procurement department responsible for catalogs. This is somewhat surprising, regarding Van Weele's (1992) claim that the procurement department is responsible for optimizing order processes. Other purchasers state that the business units are responsible themselves. Most purchasers see a pro-active attitude at procurement, but it will always be a combination of efforts between them and the business units. This is mainly because the catalog ownership is with the business, since the contract is also managed by the business units. Other purchasers see themselves as responsible early in the purchasing process and work together with the supplier to realize the catalog. The purchaser with the highest seniority, however, literally stated that '*procurement should spread the 'catalog gospel' throughout the company*'.

Supplier benefits

All purchasers point out that another link in the supply chain can use catalogs to its advantage: the supplier. Regarding the operational process, PO's are sent to the supplier clearly defined according to the specifications that were negotiated. This has a direct link with the invoice rejection benefit mentioned before: better PO's drive the supplier to send better and matching invoices, resulting in less work and frustration for both organizations. Catalogs make it possible for the supplier to combine its products and offer them as a service. An IT supplier could, for instance, offer a work station instead of a separate computer, separate keyboard and separate mouse. Another important advantage for the supplier is the possibility to post commercial communication on his site in case of a punch-out catalog. The introduction of a catalog at NS arouses enthusiasm at the supplier, who is willing to invest time and money to realize the catalog. Some purchasers point out that a catalog is only interesting for a supplier when there is sufficient turnover and order volume. This is a justification for my choice of commodities regarding my selection of instances and also a confirmation of Porter's (2001) claim that products and services with very low order frequency are no candidates for e-procurement.

Outcomes of this study

When asked to quantify the benefits of a catalog regarding cycle time, cost and quality, most purchasers did not have accurate expectations. Especially when it comes to cycle time, their estimates were way off in comparison to the actual outcomes. Most purchasers estimate the cycle time of a catalog PR equal or less to half the cycle time of a non-catalog PR, only one of them estimated the difference in cycle time to be 25%. The actual percentage of 19% is considered low by the purchasers, where I have interpreted this outcome as spectacular. Regarding costs, the main idea was that adding an approver to the approval flow in a catalog request should not be necessary. The average estimated difference was about 30%. The actual percentage being the double of their estimation stunned them, making them excited to invest some extra time in new catalog introduction. Quality is sometimes estimated according the actual outcome of 60%. Most purchasers, however, have estimated this percentage much lower than 60%, again making most purchaser excited about catalog use.

One specific outcome, the negative relation between order size and cycle time, surprised the purchasers, although they have several explanations for this outcome. The first one is rather negative: idleness. They also mentioned the fact that sometimes orders are made after the invoice has already been received. The requester then builds the order according to the invoice. Another explanation could be that more detailed orders might be perceived as initiated by 'more knowledgeable' requesters.

Understanding the number of catalogs at NS

The purchasers have given several explanations of why NS does not use more catalogs at the moment, while both theory and practice have proven the benefits of this type of standardization. Most mentioned reason is the procurement focus on the tender process and the resulting contract. The contract is considered procurement's deliverable, and the operational process is not given sufficient attention. Given reasons for this are the lack of management attention and sometimes the lack of procurement skills. Although procurement's management ask for some details about the operational process when a tender is initiated, the management attention is low. Furthermore it is stated that 'higher' procurement functions do not feel any responsibility regarding this process. This could be the main reason why analysis of the operational process, specifically catalogs, is not reported anymore. One purchaser said: "what used to be basic knowledge, has now moved to the background", referring to the past when catalog participation was reported monthly. Surprisingly enough, even with the lack of focus, there is a catalog manager at procurement. He is, however, mainly active regarding the technical availability of the current catalogs.

There are four dimensions regarding the operational process: process, infrastructure, logistics and governance. These aspects are all part of the integrated model of OBB by Johnston & Lewin (1996) mentioned in my theoretical exploration, especially the environmental, group and organizational characteristics. Governance is the most important: autonomy is allowed by NS' management. As long as this is applicable, each business unit can and will choose its own process. This makes focus on the operational process "chanceless". NS is intrinsically not cost driven, but driven by political context. The main reason for this, is the fact that the only shareholder is the Dutch government. Should the governance change, the infrastructure could be simplified, which on its turn could help to uniform the process.

There is, however, a growing focus on the operational procurement process. The reason for this growing focus is ironically enough the reason why I started this study in the first place: the benchmark of 2012. Since NS' management have imposed significant cost saving targets, procurement management has realized that they should put an effort in standardizing their process.

5.4 Managerial implications

Both theory and this study suggest that process standardization has a positive impact on cycle time, costs and quality. However, the presence of standardization does not seem to be the only variable of influence. The presence of standardization also seems to depend on political context, procurement governance, management attention and procurement skills. Given the benchmark outcomes and imposed cost savings, management might have chosen the right tool regarding their cost saving target. It is, however, strongly suggested to approach every process separately and to conduct research on the aforementioned factors before standardizing a process. Otherwise management might be standardizing standardization, without utilizing the full improvement potential.

5.5 Future research

As for this study, I have chosen the order process as object of research. Future research should at least investigate other processes. When researching other processes, one should investigate whether the amount of process steps influences the process. I would strongly recommend research with more than two levels of standardization.

Naturally, future research should be conducted for other organizations as well. A complementary step might be an investigation what role political context, governance, management attention and procurement skills play regarding their influence on the process: do they influence process outcomes directly or are they of influence on the availability and level of standardization. Future research should also investigate the

order process as part of a bigger process: the procure-to-pay process, since purchasers have pointed out standardization of ordering also benefits the invoice process. These measures will allow for broader generalizability.

Finally, this field of study is in need of improvement of the operationalization of its variables, since no generic theoretical research model or generic empirical operationalization have been proposed. It is suggested to test the relations using an experiment.

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List of Abbreviations

Appendix A

Analysis	Ariba Analysis
Ariba	Ariba Buyer
CIF	Catalog Interchange Format
EDI	Electronic Data Interchange
Excel	Microsoft Excel
HR	Human Resources
NS	Dutch Railways
LSD	Least-significant difference
OBB	Organizational Buying Behavior
PO	Purchase Order
PR	Purchase Request
RCO	Regie- en Controlorganisatie