Building metrics for assessing the business value of electronic order-to-payment cycle

Tietojärjestelmätiede
Maisterin tutkinnon tutkielma
Heikki Lempinen
2009

Liiketoiminnan teknologian laitos
HELSINGIN KAUPPAKORKEAKOULU
HELSINKI SCHOOL OF ECONOMICS

Abstract

The purpose of this paper is to build metrics for assessing the business impacts of information technology (IT) in the order-to-payment process. The extant literature provides a plethora of benefits and measures related to process automation within the financial administration. These come, however, generally in the form of one-dimensional lists and concern separate administrative functions. By going through these repetitive lists, organizations struggle with determining potential payoffs. The majority of existing studies suggests that, at first hand, automation increases productivity through decreased processing time and cost. A variety of impacts apart from cost savings has been reported yet their importance is variably stressed.

What is missing in the current literature is a structured, holistic analysis on the potential productivity gains that could be derived from a full-scale digitalization of the order-to-payment cycle – a tool that would help organizations to navigate through the jungle of impacts and measures. This paper takes a structured approach where all potential gains are pulled together in order to create a basis for proper analysis and evaluation. The idea is to construct a model that would not only pinpoint potential benefits of process automation but also explain how the resulting economic value is created.

In this paper, the order-to-payment cycle is first divided into three distinct sub-processes (e-ordering, e-invoicing, and e-payment) in order to identify specific operational level IT impacts. Based on a literature review and expert interviews, a three-stage metrics model is formulated including business value measurements for each sub-process and the entire order-to-payment cycle. Finally, process-oriented approach is used to investigate how the underlying impacts contribute to company-level economic value added. In addition, the importance of electronic system integration is highlighted by pointing out IT impacts on inter-process linkages. Thereby, the final product is a vertically and horizontally integrated evaluation tool.

The proposed measurement model is then tested in a business context – an in-depth case study at a Finnish design company. The case results show that the model works well as an analysis tool. The results also indicate that the impacts of automating the order-to-payment cycle in the case company relate closely to cost avoidance. Consequently, the company makes IT investment decisions based on estimated cost savings potential. However, once the electronic systems are at place, strong emphasis is given to asset utilization as well – better use of IT could enhance the utilization of existing human resources and capital. The revenue-creating impacts of process automation are acknowledged yet particularly difficult to observe and measure and thus treated with some reservations.

Keywords: Metrics, measurement tool, order-to-payment, purchase-to-pay, e-order, e-invoice, e-payment, IT business value, case study.

Tiivistelmä

Tutkielman tarkoitus on rakentaa mittaristo taloushallinnon prosessien sähköistämisen liiketoimintavaikutusten arvioimiseksi. Fokusalueena oleva prosessi ulottuu ostotilauksesta laskunkäsittelyn kautta maksuun. Aihetta koskeva, olemassa oleva tutkimus esittää runsaan määrän sähköistämisen vaikutuksia ja niitä kuvaavia mittareita. Tämä tieto on kuitenkin jäsentämätöntä, hajanaista ja koskee useimmiten erillisiä hallinnollisia funktioita. Tämän vuoksi yritysten on vaikea arvioida hyötyjä selkeästi. Aiemmat tutkimukset esittävät prosessien sähköistämisen ensi sijaisesti parantavan tuottavuutta työajan ja –kustannusten säästön myötä. Kustannustekijöiden lisäksi muitakin vaikutuksia on esitetty, kuitenkin vaihtelevilla painotuksilla.

Alan tieteellisestä kirjallisuudesta puuttuu siis kattava, jäsennelty analyysi ostotilaus-maksu prosessin sähköistämisen vaikutuksista. Yrityssektorilla lienee kysyntää työkalulle, joka auttaisi käsittelemään systemaattisesti tätä moniulotteista aihetta ja tunnistamaan potentiaaliset hyödyt. Tässä tutkimuksessa kootaan yhteen kaikki aiheeseen liittyvä hajanainen tieto ja yhdistetään se strukturoiduksi kokonaisuudeksi. Tarkoituksena on kehittää malli, joka kartoittaa monipuolisesti automatisoinnin vaikutuksia ja pyrkii lisäksi kuvaamaan mekaniikan, jonka välityksellä lopullinen liiketoiminnan lisäarvo syntyy.

Ostotilaus-maksu -kierto jaettiin ensin kolmeen osaprosessiin; e-tilaus, e-laskutus ja e-maksu, operatiivisella tasolla tapahtuvien vaikutusten selvittämiseksi. Kirjallisuuskatsauksen ja asiantuntijahaastattelujen perusteella rakennettiin kolmetasoinen mittaristo, joka sisältää indikaattoreita kullekin osaprosessille erikseen sekä koko tilaus-maksu –kierrolle. Alempien tasojen mittareiden yhteys organisaatiotason liiketoimintavaikutuksia kuvaaviin suureisiin hahmoteltiin prosessiluonteista teoreettista kehikkoa apuna käyttäen. Viimeisenä elementtinä malliin lisättiin horisontaalisen järjestelmäintegraation vaikutusten kuvaus. Lopputuote on näin ollen vertikaalisesti ja horisontaalisesti integroitu arviointimalli.

Mittariston toimivuutta testattiin case-tutkimuksen avulla suomalaisessa designyrityksessä. Tutkimuksen tulokset osoittavat mallin hyödyllisyyden toimintojen analysoinnin työkaluna. Case-yrityksessä ei systemaattisesti mitata tilaamisen, laskun käsittelyn ja maksun sähköistämisen vaikutuksia. Koetut hyödyt liittyvät kuitenkin läheisesti kustannusten karsimiseen. Näin ollen yritys tekee teknologiainvestointeihin liittyvät päätökset ensisijaisesti arvioituihin kustannussäästöihin nojautuen. Toisaalta järjestelmäratkaisujen käyttöönoton jälkeen tärkeänä koettiin erityisesti pääoman käytön tehostamiseen liittyvät seikat. Tuottoa lisäävät vaikutukset koettiin myös jonkin verran tärkeinä. Näihin suhtauduttiin kuitenkin varauksella, sillä tuottovaikutuksia on yrityksen arvion mukaan erityisen hankala havainnoida ja mitata.

Avainsanat: Mittari, mittaristo, arviointimalli, e-tilaus, e-lasku, verkkolasku, e-maksu, case-tutkimus.

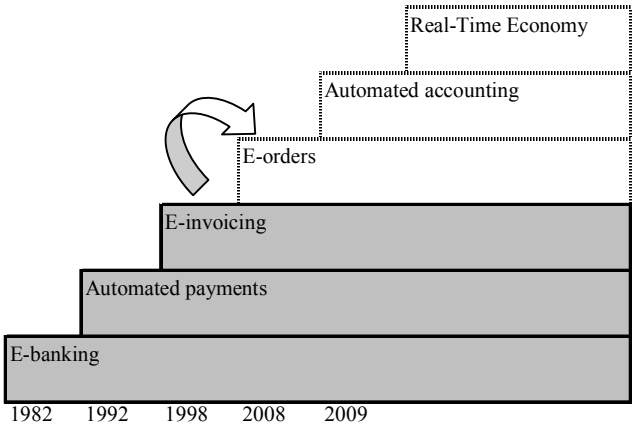
Table of Contents

List of Figures and Tables

1 INTRODUCTION

This study is a part of Real Time Economy program which is a joint collaboration between the Helsinki School of Economics and Tieto Corporation. The four-year program focuses on financial value chain transactions (payments, invoices, ordering and accounting). In the first phases of the program focus was on electronic payment and invoicing systems. The next step on the Real Time Economy Ladder is Full Value Chain (FVC), extending the range of transmitted messages between the buyer and the seller in a commercial transaction (Penttinen (Ed.) 2008). The contribution of this paper to the program is to try to climb a step up in the RTE ladder by integrating automated payments, e-invoicing and *e-orders* under the electronic order-to-payment process concept.

Figure 1.1 Steps on the way towards real-time economy



Source: Penttinen (Ed.) (2008)

1.1 Objectives

How can we utilize information technology (IT) to increase productivity? What IT innovations enable us to perform tasks in smarter ways than we used to? One important source of productivity growth lies in improving the processes of the financial administration. Using IT in financial administration has been recognised as one of the most important sources of profitability growth in Europe (EuropeanCommission 2007; EU 2006). As an example, the European Association of Corporate Treasurers (EACT) has estimated that by moving from paper-based invoicing to electronic invoicing, companies across Europe could save 243 billion euros in processing costs alone (EuropeanCommission 2007).

Regardless of the promising numbers above and reported success stories in this area (e.g. Penttinen 2008), wide-ranging adoption of IT in the financial administration lags behind. The problem is that companies do not see potential gains clearly enough. Many academic studies underline IT payoff potential in this context, yet the existing literature on the topic is more or less a "smorgasbord" of measures without a proper structure around it. Hence, it might be challenging for companies to piece together the required information and identify relevant measures from this diversity. Also, the existing studies tend to be bounded to cover impacts and measures assigned to individual functions; virtually no research exists discussing the effects of digitizing the entire flow of activities from order to payment. This work should thereby offer visibility over the entire cycle; the objective of this study is to build metrics for assessing the business impacts of an electronic *order-to-payment cycle* i.e. automated purchase orders, incoming invoice handling and payment.

Measurement in this context can be roughly divided into two categories; the business value of IT is measured as basis for investment calculations as discussed above and for process monitoring purposes once IT systems are at place. The commercial research partner for this work, Tieto Corporation is in the business of developing process management tools. They presented a rather descriptive

analogy to reflect the current state and to motivate for studying the topic; "the electronic order-to-pay process today is like the paper machine in the early 20th century". An engineer could operate the machine by a "gut feel" yet nobody really knew what was happening in the process. Similarly, business impacts of the order-to-payment process automation can be poorly monitored in many organizations today. The current practice is roughly "companies implement first, then wait and see what happens".

Now, after decades of development, paper machines are run centrally from control rooms where information systems provide real time information about functioning of the machine. If a problem occurs, the operating system provides an immediate alarm. Within the financial administration, what managers probably lack is the arms to evaluate IT investments (both before and after) but also measure and manage IT system performance *during* processes. Business impacts are often visible after a relatively long period of time and thus it's impossible for the managers to continuously improve operations, identify possible inefficiencies and other problems in the process and react accordingly. The vision is to create a dashboard where management could monitor performance of an "order-to-pay machine". Companies could also get real time feedback from process restructuring activities and even plan capacity in advance to avoid process bottlenecks. It turns out that there have been (limited) commercial initiatives in this field, yet academically the topic is more or less untouched.

Invented in France 1799 by Nicolas Louis Robert, the first paper machine was 60 cm in width and able to produce 9 meters of paper per minute. The largest paper machines today are 11.3 meters wide with capacity of 2000 m/min. Development of real time operating systems has probably had only a minor effect on this huge capacity improvement. However, since integration of e-ordering to e-invoicing and e-payment systems is still in its infancy, there probably still is untapped potential to exploit. Whether implementing these IT systems ultimately leads to performance improvements for every firm, it's difficult to say. However, with better process management, even those companies who have implemented yet

haven't succeeded might be able to do a bit better. Either way, they should be able to identify the *business* value of information technology in addition to operative level IT performance. It should be kept in mind that it took decades to develop paper machine monitoring to its current state and there probably is not a silver bullet that would crack the puzzle in this context. However, there is need for researchers to take the first steps –carefully examine the process, put proper measures in place and pinpoint mechanisms of business value creation.

In conclusion, quantifying benefits IT offers for businesses in terms for productivity and profitability improvement is not always simple. Proper evaluation would offer rationale for IT investment at first hand and also the opportunity to utilize potential of existing computer-aided processes to the full. In this paper, I strive to build a model that would make evaluation less challenging by gathering the currently scattered information into a structured entity. Thus, the research question is:

How to build a generic measurement model (i.e. applicable to many organizations) which would first, pinpoint all sources of potential gains due to order-to-payment automation and system integration and second, identify how the resulting business value is created?

1.2 Scope of Thesis

The process is bounded to include only electronic processing and transfer of documents between the trading partners ranging from identifying order requirements until payment of goods. This paper is limited to study the process from a buyer point of view i.e. in the context of electronic procurement.

It should be noted that the electronic order-to-pay process itself is a part of a far longer process, a supply chain. Actually, nowadays scholars speak increasingly of supply networks instead of chains in recognition of the network of activities

happening between multiple level supply chain partners. The point is that the complexity of process management is ever increasing as processes are considered increasing in scale and scope. On the other hand, many companies probably still treat ordering, invoicing and payment as separate functions and therefore are not necessarily able to utilize the full potential of automating the process. Thus, a well-grounded scope for the studied activity should be somewhere in between "separate units" and "supply network" i.e. a clearly defined process constructing of three phases from order to payment receipt.

The purpose of this paper is to provide an *extensive structured description* over the potential gains from adopting an electronic order-to-payment cycle without necessarily stating exact numbers at this point. Further use of the model; namely choosing the actual metrics, measuring and decision making based on the results is considered as the user organization's own responsibility for now and is thus excluded from the study.

1.3 Structure

The structure of the study is as follows. The second section includes a literature review on the general topic of business value of information technology and discusses some measurement tools. In the third section, the electronic order-to-payment process is defined and described in detail. Methodology is discussed in section four. In the fifth section, existing literature on electronic ordering, invoicing and payment impacts is reviewed first. Finally, based on the literature review and expert interviews[1] a catch-all evaluation tool is developed. In section six, the proposed model is tested in the context of a Finnish design company. In the final section, we draw conclusions and suggest avenues for further research.

[1] A handful of interviews with field experts were conducted to collect comments and views how to build the model. All the interviews are recorded and filed.

1.4 Terminology

Measure, metric

A performance *measure* is a set of metrics used to quantify the efficiency and effectiveness of an action. Therefore, the term *metric* refers to definition of the measure, how it will be calculated, who will be carrying out the calculation and from where the data will be obtained (Neely et al. 1995).

E-ordering

"The e-ordering process deals with the electronic transmissions of documents during the e-procurement phase that starts with the issuing of orders by the buyer and ends with the receipt of an order response and the transmission of the delivery instructions of the ordered goods or services from the supplier" (PEPPOL Web 2008). The definition used in this paper is slightly extended including some pre-submission internal buyer activities.

E-invoicing

Penttinen & Hyytiäinen (2008) define e-invoicing as invoices transmitted through open standards e.g. XML-format. They leave out EDI bills and invoices sent as e-mail attachments. Defined in this paper more widely as "the automatic processing of incoming invoices" (Tanner et al. 2008).

E-payment

Defined as "payment services that utilize information and communication technologies" (Raja et al. 2008). In this context, e-payments refer to electronically processed and transferred settlements between businesses.

2 BUSINESS VALUE OF INFORMATION TECHNOLOGY

2.1 Productivity paradox and beyond

Effective measurement of information system success has been a serious concern for both managers and scholars for the past couple of decades - attempts to quantify the benefits of IT have often resulted in inconclusive or inconsistent results (Byrd et al. 2006). Research in IT business value examines the organizational performance impacts of information technology, such as productivity and profitability improvement, cost and inventory reduction, competitive advantage and other performance measures (Melville et al. 2004). There is a vast amount of studies regarding IT business value and almost as many proposed instruments to evaluate it; quantitative financial measures, information value measures, service quality tools (SERVQUAL) and multi-dimensional analysis have been used, among others (see Cronk & Fitzgerald 1999 for review).

In spite of the great promise of IT driving the biggest technological revolution men have known, there has been heated debate in IS literature for the past decades about whether IT usage actually pays off (Brynjolfsson 1993). Labelled the *productivity paradox* of information technology, Brynjolfsson (1993) explains that although computing power in the (U.S.) economy has increased by more than two orders since 1970s, productivity seems to have stagnated. Particularly in the 80s, many studies claimed that the overall IT productivity impacts are neutral or even negative (e.g. Salerno 1985). Robert Solow, winner of the Nobel Price in economics 1987 stated that "we see the computer age everywhere except in the productivity statistics" (New York Times Book Review 1987). Yet, the well established view today is that IT-intensive firms are more productive (e.g. Dedrick et al. 2003, Aral et al. 2006). According to Brynjolfsson & Hitt (1998), the critical question for IT managers is not "Does IT pay off?" but "how can we best use computers?"

There has been further debate about the causality of IT productivity impacts; according to Aral et al. (2006), the critical question actually is that does IT cause productivity or do productive firms simply make more IT investments? Both alternatives would lead to similar results in statistics if a comparison of company IT intensity to productivity is used as an indicator. Yet, by examining a comprehensive data set they find that firms, who successfully implement IT, react by investing in more IT initiating a "virtuous cycle" of investment and gain.

Brynjolfsson & Hitt (1998) refer to business value of IT as its ability to contribute to productivity growth. Productivity is defined as the amount of output produced per unit of input, say for example the amount of products coming out from a production line per labour hours. If people would only work harder or use additional other resources to increase output, they would at the same time increase input and the ratio wouldn't change. If the production line is automated, on the other hand, eventually more output can be produced with same human input. Productivity growth thereby comes from using resources more efficiently, or as Brynjolfsson & Hitt (1998) express it "productivity growth comes from working smarter". This is the promise of computers; this is what IT should be able to offer.

In the case of an automated order-to-pay process, probably a better way to describe productivity impacts would be "less human input is needed to produce the same amount of output". This is drawn from the idea that buying i.e. ordering products and paying for them is something that every company has to do to be able to produce output. The objective hardly is to buy more or pay more bills with the existing resources; it is rather to sell more, order accordingly and pay but try to do it as effectively as possible. Thus, the intuitive business impact of this process would relate more or less to avoiding costs instead of making profits. This is based on the assumption that purchasing capacity and efficiency is not standing in the way of business growth. Hence, the productivity impacts of automating this supportive business process should come out cost-centric.

It has to be kept in mind though that other inputs and outputs besides production quantity and labour hours have to be taken into account when evaluating IT productivity. The problem is that inputs and outputs are often difficult to observe and measure. "Tons of steel" would have been a reasonable estimate for the value of output fifty years ago but nowadays value depends increasingly on intangible variables such as quality, convenience and timeliness in addition to the amount of products produced (Brynjolfsson & Hitt 1998). As for the inputs, there are also many other variables involved besides labour hours and IT investment e.g. staff training and business process redesign efforts.

In fact, Brynjolfsson (1993) states that one of the possible explanations for the productivity paradox could be mismeasurement of inputs and outputs; benefits managers often attribute to IT such as increased quality, variety, customer service, speed and responsiveness are not well accounted for in the productivity statistics nor in other company accounting numbers. On the other hand, input figures can be overestimated. Sometimes the metrics are simply out of place. For example, consider that banks use the number of written cheques as an indicator for output. The increasing number of automated teller machines (ATMs) naturally leads to fewer checks being written and can thereby actually result in productivity reduction in light of statistics (Brynjolfsson 1993).

Before going any further, perhaps it is better to identify the different levels of impact in IT business value research. So far we have discussed productivity as an indicator for success. But is productivity everything? Brynjolfsson & Hitt (1998) point out that according to "economist Paul Krugman[2], in the long run it is almost everything", because it determines no less than our living standards and the wealth of nations. This clarifies that the discussion about productivity in IT business value research evaluates direct company level IT impacts and even goes as far as trying to explain macro-level impacts of IT usage.

[2] Economics Nobel Prize Laureate 2008

Overall productivity numbers, however, reflect the *average* individual companies' performance. Ray et al. (2005) suggest that even if IT improved efficiency and effectiveness in an absolute sense, it might not improve company performance relative to competitors. For example, process automation surely saves time and improves quality for the individual company but relative advantage depends on how widely diffused the technology already is or how easy it is to imitate. Brynjolfsson (1993) suggests that this could actually be a reason for the macro-level productivity paradox i.e. "IT rearranges the shares of the pie without making it any bigger".

Brynjolfsson & Hitt (1998) discover that according to statistics, there is actually huge variation in productivity and IT investment across firms. However, when the results are plotted and a line drawn through, it slopes upwards meaning that firms with more IT investments are compensated by increased output. The authors explain that variance by proposing that about half of IT value is due to unique characteristics of firms and the other half shared generally by all firms. They argue that the greatest benefits of IT investments emerge when implementation is accompanied with other complementary investments, such as new strategies, training and *business process redesign*. Dedrick et al. (2003) conclude, based on an extensive review on studies related to the subject, that IT investments are not just tools to automate existing processes but enablers of organizational change which eventually leads to performance improvements.

According to Tallon et al. (2000), some insights into IT payoff can be attained by firm-level research on the "productivity paradox", principally in the form of returns on IT investment (IT productivity on the company level can be measured by comparing some IT factor to an organizational performance measure, e.g. annual IT expenditure vs. pre-tax profit). They argue, however, that too little attention has been given to other IT impacts such as improved inventory management, greater product variety and customer service. To be able to fully understand the benefits, they claim, additional metrics should be considered.

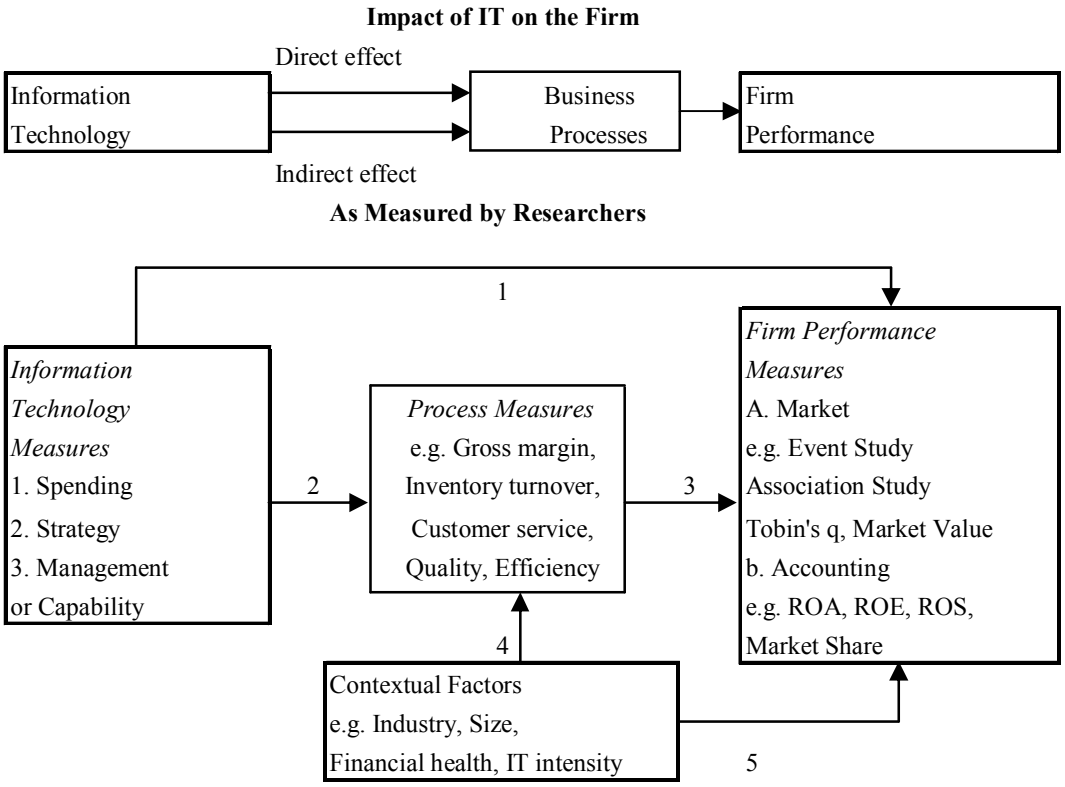
Although the discussion so far has provided few practical tools for assessing the business value of IT regarding this study, some valuable points have emerged. First of all, it is crucial to see that there is a variety of tangible and intangible variables to consider – maybe not all IT investments are made simply to cut cost. Second, a process management and design view should be highlighted when building the metrics. Gonzales-Benito (2007) found that IT investments have positive effect on operational purchasing performance since the use of IT allow companies to adopt certain purchasing practices and facilitates greater strategic integration of the purchasing function. Finally, it has become clear that majority of the literature reviewed so far aim to measure direct impacts of IT on company level performance or even on a wider scope. Now the question remains how to measure business impacts of an electronic order-to-pay process; one specific business activity inside a company?

To gain insight on activity-specific impacts inside the process, it has to be split open into smaller phases, try to identify the attainable benefits in each phase and build metrics for them first. This will, however, result only in a list of operative-level measures which hardly give much insight on business impacts of automating the entire chain. On the other hand, the overall company, industry or macro-economic level analysis of IT productivity impacts are too general and cannot provide information that is accurate enough for process monitoring purposes. Thus, there should be some instrumentation in the middle to combine lower-level measures to top-level business impact indicators.

According to Silvius (2006), there are two distinct approaches to be found in IT business value literature; the variance approach investigating *what* the relationship between IT investment and organizational performance is, while the process approach tries to find out *how* this relationship works. Most research presented so far try to explain the productivity paradox by investigating direct company level impacts of IT and thus falls under the "variance approach" category. A growing body of IT business value research, however, prefer the process approach, suggesting a multi-dimensional impact structure in the organizational hierarchy.

To clarify the different research approaches in evaluating relationship between IT and firm performance, Dehning & Richardson (2002) propose three common research paths (plus two additional paths) presented in the figure underneath:

Figure 2.1 Research paths in IT value research



Source: Dehning & Richardson (2002)

Path 1 is a direct link between IT and firm performance, whereas in paths 2 and 3 IT is considered to impact firm performance through business processes. Research in path 1 evaluate IT impacts by using market measures such as market value or accounting measures such as ROA and market share. On the other hand, research in path 2 describe the relation between IT and business process performance by measuring e.g. customer service, quality and inventory turnover. Path 3 then describes how these process measures combine or interact to determine overall firm performance. Paths 4 and 5, in turn, explain how conceptual factors such as firm size and industry affect process and company level performance.

Dehning and Richardson (2002) review a comprehensive set of studies and list

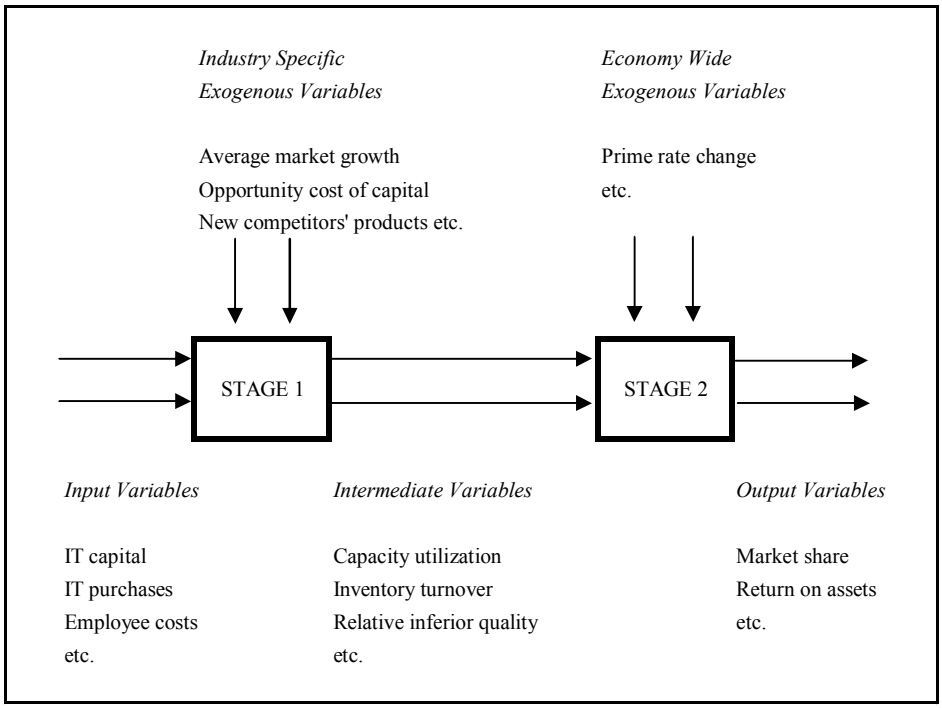
them according to paths used in each study. To create a link between this description and the literature reviewed in the this chapter, it is clear that studies on productivity and productivity paradox by e.g. Brynjolfsson (1993) and Brynjolfsson & Hitt (1998) walk path 1 discussing direct company level IT impacts. Since the purpose of this paper is actually not to find out what the business impact of process automation is, but rather to investigate how it is created, we should walk through paths 2 and 3 – use intermediate process-level measures in the middle to evaluate IT business impacts. Thus, the *process approach* is chosen as the theoretical approach in this study. It is therefore necessary to familiarize oneself more deeply with literature on the subject i.e. process-oriented approach and multi-stage models.

2.2 Process-oriented approach for evaluating IT business value

According to Barua et al. (1995), the growing concern of scholars is that IT effects on the enterprise level performance can be identified only through *a web of intermediate level contributions* - there is some evidence that IT impacts exist and that they can be detected by lower-level analysis in the organization. The lower level impacts, in turn, are expected to affect higher level performance measures. To evaluate these, Barua et al. (1995) propose a process-oriented methodology, which involves a two stage analysis of intermediate and higher level output variables[3]. They strive to open up the black box of IT usage, detect and measure IT impacts where they occur - their main thesis is that economic contributions of IT can be measured at the operational level, where IT systems are implemented. The higher order impacts can be then traced through a chain of relationships within the organizational hierarchy.

[3] The 1995 article "Information Technologies and Business Value: An Analytic and Empirical Investigation" published in *Information Systems Research* by Barua, Kriebel and Mukhopadhyay is cited in 161 academic papers until this day (ISI Web of Knowledge)

Figure 2.2 Two-stage model for evaluating IT business value

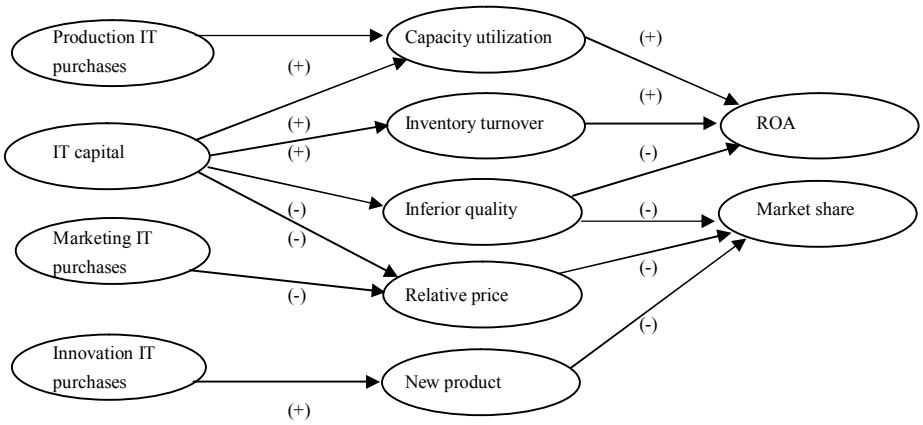


Source: Adapted from Barua et al. (1995)

The different level variables are connected in stages 1 and 2 so that first, an intermediate variable is a function of some input variables and industry specific exogenous variables e.g. capacity utilization is a function of IT capital, market growth etc. Similarly, final performance variables are functions of some intermediate and economy wide exogenous variables, for example market share is a function of relative quality, prime rate change etc. These connections then form a hierarchical chain of impacts.

Barua et al. (1995) test their model with an empirical study and find more or less significant impacts on two stages, presented in the figure underneath. Without going through a further analysis of the results here, these findings highlight the original thesis proposed by the authors - the most significant contributions of IT investments occur at lower organizational levels near where they are implemented. The intermediate contributions, in turn, affect final output measures.

Figure 2.3 Empirical findings on IT business impact relationships



Source: Adapted from Barua et al. (1995)

Barua et al. (1995) begin with the idea that company performance comprises of performance generated by its strategic business units (SBUs) such as production, marketing and innovation. Each of these primary and secondary activities, in turn, is expected to have multiple applications attached to them in any medium or large organization. The authors claim that the effectiveness of IT applications *is not uniform* across all activities. Thus, a direct firm level IT impact evaluation does not provide visibility that is necessary for well-grounded managerial decision making, since it simply aggregates impacts of all IT applications across activities.

Instead, Barua et al. (1995) suggest that IT impact analysis is better done on the activity or function level. Application level would be even better in terms of accuracy, but since there can be a significant total number of applications in a company, a comprehensive analysis of all applications would require a huge amount of data. Another problem, they claim, is that allocation of resources consumed in each application may not be easy to address. Activity or function level analysis makes better sense because inputs and outputs are easier to estimate, still being able to deliver results that are reasonably informative and accurate enough. To justify for the function level analysis in particular, the authors state that budgets are usually still appointed according to functional division, thus making it easier to evaluate inputs.

As for this study, the order-to-pay process could be seen as one of these business activities that *contribute* to company success. For clarification, the activity could be further divided according to traditional business functions: ordering, invoicing and payment. IT initiatives and investments i.e. input in a particular function should affect some intermediate measures on the process level and finally contribute to overall IT business impacts i.e. output. Putting it to case-specific terms, automating an order-to-payment process yields application-specific impacts and through some yet unidentifiable intermediate variables contributes to overall IT business value for the company.

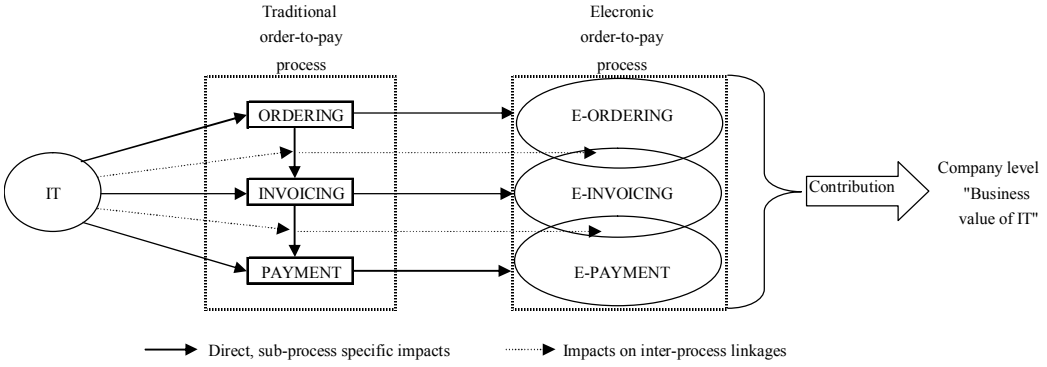
An important side note to make here is that actually, the functions; ordering, invoicing and payment are better yet sub-processes of the order-to-pay activity. Tallon et al. (2000) argue that IT creates value for the company via individual business processes, or *inter-process linkages*, or both – the greater the impact of IT on processes and inter-process linkages, the greater the contribution of IT to firm performance. This encourages investigating IT impacts of individual sub-processes e-ordering, e-invoicing and e-payment but also pay great attention to IT impacts on inter-process linkages – in other words investigate the impact of *electronic integration* in an order-to-pay process.

Grouping IT impacts to three levels; application-specific impacts (e-ordering, e-invoicing and e-payment), integrated process level impacts (order-to-pay) and finally company level business impacts helps to clarify the "big picture": First of all, the use of IT impacts sub-processes directly, resulting in some impacts which are specific to each function. Second, IT usage impacts the entire order-to-pay process via inter -process linkages thus enabling full chain optimization. Finally, linkages between process and company level reveal the *contribution to business value* of IT. Note that to assess the overall IT business value of the company, we are still missing IT impacts on other company activities and the entire integrated supply chain or network.

The aim in this paper is thus to investigate these three levels of impacts and build

metrics to measure them. In this case, the hierarchy should be constructed so that the lowest layer comprises of the electronic order-to-pay process and its phases. They should be attached to top-level performance measures through some intermediate metrics. Deeper examination of the impacts and related metrics follows in chapter five. In measuring business impacts of IT in an *electronic* process, the generic idea is to see how business performance changes when "e" is put in front of ordering, invoicing and payment.

Figure 2.4 Conceptual model for investigating order-to-payment cycle IT impacts

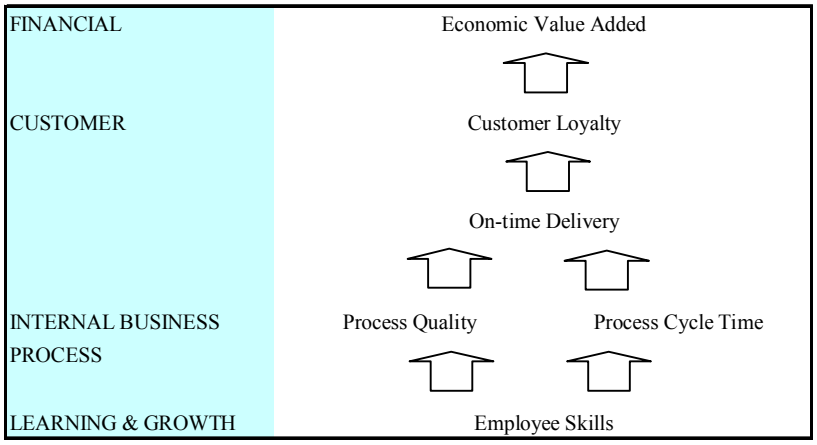


2.3 Uncovering the hierarchy; identifying chains of IT impacts

To better identify chains of different stage metrics for IT impact evaluation, some studies have borrowed a very well known multi-stage framework from strategy literature. The Balanced Scorecard, introduced by Kaplan and Norton in 1992, is a tool that translates a company's mission and strategy to a comprehensive set of organizational performance measures across four linked perspectives: financial, customer, internal business process, and learning and growth (Kaplan & Norton 1996). The Balanced Scorecard communicates a holistic model that links individual efforts and accomplishments to business unit objectives through a consistent series of objectives and measures. The idea is that each individual person could see how their efforts contribute to achieving broad organizational goals, thus offering means for organizational learning and improvement.

To be able to track these linkages, the model needs to be more than a collection of critical indicators – the scorecard incorporates a complex set of cause-and-effect relationships among outcome measures and the related performance drivers. These relationships can be then traced trough sequences of "if-then" statements. To clarify this, Kaplan & Norton (1996) gives an example (figure 2.5 underneath):

Figure 2.5 The balanced scorecard chain of cause-and-effect relationships



Source: Kaplan & Norton (1996)

To start the analysis top-down, suppose that economic value added (EVA) has been chosen as a financial output measure in the scorecard. First, the performance driver for this is identified to be repeat and increased sales from existing customers. Customer loyalty, in turn, is needed to achieve this. Further, on-time delivery is highly valued by customers and thus included in the customer section of the scorecard as a driver for loyalty. The next step is to identify what internal processes the company must excel at to achieve improved on-time delivery – e.g. shorter process cycle times and quality. As for the last link, these process improvements can be made through training and improving the skills of their operating employees.

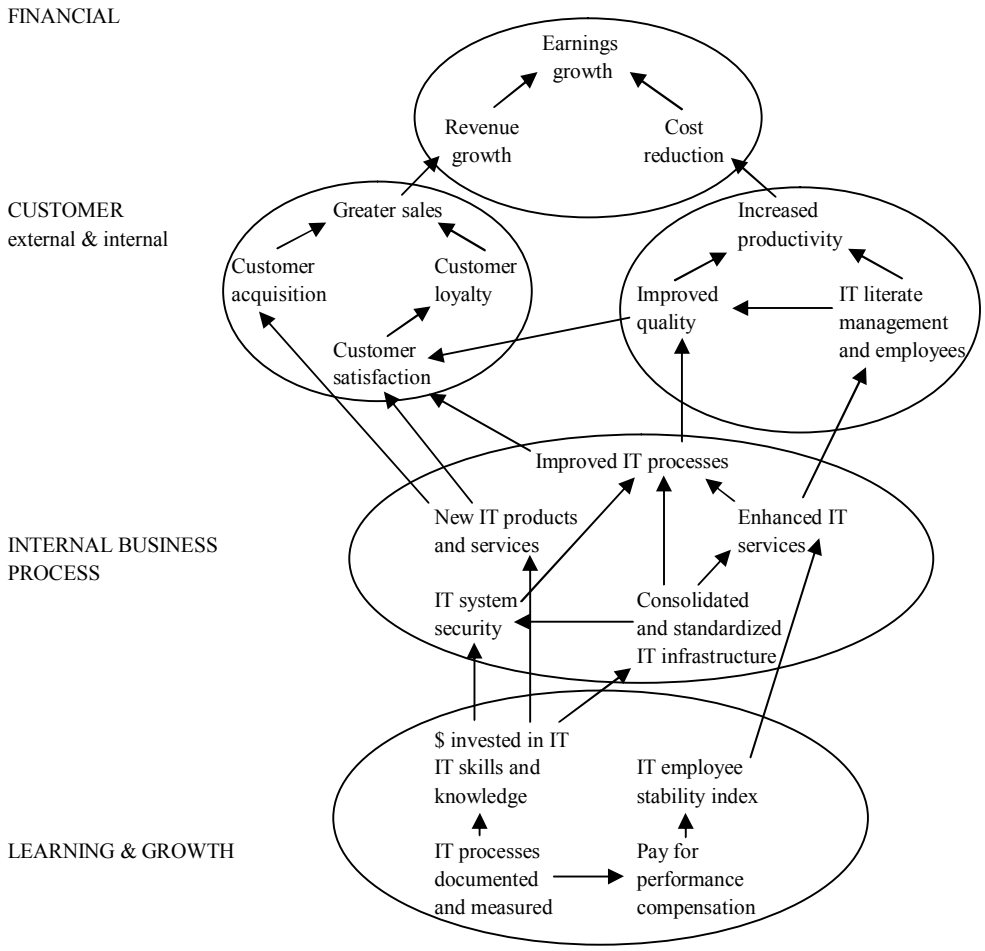
The same chain can be formulated bottom-up as well, by making a series of if-then statements: *If* employee skills improve due to training etc, *then* these employees are presumably able to produce higher quality output in less time, if process quality and cycle time improvement is achieved, then the percentage of

products delivered to customers on time will increase, if on-time delivery improves, then customer satisfaction increases, if customers are more satisfied, then it will eventually lead to customer loyalty, and finally if customer loyalty is achieved, then economic value added is affected through repeat and expanded sales from existing customers.

To put the long story short, efforts in improving employee skills affects EVA though a chain of impacts in the previous example. Respectively, efforts to increase IT intensity in a specific function could be seen to affect company level financial measures through a similar chain. Following this idea, Epstein & Rejc (2005) introduce the IT Balanced Scorecard - a tool to tackle the problem of properly measuring and evaluating IT payoffs. The authors argue that an IT performance measurement and management system must focus determining the key drivers of IT success and the causal relationships among them and develop numerous performance measures to track IT performance. They develop an IT Balanced Scorecard to help uncovering these measures, drivers and linkages.

Epstein & Rejc (2005) follow the guidelines by Kaplan & Norton by including the original four perspectives in the model; learning and growth, internal process, customer and finally financial perspective. As for the input, company IT success depends on various learning and growth related elements, such as IT capital, people training, performance measurement and incentive systems, and behavioural effects. IT learning and growth then affects internal processes, such as standardization, integration, security and overall quality of IT processes. Next, the authors divide the customer perspective further in to internal and external customers; internal customers' satisfaction reflects in their increased productivity, quality of work etc. External customers' satisfaction, in turn, will lead to higher customer loyalty, new customer acquisitions and greater sales. The internal customer perspective finally impacts financial measures from the cost reduction side whereas external impacts the increased revenue side.

Figure 2.6 Causal relationships in the IT Balanced Scorecard



Source: Epstein & Rejc (2005)

Now the question remains whether to start from the lower level performance indicators or to go top-down? There is hardly any use for a list or "catalogue" of lower-metrics picked up from literature without deeper understanding of their relationships to corporate strategy. There are quite a lot of different-type metrics proposed in literature and the managerial problem might be that which metrics to choose or prioritize. According to Kaplan & Norton (1996), all scorecards use some generic outcome measures which reflect the common goals of many strategies. However, the lower level performance drivers tend to be business unit specific.

For example, a company whose main goal is improve efficiency with e-purchasing should probably not use customer service-related metrics to monitor

process performance. Therefore, business professionals should approach monitoring top-down. However, in building the metrics it is inevitable to begin with the floor level; collect detailed perceived benefits of different process phases to identify improvements that can be achieved and then formulate metrics to monitor success in those dimensions. It must be kept in mind though, that performance in these does not necessarily reflect the impacts of automating the entire cycle; therefore intermediate process level variables are needed.

2.4 Applications; Business Activity Monitoring and Key Performance Indicators

As for the management information system point of view, it should be wise to have a look at commercial process management applications as well. First introduced by Gartner, Inc, Business Activity Monitoring (BAM) is software used for monitoring business activities by aggregating, analysing and presenting real time information about operations, processes and transactions inside an organization[4]. The goal of BAM is to enable better informed business decisions, identify problem areas in real time and allowing companies to take full advantage of emerging opportunities by re-positioning themselves when needed (Jiang et al. 2007). The top-level monitoring is done via Key Performance Indicators (KPIs) visible on a BAM dashboard. KPIs, on the other hand, consist of underlying lower-level operational performance indicators. In other words, KPIs represent the measures comprising of underlying metrics.

BAM projects in real life usually concentrate on some specific stream, including only a couple of transactions[5]. As for this paper, BAM should be considered rather as an analogy. The point of contact for BAM and this study is related to the long-term vision of creating a "dashboard for electronic order-to-pay process".

[4] Labelled "Business Process Intelligence", Tieto Corporation is developing similar tools for proactive process management

[5] Expert interview: Tapani Turunen, Tieto Corporation

The focus is on sketching a conceptual framework and outlining performance indicators, rather than "implementing applications".

BAM is used in many business areas and industries. Coming back to the paper machine analogy, an often used key performance indicator in manufacturing is Overall Equipment Effectiveness (OEE). It is a hierarchy that comprises of four performance indicators; the top-level OEE and three underlying measures: availability, performance and quality. The purpose of the OEE metric is to directly indicate the gap between actual and ideal performance by measuring how well a manufacturing unit performs relative to its capacity. On the other hand, the purpose of the underlying metrics is to identify why and where the performance gap exists (Jonsson & Lesshammar 1999). The electronic order-to-pay process could be seen as a machine of some sort as well - it is a process that consumes inputs and produces outputs. Perhaps the use of OEE-type performance indicators could actually help in steering the business activity.

As mentioned, it is clear that there is a variety of performance indicators to be considered relating to the electronic order-to-pay process. One area that would be interesting to study regarding KPIs is Supply Chain Management since there is, in addition to process industries, a strong link to SCM in this study as well. Carman & Conrad (2000) argue that successful KPIs in the SCM context are not just internally focused metrics, but also forward facing and focused on the customer. Even the intra-company measurements must be directed towards improving execution to meet customer requirements. Customer-driven measures often provide an early warning long before profit impacts of not meeting customer requirements become visible on the financial statement. Such fast-feedback measures need to be included in the metrics model. All in all; this clarifies that we should not use measures that only evaluate internal efficiency, but external market-driven performance needs to be considered as well.

The earlier presented Balanced Scorecard is actually a commonly used tool for supply chain performance monitoring. To mention another similar type of tool,

the supply chain operations reference model (SCOR) has been used as an enabler for process-oriented supply chain business intelligence. For example, Gulledge et al. 2008 strive to automate the SCOR model by using data from integrated enterprise systems (Oracle E-Business Suite). They argue, that to achieve full benefits from the SCOR model, effective business process management and the SCOR KPIs must be implemented and used. They propose indicators such as order fill rate, fulfilment lead time, total supply chain costs, material acquisition and net asset turns as the SCOR top-level KPIs.

Now the question remains, how to formulate and choose the right KPIs? According to Maskell (1989), there are seven principles in performance measurement system design:

1) the performance measure (or KPI) should directly relate to the firm's strategy;
2) non-financial measures should be included;
3) measures should vary between companies and departments;
4) measures should change according to changes in circumstances;
5) measures should be simple and easy to use;
6) measures should provide fast feedback; and
7) measures should stimulate continuous improvement

Actually, the target of this study is articulated in principles 6) and 7); the idea is to build measures and metrics that would provide fast (real-time) feedback on performance, thus enabling managers to react fast and continuously improve operations. Also, we have already recognized the need for non-financial measures (2). As for the other principles, it should be kept in mind further in the paper that first, measures should be simple and easy to use (5) and they should be changed when circumstances change e.g. now during an economic downswing, companies might want to emphasize cost avoidance (4). In general, the message in (1), (3) and (4) is that measures are context-dependent, whether dictated by strategy, location or environment. In this paper, the starting point is to consider metrics that

are specific for the studied process and then precede bottom-up and create a holistic model for monitoring top level business impacts of the whole order-to-pay process, regardless of specific strategies or contexts. The idea would be that managers could then use the tool top-down, emphasize measures that relate to their company strategy and/or circumstances and then pick metrics accordingly.

3 PROCESS DESCRIPTION

A business process is "the specific ordering of work activities across time and space, with a beginning, an end, and clearly defined inputs and outputs" Davenport (1993).

Idea behind the Full Value Chain concept and this study is that e-ordering, e-invoicing and e-payment should be integrated to be seen as a single process rather than separate functions. The current interest is particularly in the step of integrating e-ordering in the chain; e-invoicing and especially e-payment systems are already quite widely adopted. Therefore, special attention in this study has been given to describing the e-ordering process.

Terms e-procurement and e-ordering are used somewhat inconsistently in literature. It is crucial to notice that they are two different things, in fact, e-ordering is an individual part or phase of e-procurement and thus is included in the term e-procurement. E-procurement additionally includes contracting and sourcing issues among other things. Actually e-procurement can be seen to include e-invoicing and e-payment as well. Thus, the electronic order-to-pay process can be seen as the "tail" of an e-procurement process.

To be able to set proper bounds for the electronic order-to-pay process, piece together and build a structure around it, careful examination of the sub-processes is required first. Once compositions of the sub-processes are clearly defined and illustrated the last step is to combine them and build a comprehensive process description of the entire flow.

3.1 E-ordering process

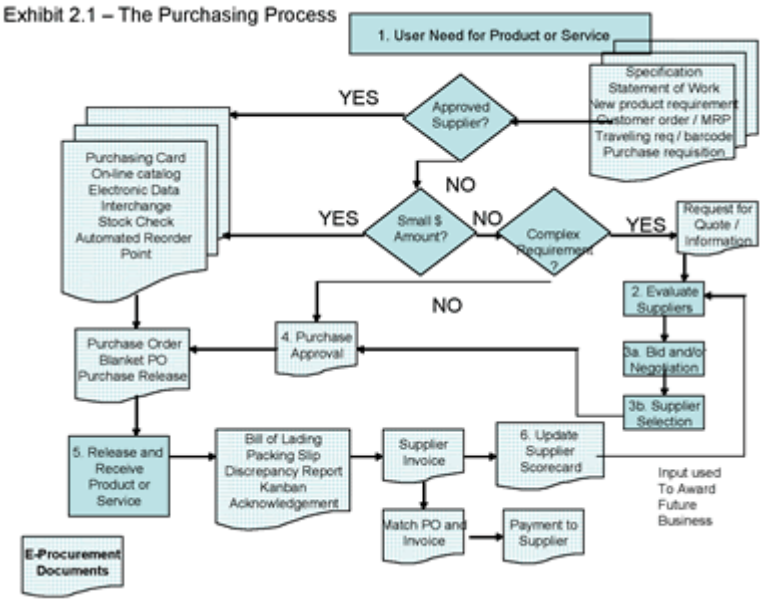
To start off, Brun et al. (2004) divide the *e-procurement* process into five phases:

1) *Order request*. After identifying a need for some components or items, internal operators transmit an order request to the purchasing department.
2) *Order acceptance.* Orders are accepted after verification of needs and budget limits.
3) *Order emission.* Order requests are put together and sent to a selected supplier. All order information is recorded in the company information systems; users receive confirmation of the purchasing activities made.
4) *Order receipt.* Received orders are checked for errors and suppliers contacted. Finally the users get information of the availability of goods.
5) *Invoices filing.* Suppliers send invoices, once the goods have been delivered and accepted. The receiving company monitors them before payment.

The reason for choosing this particular division as a starting point for constructing the process description is that the article by Brun et al. (2004) discusses value assessment of e-procurement projects and proposes performance indicators for each of these sub-activities. Building performance indicators or metrics is exactly the purpose of this study as well. Another supporting argument relates to the mention of the current challenge being in the e-ordering phase. Ordering comprises of quite a long chain of transactions and thus it seems reasonable to investigate IT impacts similarly to Brun et al. (2004) i.e. by dividing the process into even smaller sub-phases.

The next purchasing process flow chart was used to get visual insight on the e-ordering process description.

Figure 3.1 Electronic purchasing process



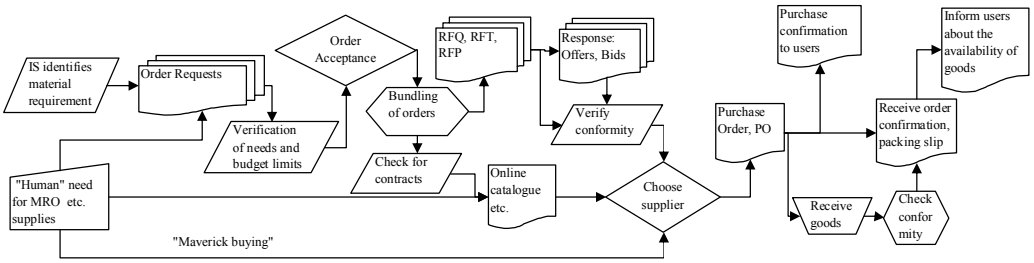
Source: Supply Chain Management Portal (2008)

There is one more thing that has to be noted regarding the starting point of the ordering process. In the picture above, process flow is initiated by "User need for product or service". Chang et al. (2004) divide procurement into two main categories: Indirect procurement refers to non-production oriented purchasing of goods and services such as maintenance, repair and operating (MRO) supplies. Direct procurement refers to purchasing for production requirements i.e. raw materials and parts needed for producing the final product.

Direct purchasing can utilize IT to the fullest; ERP systems are able automatically identify raw material requirements for production and replenishment requirements in retail trade etc. Indirect purchases, in turn, are usually initiated by humans but can be semi-automated by using e.g. online catalogues. Thus, it is good to illustrate these two streams separately already in the process flow description. The final electronic ordering process flow description comprises of elements drawn from Brun et al. (2004), the above Supply Chain Management portal flow chart and expert advice[6].

[6] Expert interview: Martti From, TIEKE

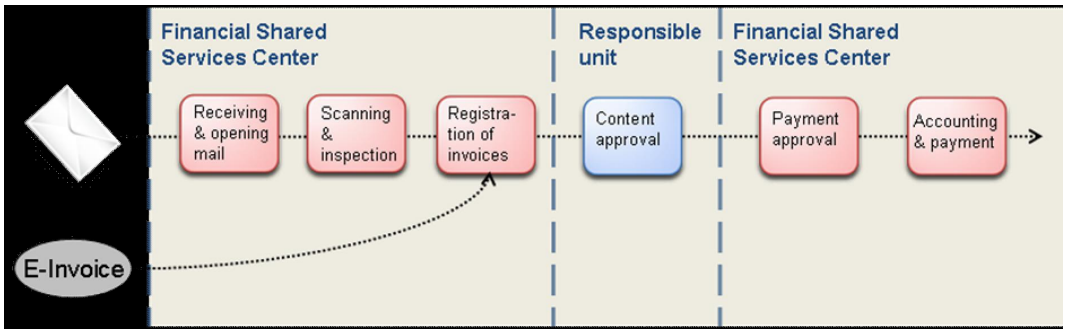
Figure 3.2 Electronic ordering process flow



3.2 E-invoicing and e-payment processes

As for e-invoicing, an example illustration of incoming invoice handling process can be found in Penttinen (2008):

Figure 3.3 Invoice handling process



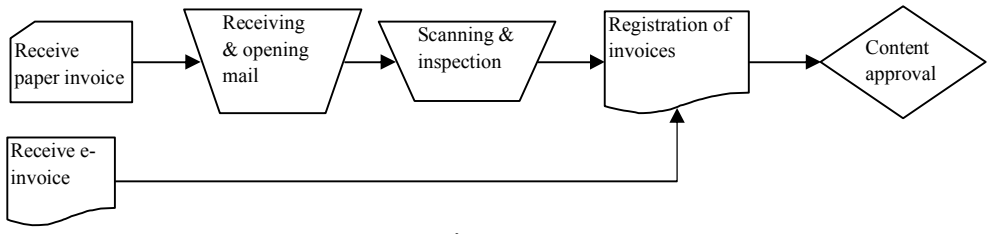
Source: Penttinen (2008)

There are some important remarks arising from the above picture: First, companies usually still receive both, paper and electronic invoices - the current practice in many cases is that the received paper invoices are scanned to company ERP systems, requiring a lot of manual work. E-invoices, on the other hand, are already in a digital format when they come in and thus can be directly registered into the system. Organizations are making efforts to increase the share of incoming electronic invoices, for example by pushing suppliers to send only e-invoices. However, the problem is that only large buyers have the required bargaining power to be able to do this. For example, consider a small supplier whose income is mainly dependent on orders coming from the public sector. Now

if the state decides to receive nothing but e-invoices, the small supplier has no option but to send e-invoices – otherwise the state acquires goods or services from somewhere else and the supplier loses their most important customer.

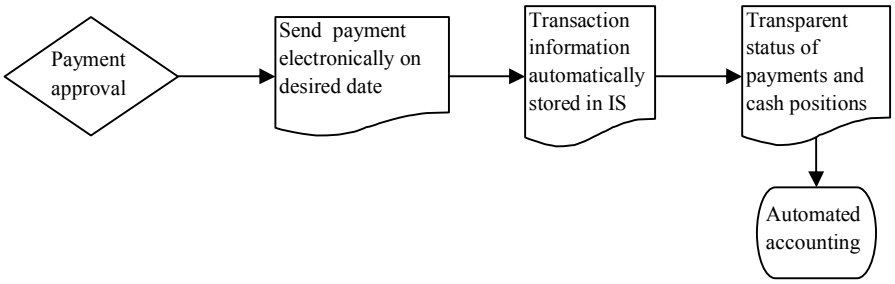
Another point to make is that invoicing activity does not take place strictly inside the invoicing function, but actually extends all the way to *users* who have made the original order request for the goods that are now being invoiced. This aspect should be significant in terms of processing and cycle time reduction. The effects of these remarks are discussed in more detail later. Finally, it seems that the last two steps in the process description by Penttinen (2008) can be better yet assigned to the payment function and are thus excluded from the final incoming invoice handling process flow description here.

Figure 3.4 Incoming e-invoice handling process



Incoming invoice processing and payment cycles naturally have overlapping descriptions in literature, particularly when they are conducted electronically. E-payment is the last stage of the whole e-commerce process and therefore without automating payments, the whole process is not automated (Guan & Hua 2003). A comprehensive description of payment cycles (both paper-based and electronic) can be found in Cotteleer et al. (2007). By combining elements from Penttinen (2008) and Cotteleer et al. (2007), the final yet simple process flow description for electronic payments was formulated.

Figure 3.5 Electronic payment process



What is noteworthy regarding the comparison between paper-based and e-payment in the illustration by Cotteleer et al. (2007) is that it visualizes the payment process efficiency improvement potential. Most of the manual work including check sorting and entering of data into ERP systems is unnecessary and therefore e-payment offers direct cost savings. Checks need not to be shipped anymore between the bank and transaction parties which should allow dramatic cycle time reduction. Due to automated processing, the probability for human errors also reduces.

3.3 Order-to-payment process flow

Finally, all sub-process descriptions were put together in one picture illustrating the entire order-to-pay process flow (Exhibit 1). Note that this is a theoretical description aiming to sketch a "generic" process.

By walking through the process flow description at this point should provide ground for later discussion of impacts and metrics (chapter 5). As already stated process input comes from automated ordering systems (according to production requirements, replenishment etc.) and/or human-initiated order requests. The automatic ordering system sends order request to the purchasing department where IS verifies budget limits and needs automatically before order acceptance. After this, the system bundles accepted orders and checks existing contracts with suppliers if some products could be ordered straight through e.g. online

catalogues. If not, requests for quotation, proposal or tendering are made to elicit supplier offers. As for the human input, they can similarly decide whether to buy straight from a catalogue or make an order request for purchasing. However, the worst case scenario is that people bypass both, contracts and centralized buying and order directly from a random supplier, referred to as "maverick buying".

After the supplier has been chosen, purchase orders are sent electronically and at this point, users get immediate purchase confirmation. Users refer to the people or systems that originally made the order request; the user-related activities are illustrated by painted boxes in the process flow description. It is important to notice that if the stream is fully automated, very little human intervention is required until this point; actually only in order acceptance and in choosing the supplier. Moreover, in the ideal situation these phases require nothing more than pressing the "ok-button" - the information system automatically checks that requirements are met at each point.

In the last phase of the ordering process, order confirmation is received. It contains detailed information of the order, time of delivery, invoice information etc. which is then compared to the actual delivered goods before receiving the bill. At this point it is crucial to note that the electronic order confirmation should be *visible for all immediately*; production knows exactly when to expect raw materials and is thus able to make better production planning, sales people see replenishment schedules and the invoicing department gets immediate information about what kind of invoices are about to come in and when. An incoming invoice can be then automatically verified against the order confirmation and approved for payment again with one "click". The invoicing department is also able to make better workforce resource planning when they know the volume of incoming invoices in advance.

As for the user side, e.g. when raw materials are ordered for production and a paper bill for the goods comes in to invoice handling unit, it would be normally sent forward to the production unit for approval where production personnel

manually checks that what they ordered is in line with the invoice. Then they would send the approved invoice back to the invoice handlers to be sent forward to payment. It's not hard to believe that in large companies, this cycle can take days or even weeks – in some cases even so long that due dates are exceeded and thereby extra interest has to be paid for late payments.

In the case of e-invoices, efficiency in this approval loop can be dramatically improved. Instead of sending papers between units, the e-invoice is directly visible for all units through integrated IT systems. Additionally, the system checks automatically that order confirmation matches with the invoice, thus allowing tremendous reduction in manual handling work and valuable human resources can be used elsewhere. This clarifies that efficiency gains can be attained not only by streamlining activities inside the sub-units, but also by taking advantage of synergy created by integrating these activities. As discussed in the previous chapter, IT impacts on inter-process linkages must be studied as well. An expert commented similar observations from the field - transmission capacity as such is not the issue any longer, the current challenge is better yet how to make different sub-process systems understand each other[7].

After the invoice has been approved by the user, it is transferred to accounts payable. Accounts payable makes a payment proposal which is sent to payment for approval. Payment is then made at the exact time and date that the company desires and payment information is stored in the IS. One more remark regarding e-payments and the inter-process linkages is that since the order and invoicing data is immediately visible to all, they are offered better visibility to cash requirements – how much to pay and when. This will allow better cash management and forecasting. A deeper examination of related business impacts follows in section five.

[7] Expert interview: Jyrki Poteri, Tieto Corporation

4 METHODOLOGY

Since the purpose of this study is to find out how the use of information technology creates business value in the order-to-payment cycle context, the first logical step was to conduct an extensive review over the general subject of business value of IT. It soon became clear that there are two quite different approaches to evaluate the impacts of IT, the variance approach studying *what* the impact is and on the process approach studying *how* this value is created. Process approach was chosen because of its suitability regarding the research question. Literature on process-oriented models was reviewed next. Due to the specificity of the context, I soon realised that there is no possibility to choose only one model and use it as such, but rather combine elements and create an own, modified evaluation tool.

As the second part of the literature review, I collected observed and perceived benefits regarding e-ordering, e-invoicing and e-payment to get in-depth knowledge of order-to-payment cycle automation potential. Also, a handful of interviews with field specialists were conducted to get comments and new ideas for metrics building along the way and gain deeper understanding of the branch. The expert interviews were particularly useful in determining the value created by IT impacts on the inter-process linkages – it is something that until now was perhaps implicitly understood by business people but not explicitly stated in the books. More specifically, to develop the measurement tool, I interviewed industry experts (companies providing e-payment, e-invoice, and e-procurement services, the Federation of Finnish banks, the Finnish Information Society Development Centre etc.) and academic professionals (professors at the Helsinki School of Economics).

The purpose of the model is to offer a holistic view over the electronic order-to-payment cycle. It is a generic evaluation tool which should be adjusted according to the needs and strategies of each individual firm using it. Given the purpose of this tool, it should be interesting to see if it really can be taken back to company

context by conducting an empirical study i.e. test that it can be adopted and if it actually delivers any value to the users.

The original idea was to conduct a survey study for evaluating validity and relevance of the metrics proposed. However, it became evident that it would be very difficult to formulate a questionnaire that would elicit good answers considering the complexity of the subject. On the other hand, it is clear that since we are only taking the first steps towards real-time economy and the full value chain concept, companies might still be quite unfamiliar with the topic. Integrating ordering systems in the electronic value chain is something that only precious few companies have done – most companies are still struggling more or less with e-invoices. Hence, at this point of time it would have been challenging to find a sufficient amount of "right" people to answer the questionnaire.

Thus, I chose to narrow down the sample size at first to only one "main" company and make an in-depth analysis. For the illustrative case part, at Marimekko, six people in total were interviewed, each representing different areas that were relevant regarding our study. Interviewing people from buying, invoice handling, treasury, IT system development and supply chain management offered extensive cover over the entire order-to-payment cycle.

Additionally, I conducted two complementary case studies to broaden the angle. It seemed reasonable to investigate different "type" companies; namely manufacturing (Marimekko), retailing and service provider. This offered a good cover over multiple branches and prevented the viewpoint from being entirely one-sided. Case Marimekko is thoroughly reported in section 6.1 whereas the main results from supplementary case studies are reported in short in chapter 6.2.

As stated, I chose to use the case study methodology to illustrate and test how the proposed measurement tool works. The case study methodology has distinct advantage when a "how" or "why" question is being asked about a contemporary set of events, over which the investigator has little or no control (Yin, 1994). This

research discusses how companies use information technology in their financial administration and what factors and measures they perceive as important in the process.

Furthermore, the strength of the case study approach is that it enables the capture of "reality" in considerably greater detail and the analysis of a considerably greater number of variables than is possible with many other approaches (Galliers, 1991). This was especially important regarding this work as the objective of was to find the underlying measures to IT investments in financial administration, and not just the company policy statements. However, any generalizations regarding the topic cannot be made based on case study results and thus there is need for future research to take a more quantitative approach to the subject.

5 BUILDING MEASURES FOR ORDER-TO-PAYMENT CYCLE AUTOMATION

In developing the measurement tool to analyze the order-to-payment cycle, the process view discussed above is adopted and the order-to-payment cycle is divided into three distinct processes: e-ordering, e-invoicing, and e-payment.

5.1 Operative level impacts and metrics

The purpose of chapter 5.1 is to primarily review literature on impacts of automating ordering, invoice processing and payments. First, particular impacts on each function are discussed separately in subchapters 5.1.1 – 5.1.3 and metrics to measure them are formulated. Finally, in chapter 5.2 all measures are put together and an end-to-end hierarchical structure of metrics is presented.

5.1.1 E-ordering impacts and metrics

The classic argument for adopting e-procurement systems is that it creates substantial cost savings (e.g. Bakos 1997). To find out how these savings can be achieved, Johnson & Klassen (2005) discuss three different dimension of e-procurement in their article; e-sourcing, e-coordination and e-communities. Many e-procurement studies address *e-sourcing* issues e.g. the emergence of electronic (reverse) auctions and other transparent e-marketplace structures which have allowed companies to negotiate better prices for purchases and reduce search costs etc. *E-communities*, on the other hand, refer to different e-procurement systems platform structures. Proprietary platform procurement systems are closed links between buyers and suppliers (often EDI-systems), open platform procurement systems are open Internet-based systems and hybrid platforms have elements of both.

Probably the most important dimension regarding this study is *e-coordination*. It is defined as the technologies that automate business processes both within the organization and with suppliers. Examples include electronic purchase-order systems, online catalogues and such. Johnson & Klassen (2005) argue that according to many studies e-coordination seems to have a greater positive impact on performance outcomes compared to e-sourcing. They note that reported benefits of e-coordination are diverse and varied, including cost savings from process improvements (less slack and reduced rework due to errors), price reductions, greater visibility of orders and enhanced inventory turnover and accuracy, among other things. Also, it has been reported that fewer Request for Proposals (RFPs) elicit no bids when sent electronically.

Ordering automation can lead to purchase price reductions due to multiple reasons. First, since e-ordering allows better coordinated and centralized buying, orders can be bundled to be able to negotiate volume discounts. Second, e-ordering systems provide a transparent bidding platform for a growing number of suppliers, thus increasing price competition. Reduced probability of human mistakes in ordering and storing due to the use of IT allows improves inventory accuracy. Enhanced inventory turnover, in turn, is largely due to reductions in average inventory levels.

Inventory level reductions come from increased inventory accuracy and enhanced transparency of incoming raw material and replenishment deliveries. Other effectiveness and efficiency gains provided by e-ordering systems include lower transaction costs mainly due to less manual work in the process (Presutti 2003) and shorter order cycle times meaning that users receive requested goods or services faster (e.g. Johnson & Klassen 2005, Presutti 2003, Reunis et al. 2001).

At this point it seems reasonable to list the above mentioned impacts and perhaps formulate metrics to measure them. The logic behind metric design is fairly simple; e.g. for the benefit “reduced cycle times” proposed metric would be “e-ordering cycle time” and benefit “fewer RFPs that elicit no bids” could be

measured by "RFP response rate". Unlike the ordering IT benefits and impacts presented so far, Brun et al. (2004) directly propose performance indicators for evaluating IT impacts on each of the five-phase e-procurement process:

Table 5.1 Proposed performance indicators for e-procurement phases

E-procurement			
Phase	*Proposed Performance Indicators*	*Benefit's profile*	*Source*
Order request	Non-value added activities	Low	*Brun et al. (2004)*
	Inventory level	Medium-Low	
	Internal users' level of satisfaction	Medium-High	
	Obsolete inventory	Low	
Order acceptance	Non-value added activities	Low	
	Extra-costs due to useless purchased goods	Low	
	Internal users' level of satisfaction	High	
Order emission	Non-value added activities	Low	
	Paper and phone costs	Medium-Low	
	Errors due to data duplication	Medium-Low	
	Safety inventory/stock-out trade-off	High	
	Inventory management costs	Medium-High	
	Flexibility in changing orders already released	High	
	Mix and quantity flexibility	High	
	Purchasing LT	High	
	Price	High	
	Extra-cost due to non-conformity management	High	
Order receipt	Non-value added activities	Low	
	Paper and phone cost	Medium-Low	
	Conformity of stored goods	Medium-Low	
	Purchasing LT	Medium-Low	
	Internal users' level of satisfaction	High	
Invoices filing	Non-value added activities	Low	
	Paper and phone cost	Medium-Low	
	Errors due to data duplication	Medium-Low	

Source: Brun et al. (2004)

Performance indicators which have not yet been discussed were picked from the list and this time the related impacts were formulated, for example the metric "paper and phone costs" can be seen to measure an impact labelled "reduced paper and phone costs". Some of the metrics were used as such and some with slight modifications e.g. safety inventory/stock-out trade-off was divided into two; safety inventory holding costs and stock-out occasions. By combining all the impacts and metrics presented a final list was created including impacts with short

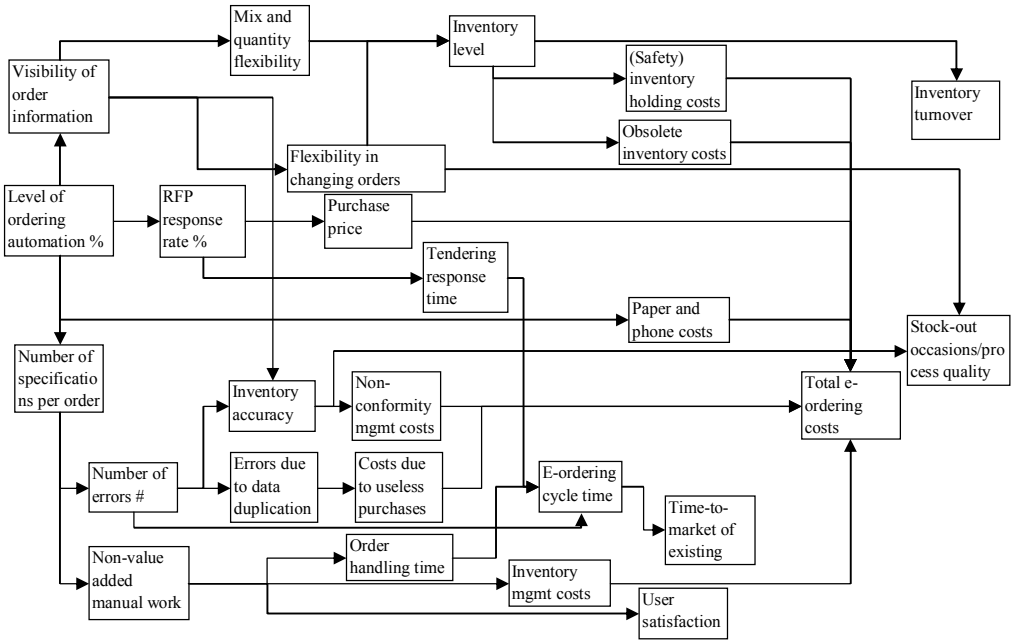
descriptions for each, literature sources and finally the proposed metrics (Exhibit 2).

What we got now is a list of metrics with rather low informative value regarding how they contribute to IT business value. It was earlier discussed that the business impacts are created through a hierarchy of contributions within the organization. Thereby it seems clear that the metrics cannot all be assigned to the same impact "layer" but in stead have to be categorized according to a certain hierarchical division. For example, one particular typing error made by a single invoice handler can influence the output of the whole process thus affecting customer service level of the entire business activity.

Let me give you another example to clarify the above presented idea: by refueling your car, your ultimate goal probably is not to simply run the engine but better yet to get from one place another. The impacts of refueling would thereby be 1) engine runs and 2) one is able to get from one place to another. The latter is clearly a "higher" level goal, for which being able to get the engine running is actually a prerequisite. Similarly, error reduction is not necessarily the main objective when companies implement electronic ordering systems; they rather seek to create economic value added by reducing costs. However, error reduction leads to less manual work in solving disputes thus affecting transaction costs. Again, transaction costs should be considered as higher level impact than the number of processing errors. The message is that the metrics must be somehow categorized, already in this phase.

To start off in building this architecture, the following figure depicts measures for e-ordering process and the main linkages between them. Of course in reality all the metrics are somehow related to each other; however the idea is to identify some paramount cause-and-effect paths between them.

Figure 5.1 Causal structure of e-ordering metrics



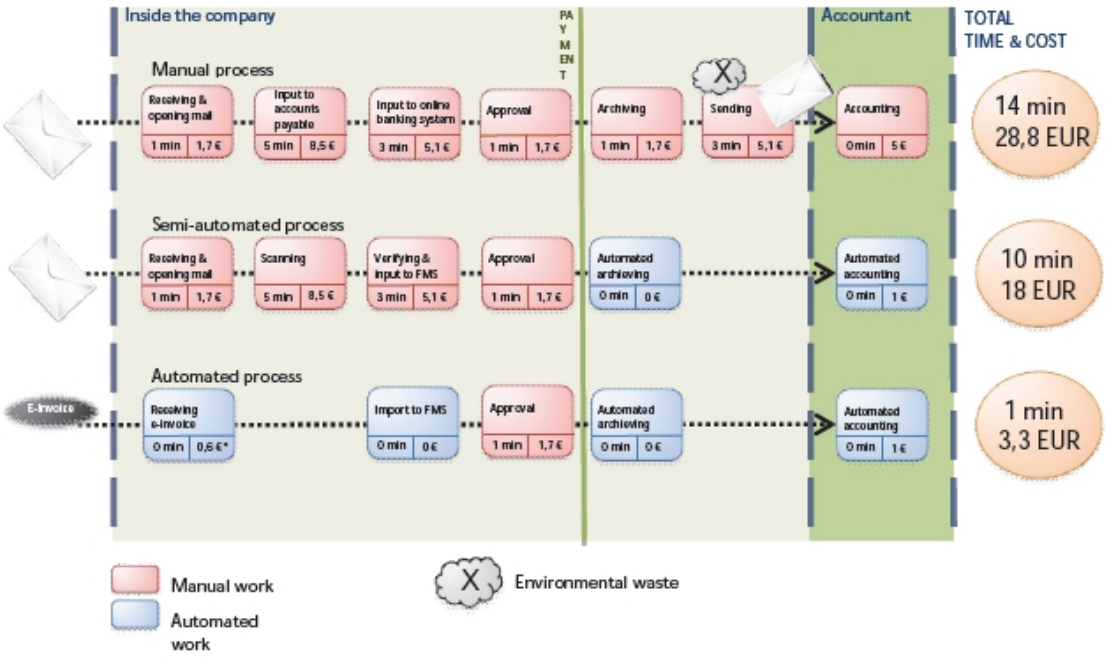
5.1.2 E-invoicing impacts and metrics

Penttinen & Hyytiäinen (2008) argue that adopting e-invoicing has clear benefits; transition from paper bills to e-invoicing brings considerable financial savings. It has been estimated that in Finland, incoming paper invoice incur cost of 30-50 euros to the receiving company. By moving to electronic invoicing, these costs can be cut up to 80% (Penttinen 2008).

To understand how these cost savings can be attained, let us next have a look at an illustrative figure drawn from Penttinen (Ed.) (2008). It depicts the incoming invoice handling process in the context of a micro company and compares the efficiency of manual, semi-automated and fully automated processes. Although the numbers are case-specific, one gets a clear view of the relative differences. The logic behind this picture is of generic nature; incoming invoice handling automation decreases processing time thus allowing cost savings due to reduced manual work. This clarifies that companies are able to realize benefits by semi-automating the process i.e. converting paper invoices to electronic format

themselves, yet more potential is attainable by increasing the share of e-invoices, later referred to as "e-invoice penetration".

Figure 5.2 Handling time and cost of incoming invoice handling phases in the context of a micro company



SOURCE: Penttinen (Ed.) (2008)

Each box contains a number of minutes representing the time it takes to carry out that particular transaction and also its cost in euros. As we can see, much of the invoice handling process can be automated and the potential cost savings are therefore quite impressive; handling time can be squeezed from 14 minutes to only 1 minute and handling costs can be reduced from 28,8 euros to 3,3 euros. In the case of sending e-invoices, the potential for cost savings is actually far more conservative.

As a particular case example Penttinen (2008) found that the city of Tampere, Finland has been able to achieve multiple benefits with the implementation of e-invoicing in 2005. They have managed to cut almost 50% of invoice handling costs, considerably reduce errors in the invoice handling process and free up resources (six to seven man-years) to serve the city in more productive work

areas. The implementation also improved the image of the city as an employer, increasingly attracting young professionals to work for them. On the top of it all, there had been a strong increase in the meaningfulness of work for the invoice handling teams. All the above mentioned workforce-related things combined should lead to enhanced average employee productivity; this impact is measured by the metric "value added per employee" in the model.

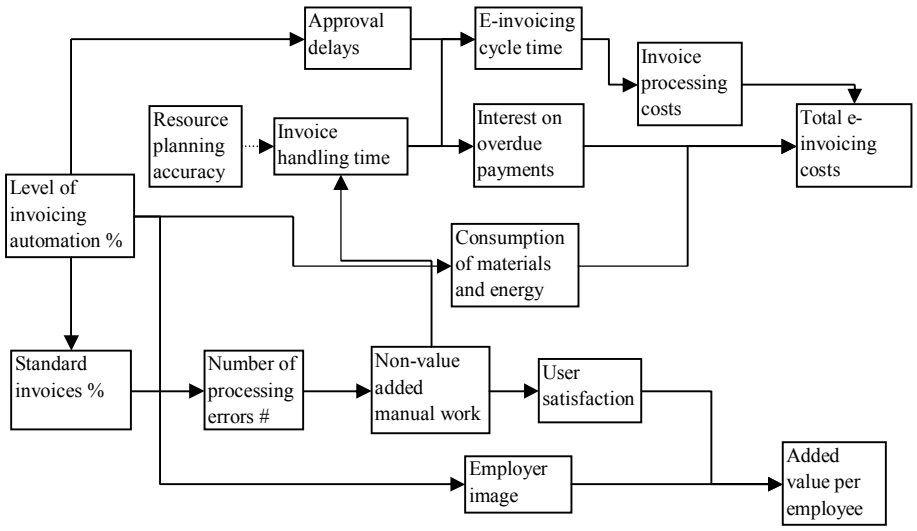
However, it should be noted at this point that the staff-related impacts can be tricky in general, more or less like a double-edged sword. Namely, there is no guarantee that the idle work contribution is used in more productive areas of work. Instead, it might be that the people, who formerly made the routine work, become useless in the sense that they do not have the necessary skills and abilities to do anything else and are therefore being fired. What could happen in fact is that those people are replaced with other people who are more skilful. However, firing people can be financially and "mentally" costly and if the company thereby avoids it, automation can lead to organizational slack rather than profitability improvement.

Other e-invoicing impacts suggested by Penttinen (Ed.) (2008) include increased transparency, improved real-time reporting capabilities and increased number of payments made on time (due to reduced circulation times). From buyers' perspective it can be advantageous in the sense that they do not have to pay extra interest on overdue payments. In addition to enhanced process efficiency they can avoid direct costs! E-invoicing implementation has also major environmental effects; getting rid of paper invoices, i.e. 20 billion letters circulating in Europe would save 400.000 tons of paper, over 12 million trees and 1.350 GWh of energy, among other things (Penttinen & Hyytiäinen 2008). As for the business impact of this, cost effect is clear: direct savings can be achieved through reduced material and energy consumption. On the other hand, revenue-side impacts can be attainable as well; customers today are environmentally conscious and it might be that they see "environmental quality" in products of a company who makes efforts to preserve the environment (green IT).

According to Penttinen (Ed.) (2008) reduction of manual errors in e-invoicing has (partly as a by-product) improved customer service in some organizations. Well this probably concerns more the sender of invoices – incorrect invoices in most cases lead to poor customer satisfaction (e.g. Elisa, the largest mobile operator in Finland lost a great deal of customers, including myself, last year due to poor success in renewing their invoicing systems). However, this is another argument that hints to the direction that there are causal relationships between impacts and metrics and that they *can* be identified. This notion originally encouraged to investigating impacts in the form of a multi-level "tree".

The following figure depicts the measures for e-invoicing process (the complete list is in exhibit 3):

Figure 5.3 Causal structure of e-invoicing metrics



5.1.3 E-payment impacts and metrics

The promise of e-payment has been that they ease payment and lower transaction cost (Southhard 2004). Cotteleer et al. (2007) listed top ten attributes based on perceived value for B2B e-payment users across multiple U.S. industries and found that transaction cost savings was considered most valuable. These cost savings come from improved processing efficiency – no more manual feeding of

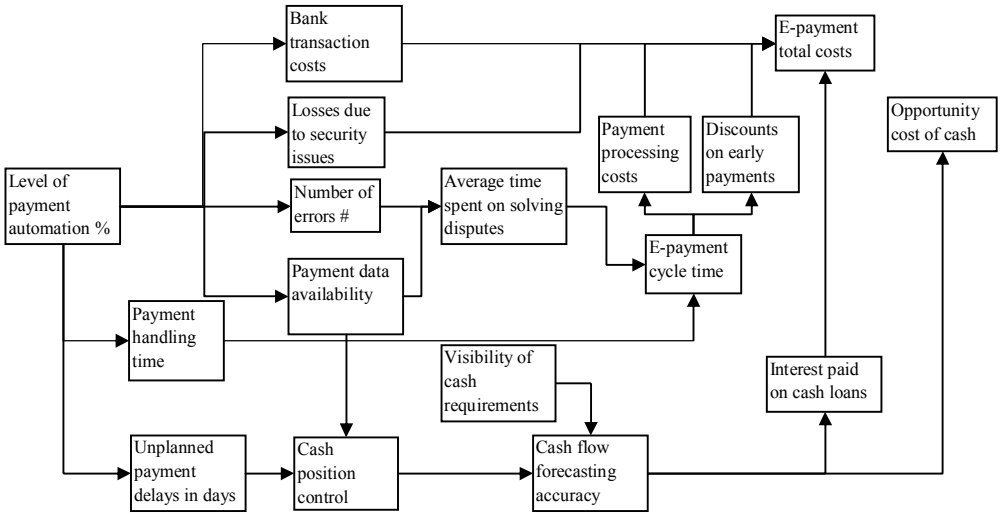
payment information is needed etc. Shorter payment cycles can also result in savings for the buyers in form of possible vendor discounts for early payments (Jolly 2007).

Some of the perceived benefits listed by Cotteleer et al. (2007) such as global coverage and reduction in fraud and credit loss potential relate to electronic payment as a platform. As a particular example regarding global coverage, the Single Euro Payments Area (SEPA) makes all euro-area payments "domestic" by offering a platform where all payments go through a centralized clearinghouse in same time (max. 2 days) and with same bank transaction fees. Hence, particularly in the case of foreign payments it reduces payment delays and allows for improved control of payment timing and cash flow. In general the buyer's ability to control timing of payments improves transparency, auditing capabilities and cash forecasting (Jolly 2007). As for fraud and credit loss potential, the e-payment platform offers a secure and reliable network for sending payments.

A couple of points that need to be addressed regarding the previous paragraph: First, bank fees for e-payments in general are lower compared to paper-based payment methods (Jolly 2007). Second, as for the improved auditing capabilities, there are two benefits in the list presented in Cotteleer et al. (2007) which directly relate to integration of invoicing and payment data into accounting systems, which is the final step in the whole procurement process. RTE program agenda proceeds step by step towards the real-time economy. In the current phase, the emphasis is on automated ordering and integration into invoicing and payment systems. The next phase of the RTE program focuses on automated accounting and thus the discussion should be excluded from this study. That is why there are no metrics appointed to benefits labelled "possess remittance data" and "integrate data and payment information" in exhibit 4. Actually, in the invoicing context the same thing applies to benefit "enable real-time reporting" (Exhibit 3). I will just notify here that further benefits could be attained by extending the full value chain with automated accounting and leave the door open for future research to fill in the gap.

Other e-payment benefits relate closely to improved availability and accessibility of data. All transaction data including detailed order information combined with payment data is directly stored in IS and can be easily found and retrieved thus allowing enhanced reconciliation and dispute management. On the other hand, immediate information of orders made improves visibility of cash requirements. Combined with better cash position control; cash flow forecasting gets easier allowing companies to take advantage of it mainly in two forms. First, in the situation where a company is out of cash they might have the opportunity to borrow money at better rates if they know in advance exactly how much they have to pay and when. On the other hand, excess cash can be invested in more profitable sources i.e. decreasing opportunity cost of cash. Finally, I listed all impacts and measures (Exhibit 4) and constructed a metric tree for e-payment similarly as before with ordering and invoice handling.

Figure 5.4 Causal structure of e-payment metrics



5.2 Constructing the evaluation tool

So far we have reviewed a set of impacts and metrics each assigned to a particular function along the order-to-payment cycle. However, this is insufficient due to a couple of reasons. First, it is challenging to use these function-specific measures as such to indicate the final company level business impact. As earlier stated, we should be able to prevent measures from "floating around" by building a hierarchical structure around them. As a side note, one field expert proposed that the absence of structured evaluation causes real-life business problems; some of the metrics used for evaluating process level performance can be included in cross-organizational service level agreements (SLAs) without actual knowledge of their economic effects. For example, is it better to improve utilization rate by 0.5% rather than reduce cycle time by half a second, business-wise? This leads to operations-driven improvement, rather than business-driven improvement – people in operations do not necessarily know the business impacts of their efforts[8].

Second, it was already proposed that in addition to the individual sub-process level impacts, IT usage actually impacts inter-process linkages as well. Namely, even if companies could squeeze out the full potential of separate phases, it might still be that the performance of the process in total is far from optimal due to inter-functional bottlenecks, slack etc. Therefore we must strive to uncover the linkages between IT inputs on the grass-root level and the company level economic outputs as well as between the three functions. It was already pointed out that there are drivers linking the presented metrics to each other e.g. automated invoicing reduces manual errors leading to increased customer satisfaction. Hence, instead of presenting just a list of impacts and performance indicators, metric "trees" were displayed already for each sub-process visualizing the main cause-and-effect relationships between the metrics. In this chapter, the idea is to continue these paths through the entire hierarchy of impacts both horizontally and vertically.

[8] Expert interview: Pekka Brusila, Tieto Corporation

First, in chapter 5.2.1 we identify different levels of impact, namely function, process and company level, categorize metrics accordingly and thereafter create a bridge between the floor level contributions and the business value of IT by linking different level measures together in a vertical fashion. Next, in 5.2.2 we review aspects related to the horizontal electronic integration between the three functions. Finally, in 5.2.3 we make the finishing touches and present the final vertically and horizontally integrated evaluation tool.

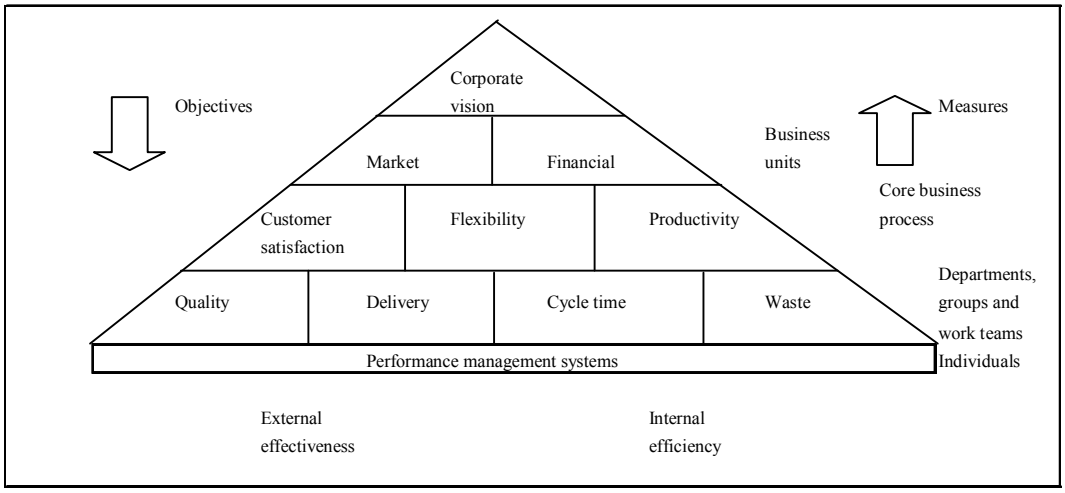
5.2.1 Building the vertical hierarchy

It was earlier justified and decided that this study uses a process-oriented approach for evaluating business impacts of IT. The two-stage model by Barua et al. (1995), the IT Balanced Scorecard (Epstein & Rejc 2005) and different SCOR models detect the mechanics of value creation in a business activity by using intermediate level metrics in the middle to be able to derive company level business impacts. Therefore there is a need to identify and allocate metrics for each level (functional, process or company) before constructing the final set of linkages between them. The resulting frame should be more or less "a multi-stage IT balanced scorecard" for assessing the business value of automated order-to-payment cycle.

The starting point for constructing the model is to identify *inputs*; the idea would be that organization makes an effort the increase IT intensity to automate the order-to-payment cycle and its sub-processes. This could be an investment in the actual information systems or user training etc. IT spending in this context aims to increase the number of process instances going through without human intervention. Thereby, the successor measure for input "IT spending" is labelled "Level of order-to-pay automation %". This, in turn, can be seen to compose of automating the different sub-processes or functions and thereby comprise of the level of automation in ordering, invoice handling and payment. This way we get access from the input to the lowest layer of metrics in the model i.e. the function level.

We already investigated e-ordering, e-invoicing and e-payment related measures yet their final positions within the hierarchy remain unclear. The question is actually that which of the metrics remain as *function level* performance indicators and which can be assigned to higher levels. Lynch & Cross (1995) introduce a taxonomy called "the performance pyramid" which is rather helpful in this case since it offers a solid back bone for allocating measures to different levels.

Figure 5.5 The performance pyramid



Source: Lynch & Cross (1995)

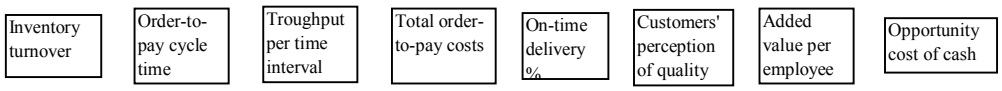
Lynch & Cross (1995) explain that the pyramid offers an effective link between strategy and operations by translating strategic objectives from the top down "how objectives are communicated down to the troops", and relating measures from the bottom up. It is as well a stage model where core business processes are seen as the bridge between top-level goals and day-to-day operational measures. The pyramid can be further divided according to two different formulations of performance; internal efficiency and external effectiveness. Efficiency can be articulated as "doing things right" and effectiveness, on the other hand as "doing the right things" (Melville et al. 2004).

As stated, the *process level* objectives (customer satisfaction, flexibility and productivity) support business strategy yet can be only achieved through floor level efforts. This lowest layer of the pyramid comprises of specific operational

criteria, namely quality, delivery, cycle time and waste. By using the pyramid to categorize the previously listed e-ordering, e-invoicing and e-payment related measures, it became clear that the vast majority belong indeed to the lowest i.e. function level. However, by following the taxonomy I elevated some measures to the business process level as well, namely: customers' perception of quality, on-time delivery, inventory turnover, added value per employee, and opportunity cost of cash.

One expert-proposed metric was included in the process level as well[9]; "Throughput per time interval" could be used for proactive process monitoring purposes. The idea is to continuously monitor the amount of process instances going through IS in order to identify problems before any financial damage occurs. If throughput is considerably lower than usual in a certain time interval, management could be informed in real time, in which case they could react rapidly to potential inefficiencies. This measure, however, presumably requires a large volume of transactions to be useful. To get a complete set of process level measures, some aggregate performance indicators were finally added in; "Order-to-pay cycle time" and "Total order-to-pay costs" reflect performance of the entire process. All in all, a total of eight intermediate level measures were listed. The following picture depicts metrics assigned for the process level. This is actually the set of performance indicators that could be visible on the "order-to-pay dashboard".

Figure 5.6 Proposed process level measures

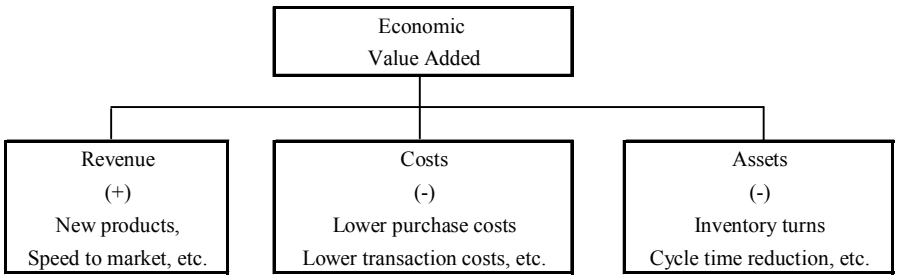


Now we have the function and process level metrics anchored. What is still missing is the *company level* measures i.e. *outputs*. Let us start from long-term company level objectives. In this study, the aim is to pinpoint all business impacts

[9] Expert interview: Pekka Brusila, Tieto Corporation

of IT in the order-to-pay process context. Hence, the output metric should measure not only how much savings one is able to achieve through internal efficiency improvement etc. A more extensive measure is required – one that takes account all components creating value added for a company. Economic Value Added (EVA) is recognized as a comprehensive measure of value creation because it indicates how well the company has performed in relation to the capital employed (Presutti 2003).

Figure 5.7 The Economic Value Added concept



Source: Presutti (2003)

E-procurement impacts on revenues arise from improved speed in getting products to market. According to Presutti (2003), in addition to new products this applies also to existing products in the sense that the ability to get products to market faster might help the supplier to achieve competitive advantage and increased market share finally ending up in revenue boosting effects. On the other hand, e-procurement driven material and transaction cost reduction potential is clear, as discussed in the previous chapters. As for the last component impacting EVA, asset utilization can be improved in this case with inventory level and cycle time reductions among other things.

EVA is particularly useful regarding this study in the sense that it isolates and emphasizes activities that help to drive value creation (division to revenue, cost and asset impacts). Therefore it should be a good choice for being the "tree top" in the model. Hence, Economic Value Added and its three components were fixed as the model's company level measures.

After categorizing the metrics, the three levels were linked by following a simple logic of "cause-and-effect". In order to connect the metrics to each other, I used Balanced Scorecard-type if-then statements. The aim was to form logical chains across the hierarchy and identify paramount "paths" between measures.

To clarify the logic, let us at least walk through one of these "paths" here. For example, if invoice handling is automated, then the number of manual errors decreases. If the number of errors decreases, then less rework has to be done and non-value added manual work decreases. If non-value added manual work decreases, then user satisfaction enhances. If user satisfaction enhances, then value added per employee increases (connection between function and process level). If value added per employee increases, then asset utilization gets better creating economic value added for the organization (connection between process and company level). All these linkages were finally illustrated with uniform arrows between metric "boxes" creating a vertical hierarchy structure to the model (Exhibit 6).

5.2.2 Measuring the value of electronic integration

Once the vertically integrated model was put together, I realized that something was still missing. The model as such seemed to provide a structured approach to evaluating IT business impacts yet it did not really cover one of the original challenges – it excluded measures that would reflect the effect of electronic, horizontal integration between the three sub-processes.

According to Jolly (2007) the use of IT reduces laborious, lengthy, paper-intensive payment routines from up to 120 days — between purchase orders, supplier invoicing, buyer invoice processing, possible dispute resolution and final payment — to less than 40 days, providing faster cash inflows and outflows. This argument is based on the idea that the entire flow of electronic documents from POs to final payment works efficiently. It emphasizes exactly the significance of *horizontal integration* of the whole business activity. IT impacts and metrics on

inter-process linkages can be seen as the determinants for success in this – they articulate the barriers and potential that initiates from automating the entire order-to-payment cycle. Two things in particular were identified (with expert assistance[10]) as the most important sources of impact in this context: visibility and availability of information, and standardization of messages. Perhaps we should discuss these next in more detail.

When a PO is made and order confirmation comes in electronically, the order data is stored in integrated information systems. Hence, as it was already noted, order information is directly visible and accessible for all i.e. production, sales etc. Meanwhile, the invoicing department gets immediate information about which invoices are about to come in and when. In large organizations, the invoicing department can make better workforce resource planning when they know the volume of incoming invoices in advance i.e. make sure that they have enough capacity during peaks and proactively avoid slack when work load decreases. It should not at least hurt to know things in advance when running (daily) operations. As for processing efficiency; incoming e-invoices can be automatically verified against electronic order confirmations and sent forward just by pressing the "ok-button" (in a fully automated environment).

The availability of information is useful for the payment function as well in the sense that they get better visibility to cash requirements. They know in advance the exact amounts that have to be paid out at a particular point of time and can therefore either invest excess cash in more productive sources or acquire cash on time and at best possible rates. The above presented effects on invoice handling and payment enable more efficient flow of documents throughout the process thereby reducing e.g. cycle times and costs. Indicators; "Visibility of order information" and "Resource planning accuracy", were added in the model to describe the above discussed effects.

As for standardization of documents, it is important to notice that the amount and

[10] Expert Interviews: Martti From, Tietoyhteiskunnan kehittämiskeskus TIEKE & Pirjo Ilola, Finanssialan Keskusliitto FKL

form of information and specifications per message must be somewhat standardized to be able to automatically transfer them between ordering, invoicing and payment systems. Cotteleer et al. (2007) present that e-payment users want information so that it can be processed straight through to internal systems. For example, the first and largest U.S. payments clearinghouse released recently a plan to help catalyze standards convergence. The traditional EDI 820 file was trimmed down to ten essential fields, before it contained hundreds of fields.

The problem with too much information is that if e.g. order documents contain many specifications, invoicing systems are not necessarily able to understand them automatically. For example, let us say that a company has ordered 150 different type products and the supplier has specified each product with unnecessary detail. When the order confirmation is processed forward, invoice handling systems might regard the information as incorrect just because it does not understand the specifications. What happens consequently is that somebody has to go through all 150 lines to verify that the order matches the invoice; business-wise this means extra work and costs. Similarly, as already stated, efforts have been made to promote invoice standards so that they can be automatically processed in the receivers' payment systems and unnecessary reformatting costs can thus be avoided.

Finally the related indicators; "Number of specifications per order" and "Standard invoices %", were added to the model. The inter-process linkages discussed in this chapter were illustrated with cross-functional dashed arrows connecting the additional metric boxes in the evaluation tool (Exhibit 6).

5.2.3 Finishing touches; final composition of the evaluation tool

Before summing up the chapter, let us briefly discuss two additional, expert-proposed metrics that were included in the model to indicate the most critical *barriers* for automation. By looking at the process flow chart presented earlier, it becomes clear that since an electronic order-to-pay process is always dependent

on some human input, the level of human usage clearly affects IT system performance. Even if there is a state-of-the-art system in place, full benefits cannot be realized if people inside the company do not use it.

The problem is that particularly in an intra-organizational setting where a top-down solution is imposed among the staff people are not always keen on altering their habits and are generally reluctant to change. Since end-users might not experience benefits of using the system, adoption lags behind and the system is not used to its full potential. This is a case of benefit imbalance between organizational and user level which is seen in many instances of *e-ordering* systems (Reunis et al. 2006). An expert explained that buyers in particular can be reluctant to adopt centralized electronic applications since automated ordering systems actually substitute their "value added" work in addition to mere routine activities[11].

Thus, there is a need for a measure that somehow monitors the level of IS adoption particularly in ordering – how large a share of ordering is conducted via centralized electronic systems and there again, how many process instances are still done the traditional way or even off-contract "maverick"-buying. The instrument used here should indicate the level of system usage, however it must be noted that there can be multiple reasons for using or not using. It seems logical to think that besides people's attitude towards system usage, this "utilization rate" would be affected by the technological uptime etc. However, in this case the attitude of purchasing staff should be the most critical. Thus, the metric "Users' attitude towards e-buying" was set as a predecessor for all other e-ordering related measures.

As for the predecessor metric in e-invoicing, organizations are making efforts to enhance "e-invoice penetration" which basically means getting rid of paper

[11] Expert interview: Pirjo Ilola, FKL

invoices and adopting electronic practices in stead[12]. The share of incoming e-invoices versus paper invoices is critically important regarding this study – the invoices have to be in an electronic form to be able to run them through the automated process. Paper invoices can of course be scanned to transform them into electronic documents. However the problem is that it requires a lot of costly manual work and time. Hence, by increasing e-invoice penetration companies can avoid direct costs.

The two above discussed measures are particularly important in the sense that organizations can contribute to these by their own actions and thereby enhance their chances to succeed in process automation.

In conclusion, the evaluation tool, illustrated in appendix 6, was constructed in steps as follows:

1) Perceived and observed benefits regarding e-ordering, e-invoicing and e-payment were collected from literature and expert interviews
2) Metrics to evaluate these impacts were formulated
3) Inputs were defined as the first step of model construction
4) Listed metrics were categorized (Performance Pyramid)
5) Function level metrics were defined (e-ordering, e-invoicing, e-payment)
6) Process level metrics were defined (total of 8 measures)
7) Company level metrics were defined (EVA and its three components)
8) Measures from the three levels were vertically linked by using sequences of if-then statements (Balanced Scorecard)
9) Impacts on inter-process linkages were identified (horizontal integration)
10) Final touches; some preliminary measures were added in
11) Result: complete vertically and horizontally integrated evaluation tool

[12] Expert interview: Martti From, TIEKE

6 EMPIRICAL STUDY

To test the proposed measurement tool, an in-depth case study was conducted in the Finnish design company Marimekko. In addition, I conducted two supplementary case studies in two other Finnish companies (large retail company and a service provider company). I did not generate extensive reports from the latter studies, but in stead included some "preliminary" findings in section 6.2.

6.1 Case Marimekko

Marimekko Corporation is a leading Finnish textile and clothing design company established in 1951. The company designs, manufactures and markets high-quality clothing, interior decoration textiles, bags and other accessories under the Marimekko brand, both in Finland and abroad (www.marimekko.fi).

6.1.1 Objectives of the case study

Marimekko was chosen as the case company because of its suitable size for this purpose and since it was in a proper phase with order-to-payment automation. Namely, using IT in financial administration is nothing totally new to Marimekko – they adopted e-banking systems and even some electronic ordering applications already years ago. However, they have only quite recently adopted electronic invoice handling systems for incoming bills. Approximately 16.000 – 17.000 invoices flow though their invoice management system (IM) every year of which the share of e-invoices at the moment is little more than 20%.

The main objective of this case study was to examine electronic order-to-payment in real-life and see if the proposed model works. It was additionally investigated that which impacts the company associates with process automation and which measures they use to evaluate them. We can thereby observe if something critical

is missing from the model and investigate potential uses of the proposed evaluation tool. To attain in this knowledge, I conducted a handful of semi-structured interviews with people from the company's financial administration, purchasing, logistics and IT departments. Since the model was built mainly based on literature sources, it was interesting to test the model in a business-context, see if it can deliver a structured description of reality and if it generates results of some value to the users. First, I analysed the order-to-payment flow at Marimekko to find out how they operate and to get insight on the current state of process automation (complete process flow description can be found in Exhibit 7).

6.1.2 Mapping the present state of operations

The company has three main categories for direct buying: materials for production, complete products to be sold, and production orders including subcontracting services etc. For simplification, in this case the main focus is on material and complete product categories.

To start off with the process flow, buyers identify purchase requirements manually by comparing the backlog of sales orders to stock lists. This data is available in the company ERP system (called Dafo) but has to be processed manually. Each item is bought by one person only and therefore bundling of purchase requirements is done in the buyer's head only. Nearly all direct purchase orders (POs) are made electronically through the company ERP system. On the other hand, indirect orders e.g. MRO purchases are not placed through centralized IS, but rather done individually via fax, e-mail, telephone etc. The share of buying that bypasses Dafo is estimated 10% of total.

POs that are made through ERP are visible for all – sales can make sales orders based on item availability information and some invoices can be verified in the financial administration against the digitally visible POs. Invoices come in electronically, yet are verified manually against price information (PO) and stock balance. Order confirmations are often received in an electronic format but are

visible to buyers only. Order confirmation is verified against the original purchase order by hand. Manual processing in this phase consumes some of the buyers' time; however the main advantage of automation in this phase would be enhanced user satisfaction rather than saving costs.

Due to the new electronic invoice handling system, all bills come in through service provider Itella (former Finnish Post), where they are pre-processed into a uniform electronic format. Namely, the company has asked suppliers to send invoices directly to Itella in three alternative forms; paper, e-mail attachments (pdf) or e-invoices. Pdf-invoices are printed out, and scanned with paper invoices, whereas e-invoices require no pre-processing. Scanned invoices also more often include mistakes which can become costly due to rework that is needed for correcting the errors.

Itella charges higher on paper invoice processing and thus by increasing e-invoice penetration, Marimekko could save direct cost. It was pointed out that increasing e-invoice penetration by an additional "unit" requires ever increasing efforts. At first, it was relatively easy to get large suppliers sending e-invoices and penetration numbers rose rapidly. However, the company has many small suppliers who do not necessarily have the required skills or resources to send e-invoices. Persuading one of these companies generates a smaller number of new incoming e-invoices and thus increasing e-invoice penetration becomes relatively more costly than with the larger suppliers. Consequently, a trade-off situation is created in which the ever-increasing effort to gain additional e-invoices would be compared to the cost of receiving and scanning paper invoices. Thus, at the moment, the optimal level of e-invoice penetration might not be in fact 100%, but rather a lower number determined by the break-even point where; cost of achieving a new e-invoice = the cost of receiving and scanning a paper bill.

All invoices are registered and sent automatically from Itella to Marimekko's Invoice Management (IM) system every night. Invoice handlers manually process the bills further and decide which "approval chain" each invoice should be

assigned to. The chain includes those individuals who are required to approve the bill before payment. Selecting a chain for each invoice is made by following certain leads included in invoice information. For example, invoices should be approved by the person who purchased the material or product, import forwarding has to be informed about international purchases, etc. This work phase consumes a lot of time and manual resources.

Once an invoice is approved by each person along the cycle, it is transferred from IM to accounts payable (Aditro Intime) where payment proposals are made, bundled and sent in batches once a day to the cashier (OpusCapita Cash Management). In the payment section, only the total sum of payment proposals is checked before approving and sending payments electronically. This is easy, fully automated and takes only half a minute and three presses of a button. Approximately 98% of payments are made through the cash management system, only payments from the company's US accounts to US suppliers have to be made through separate banking applications.

Although Marimekko has applications at place, they do not systematically measure impacts of IT usage in this context. This is mainly due to the fact that they do not consider it worthwhile to conduct wide-ranging evaluation efforts because the company is relatively small size and does not have extra human resources to do it. Some initiatives however have been made to enable measurement (e.g. purchase order data has been entered into reporting systems as basis for lead time calculations etc.), yet inflexibility of legacy IT systems seem to slow down this development. They still consider measurement important, particularly as basis for process development and as justification for further IT investments. However they feel that in many occasions it is sufficient to use estimated payoffs instead of accurate numbers.

As mentioned, from the IT system development point of view, measurement would be useful as basis for justifying for additional IT investment. In ordering, the importance of measurement would be critical particularly in terms of

monitoring supplier reliability i.e. delivery accuracy, lead times etc. At the moment, buyers monitor these "semi-automatically" at most. As for e-payments, there would be need for monitoring bank fees and exchange rate differences. Marimekko holds accounts in many countries from which they frequently "pocket" funds to Finnish bank accounts. They could take advantage of exchange rate differences due to increased control of cash flows.

6.1.3 Perceived impacts of process automation and further utilization of IT

Since there was no measured information available, people from different functions were asked to intuitively identify benefits that they consider important regarding process automation in the financial administration. Intuitive response was asked first before revealing the proposed evaluation model because I did not want to mislead the interviewees in any way or let my presence affect the outcome.

Perceived e-payment benefits were clearly stated; reduced manual feeding leads to fewer errors, handling time reduction and cost savings. The intuitive benefits of electronic ordering included processing efficiency in terms of time and cost savings, as well as uncertainty avoidance. They felt that electronic messages reached suppliers faster and more securely. It was also considered as perk, that electronic orders are automatically stored in IS and therefore easy to find and retrieve when needed. Getting rid of routine work was also seen to improve satisfaction for the users and the people could be transferred to do more productive work in stead. As for (near) future challenges, enhanced asset utilization was considered most critical due to the fact that Marimekko currently holds substantially large inventories.

One of the inventory-related problems is that since purchase requirements are manually identified at the moment, ordering relies greatly on buyers' memory and is thus prone to errors. For example, if a sales order is made and it somehow escapes buyer's attention, it could be that the product or raw material is not in

stock when needed and thereby delays customer delivery. To avoid stock-outs, the company carries large safety inventories. With more accurate inventory control, the company could cut this excess stock and allow for better asset utilization. Marimekko has recently piloted a new ERP application; automatic alarm limits for identifying purchase requirements.

The idea is that IS would send an e-mail to buyers when stock balance of an item drops under a predetermined limit. This would eliminate the risk of human mistakes and save buyers' time. Namely, most of buyers' time is spent on going through stock lists in order to spot the items that are low in availability. If IS could filter these items automatically for the buyers, the unnecessary and not to mention costly manual work phase could be cut off. This also means that inventory management would not be as much dependent on the purchasing people but "tacit" knowledge could be transferred into the system. In case people are absent (ill, on holiday etc.) buying would not stop but continue computer-aided.

Another related challenge relates to bundling of orders. As stated, it cannot be currently utilized but could be done in the ERP system if all items would not only be identified by their individual names but would also have descriptive data attached to them which categorizes them by the type of item, e.g. t-shirt, bathroom towel etc. Namely, Marimekko suppliers usually require minimum orders e.g. 1000 meters of certain fabric. By ordering aggregated amounts of plain fabric to be used in the production of e.g. different colour t-shirts, Marimekko could better utilize economies of scale. At the moment, they are not often allowed for volume discounts. Bundling could prevent from ordering "multiple minimums" and thereby reduce the amount of unnecessary items held in stock.

Intuitive benefits regarding electronic invoice handling included centralization, decreasing circulation time and also reliability of electronic document exchange compared to regular mail. The adoption of electronic invoice handling system (IM) has changed the nature of work for the invoice handling personnel; most of their time used to go to manually feeding invoice information into the systems.

Due to IM, the routine work has become useless which by itself improves user satisfaction. However, their work has now transformed primarily into managing the approval cycles, which, as a by-product, creates inverse satisfactory impacts.

Namely, particularly in the case of indirect purchases, people tend to hang back on approving invoices and invoice handlers constantly have to press those people to go and approve their bills. This is problematic due to multiple reasons: first, if invoices linger on each person's desk throughout the chain it increases cycle time. Reminding people of approvals consumes the invoice handlers' time, creates costs and decreases their job satisfaction. They felt that repeatedly pressing people is an unpleasant task.

As for direct purchases, the approval loop is not seen as a problem; buyers are committed to do it since it is one of the buyers' primary duties. However, getting information about deliveries and the availability of goods create a bottle neck. Namely, when purchased goods come in they are manually checked and registered into the ERP system which takes much time. If this process could be even partly automated, cycle times would decrease.

6.1.4 Main results and lessons learned

Finally, I asked people from different functions to comment on the proposed metrics included in the evaluation tool regarding e-ordering, e-invoice handling and e-payment (comments listed in Exhibits 8-11). The collected feedback regarding each measure was categorized (high, medium or low) according to expressed importance. The metrics were colour-coded so that green stands for highly important, yellow is medium while red stands for low. By using the collected data and the previously discussed intuitive effects and challenges, I draw "critical paths" for each sub-process and through the entire hierarchy (graphical illustration can be found in Exhibit 12). If Marimekko had an order-to-pay dashboard, these would be the measures included. The ones marked with thick solid arrows illustrate the most critical mechanisms of value creation. Dashed

arrows show paths that were considered slightly less critical yet worth stressing. Let us briefly review the analysis results next.

E-payment systems in the company are fully developed and well integrated into invoice management systems. Hence, there is limited potential for improvement in the payment section. That is why most of the boxes in payment are green and critical paths were not even drawn between them – there is hardly anything "critical" left to be improved in the payment side. Challenges relate more to electronic integration aspects between payment and the other functions, particularly in how could order information be better utilized in cash flow management and forecasting (illustrated by yellow boxes and the dashed path in payment).

It became clear that the yet untapped potential lies mainly on automating invoice handling and ordering even further. Critical paths in e-ordering include the above mentioned inventory level challenges and its effect on holding costs as well as asset utilization (turnover). One major challenge would be to automate inventory management even further to save buyers' time. On the other hand, reduced routine work enhanced user satisfaction. Another e-buying related issue is visualized by a dashed path: currently, buyers go manually through stock lists in order to identify purchase requirements and inevitably miss some requirements. This will of course lead to longer lead times and late deliveries to customers. If information systems managed inventories automatically and alarmed buyers when needed, human mistakes would decrease and thereby they would be able to deliver on-time to their customers. This could, through improved customer satisfaction, increase sales and thus create economic value for the company. The problem is, however, that these revenue side impacts are difficult to measure.

In invoice handling, circulation time was considered more critical than actual handling time and related costs. The largest obstacle was actually identified to be "approval delays" referring to the time each invoice have to wait for approval at each persons "desk". Another related critical phase is getting purchased goods

visible in stock as soon as possible. Standardization of documents was also considered highly important in order to avoid mistakes and needles rework.

All in all, it seems that impacts of automating order-to-payment cycle at Marimekko relate closely to cost avoidance. The company does not systematically measure IT business impacts in this context neither for justifying investments, nor process monitoring purposes. The message was clear – IT investment calculations are based on estimated cost savings whereas any other resulting benefit is considered as something "extra". As for process monitoring, they expressed its importance, however have limited resources to conduct it partly because of inflexible legacy ERP system.

In addition to cost effects, strong emphasis on asset utilization can be observed – better use of IT could enhance utilization of existing human resources and capital, affecting company profitability. This effect is largely due to the significant potential in enhancing inventory turns. Cycle time reduction, on the other hand, is considered a critical factor particularly because it helps the administration to deliver financial statements on time. They leave the door open for revenue impacts as well; by automating supportive business functions they can minimize the load that administrative tasks cause to the core business functions. Thereby, the people in e.g. sales and design do not get distracted and can concentrate on the revenue creating business activities. These impacts were however treated with some reservations; the message was that they are important yet difficult to observe and measure.

In conclusion, it seems that the evaluation tool can be used in a real-life company context as an instrument for communicating, categorizing and sketching impacts and related measures. The conducted analysis provides a structured template for actual measurement of IT usage in the order-to-payment cycle by organizing measures by their importance and pointing out the most critical mechanisms of value creation. To be able to really measure and get accurate quantitative results, one would have to dig deeper to identify actual metrics that best indicate desired

impacts and make efforts to collect the right data.

More specifically, part of the proposed measures (such as inventory levels and some cost items) could be translated into relevant metrics directly or by combining existing information i.e. they could be derived from data already stored in company information systems. Other would require field studies e.g. measuring the handling time spent on particular activities or user satisfaction. In fact, an important lesson learned from this case study is that the proposed "metrics" are better yet "measures" – the actual metrics have to be agreed upon according to individual characteristics of each case company.

6.2 Findings from supplementary case studies

In addition to Marimekko, I conducted supplementary case studies in two other Finnish companies, from which I report some preliminary results in this section. The purpose of conducting the additional cases was primarily to attain more varied insights in order-to-payment process automation, and get better coverage of the model's adaptability over different kinds of companies and industries. In other words, the objective was to avoid having biased results and to prevent the research viewpoint from being completely one-sided. It was interesting to see whether a different line of business or organization size would separate the companies in terms of order-to-payment automation and related effects.

The "pragmatic" case results show some similarities as well as some dissimilarities between the three case companies. Cost related effects were repeatedly emphasized which further supports the argument made in chapter 2 about impacts of automating order-to-payment cycles being cost-centric. However, the message was that once applications were implemented, challenges and post-auditing efforts related closely to better asset utilization.

All case companies had well-established, efficient e-payment systems at place

whereas e-invoicing and e-ordering functions were seen as the current area of concern. The retailing company though has been a forerunner in digitizing purchasing activities since 1980s and is thus exceptionally advanced in e-ordering. They reported that the share of e-orders in direct buying is already close to 100%, whereas current challenges relate to digitizing and centralizing indirect purchases. Actually, this was more or less the challenge in all case companies.

Marimekko does not systematically measure the impacts of IT within order-to-payment whereas the other two companies have metrics in active use. As it was already pointed out, the retailing company monitors EDI% in direct purchasing which basically is an indicator for the level of automation within the function. The service provider company monitors e.g. handling times, cycle times and throughputs, among other things. They can even track individual invoices on a very detailed level e.g. measure how long each invoice "lingers" over each phase of the cycle.

Enhancing efficiency of the e-invoice "approval loop" was considered as a major challenge in all case companies. The service provider company even had numbers and graphic presentations to show that this phase consumed a considerably large share of the total order-to-pay cycle time. Receiving and scanning paper invoices was clearly the other time-consuming phase, according to the measurement data. Other companies highlighted this aspect as well – by increasing e-invoice penetration, this phase could be cut off. This would, in turn, allow for considerable financial savings.

All case companies currently struggle more or less with e-invoice penetration and are making efforts to increase it. Actually, the retailing company has only recently announced that they will only accept e-invoices after fall 2009. In addition to direct cost savings and streamlining document circulation, higher e-invoice penetration would also prevent processing errors and thereby decrease the amount of unnecessary rework and related costs. However, all case companies reported to be in a situation where ever increasing efforts have to be made in order to further

increase the share of incoming e-invoices. This is due to the fact that small suppliers do not necessarily have the required capabilities to send them.

However, one must first ask to be able to receive. Namely, the service provider company reported a problem relating to their non-strategic purchasing activities i.e. indirect buying that is not centralized. They suggested that people are not necessarily motivated to ask for e-invoices if they just buy something once in a while. Besides, the buyers receive invoices electronically in any case, yet after the invoice handling unit has transformed the paper invoices into electronic format. Buyers can be careless since they do not have to face the costs of scanning and other related activities. That is why "e-invoice education" should already start inside company borders i.e. get the internal interest groups committed first. Influencing buyers' attitude is also critical in terms of enhancing the previously discussed approval cycle.

Case results also indicated the importance of system integration within the order-to-payment process, across the board. For example, the service provider company reported to make efforts in centralizing and standardizing ordering activities to be able to streamline the entire order-to-payment process flow. Marimekko considered standardization of documents critical to avoid inter-process errors and also expressed the importance transparent information flow between ordering and payment in order to conduct proactive cash management. In conclusion, all three case companies reported many similar effects and challenges, yet with varying stresses. Apparently, automating supportive business functions yields somewhat similar effects regardless of the industry.

7 DISCUSSION AND CONLUSIONS

7.1 Summing up the research task

In this paper, I developed an evaluation tool which strives to visualize mechanisms of value creation in the electronic order-to-payment cycle. Based on a literature review and expert interviews, a three-stage metrics model was created. The purpose of building the model was not primarily to measure the impacts of automating order-to-payment for any company in particular but rather to promote general awareness, raise thoughts, and provide a platform for productive dialogue. As the thesis topic already indicates, the task was to gather up information and *build* a structured set of performance indicators i.e. a template for quantitative measurement that can be used in many organizations. Choosing the final set of metrics, exact measurement and management were excluded from the study at this point.

Since the goal was not to find out *what* the business value of automating order-to-payment is (the variance approach) but in stead, investigate *how* IT creates business value in this context, I chose the process approach as theoretical basis and reviewed related frameworks. I collected metrics for sub-processes, e-ordering, e-invoicing and e-payment from literature and finally built an end-to-end evaluation tool. I decided to use the case study approach for the empirical part to attain detailed understanding of this seemingly complicated subject.

I conducted an in-depth case study in the Finnish design company Marimekko, as well as in two supplementary case companies, and found that the motives for automating order-to-payment relate closely to cost avoidance. Once applications were implemented, however, challenges and post-auditing efforts were directed particularly towards better asset utilization. Potential revenue-creating effects were reported as well, yet it was concluded that they are particularly difficult to observe and measure. Case results also indicated the importance of system

integration within the order-to-payment process. In this final section, I conclude the discussion by presenting the main implications, limitations and suggest avenues for further research.

7.2 Implications

7.2.1 Theoretical implications

In the end, we can conclude that the eligible measurement model was successfully completed. However, in process we learned that the original hypothesis might indeed hold; proper evaluation of IT business impacts in this context is not a simple task. Empirical results still indicate the usefulness of the proposed evaluation tool. Case results showed that the model facilitates cross-functional analysis and communication by bringing out information that is "hidden" inside separate functions. The hierarchical categorization of metrics turned out to provide a useful skeletal structure for drawing the critical cause-and-effect linkages between operational efforts and business impacts. In short, the evaluation tool helps the user organization to define relevant measures and see how these factors contribute to economic value creation. Based on this; we can safely say that the primary objectives of this study were fulfilled.

Extant literature, such as the studies reviewed in chapter 5.1, provides diverse lists of impacts and measures related to e-ordering, e-invoicing and e-payment. Yet the existing papers usually cover individual functions only and do not discuss the impact of automating the entire order-to-payment cycle. Hence, they offer a rather scattered view on the subject and make no clear division between day-to-day operational measures and company level business objectives. Companies (and scholars) might thus find it challenging to define and evaluate related *business* impacts. The research work by e.g. Brun et al. (2004) however, offers some assistance for these challenges. Namely, by describing the impacts of IT in a longer chain of activities under the "e-procurement" concept, and dividing the

process into smaller sub-phases thereby offering detailed information of how IT impacts can be measured at each phase and what is their importance. On the other hand, they do not really describe how the resulting business value is created. Structured models for evaluating the business value of IT exist (such as the models reviewed in chapters 2.3 and 5.2), yet they have not been adopted before in this context.

The contribution of this paper for research in this field is that it offers a structured, holistic view over electronic order-to-payment process measurement. It links floor-level efforts to company-level business impacts through a hierarchical structure. In addition, it depicts the effects of horizontal system integration.

7.2.2 Practical implications

Let us finally discuss some key issues regarding further, practical, use of this tool. First of all, the model provides a managerial view over and across the entire order-to-payment cycle. Second, it offers a generic template for measurement facilitating reasoned and systematic evaluation. Third, it can be used for both, process monitoring and decision making purposes within the financial administration. However, the idea is not to use the model as such in every organization but rather to modify, choose and prioritize its features according to the individual companies' strategy and needs.

As earlier stated, the model offers a set of "measures" for evaluating impacts of process automation. After choosing the relevant measures, each user organization should concentrate on defining metrics that best indicate the desired effects. For example, the amount of non-value added manual work in the ordering function could be measured by "labour costs in purchasing" (since all labour in fully automated environment can be seen as non-value added) and "employer image" could be quantified by "number of received applications per opening". They should also decide whether to evaluate e.g. the "number of processing errors", by metrics "number of user error reports", "number of complaints from suppliers" or

some other indicator. Most importantly, these "how to measure" decisions should be based on company-specific knowledge. The model only offers the guidelines for evaluation i.e. helps to answer the question "what to measure".

Another crucial task is to detect the availability of the required data. For example, ERP-data could be used to evaluate inventory turns, accounting figures to calculate e.g. handling costs, and user estimates to quantify some "hard to measure" effects, such as satisfaction. In the ideal situation, all data could be directly drawn from company information systems. However, in reality some of the data still has to be collected more or less manually. The more the data is directly accessible via IS, the less work measurement requires from the organization. Example metrics and data sources for all measures included in the model are listed in exhibits 13 and 14.

Defining the measures to be used does not require a lot of time or high level business intelligence from the company, as long as the proposed model can be used as a template. Choosing the actual metrics, however, requires understanding of internal operations. Some of this knowledge can be "hidden" within the organization, yet the case results show that any activity-specific information can be quite easily attained by interviewing a few key people from different functions. All relevant information can be finally drawn together with the evaluation tool. In conclusion, the main requirements for an organization that uses the tool are: The need and commitment for evaluation, sufficient size of operations, develop IT systems, moderate time and effort, and understanding of own business activities.

As proposed, there are two different purposes for using the evaluation tool. Namely, it can be used as basis for IT investment calculations and for process monitoring purposes. When decisions are made whether or not to adopt electronic applications, all potential payoffs must be evaluated and hence a "left to right"-analysis is most suited. However, once the relevant measures have been identified and chosen, a "right to left" approach should be used instead. The idea is that management could monitor higher-level aggregate measures top-down from an

"order-to-pay dashboard". The generic nature of the model is advantageous in the sense that it can be used from both directions; left to right and right to left.

The chosen measures should be finally given uniform, financial values, as far as possible. Costs should be easy to calculate in monetary terms, whereas revenue effects might require some considerations. For example, it could be estimated that a 5% improvement in on-time delivery will result in 2% increase in sales, etc. Some asset-side impacts could also be transformed into monetary e.g. by measuring the opportunity cost of excess cash on company accounts, which basically equals the return of an alternative investment. By comparing the potential savings and earnings to investment costs, the user organization could make reasoned decisions regarding adoption of new technologies. For process monitoring purposes, the company could use percentage values which are comparable and easy to interpret. They should, however, first calculate how business performance adjusts to certain percentage changes, to be able to set proper goals and tolerances for the performance indicators.

Brief recommendations for using the proposed evaluation tool are listed underneath:

1) categorize measures according to importance from the user organization's point of view
2) draw "critical paths" between different level measures i.e. pin down mechanisms of business value creation
3) choose the measures to be used
4) identify metrics that best indicate performance in these dimensions
5) gather the data (duration of this phase depends on how largely the data can be directly drawn from IS)
6) formulate uniform financial values to the process level measures as far as possible
7) evaluate EVA i.e. business performance in relation to the capital employed (can be used as justification for IT investments)

8) evaluate how business performance changes when process level variables change by some percentage value
9) set targets and tolerances for the variables and monitor process level measures regularly by comparing how well the "order-to-payment machine" performs in relation to previous periods (e.g. monthly reporting)

7.3 Limitations of this study and avenues for further research

This paper was limited to study order-to-payment i.e. electronic ordering, invoice handling and payment. However, it was already pointed out that extending the range of electronic financial administration by *automated accounting* could offer further improvement potential and thus would be an interesting topic to study more. It is also the next step in the Real Time Economy program.

The productivity effects of automating order-to-payment can be manifold and demand additional research efforts. For example as earlier stated, now that manual work becomes redundant, people can be reassigned to more productive tasks. However the question remains whether they are actually transferred to other duties or just fired after they got useless? The people who have previously only conducted routine work can be incompetent to do something more productive. Instead of transferring them to do the productive work, they have a high risk of getting replaced by more skilful people. Is there place for routine workers anymore?

Since the case study methodology was used, any generalisations cannot be made based on the empirical results. For instance, I cannot argue that all companies would primarily seek cost savings by automating order-to-payment, or describe the present state of electronic processes and measurement within the financial administration. A questionnaire study should be made in order to quantitatively analyse the present state of IT utilization and measurement within order-to-payment cycles across industries and business fields. It is also clear that

conducting only three case studies is not enough to make any flawless statements regarding the quality and validity of the proposed evaluation tool.

Furthermore, the model has not been used for actual measurement yet and thereby it is impossible to say whether it stands that test. It would thus be very interesting indeed to take part e.g. in real-life IT development projects and use the tool to quantitatively analyse potential payoffs. It would also be interesting to see if the model could be used as a template for designing process monitoring applications. In conclusion, a considerable amount of work remains undone around the topic, however the first verses in the Full Value Chain discussion have now been articulated.

References

Aral, Sinan; Brynjolfsson, Erik & Wu, D.J. (2006). Which Came First, IT or Productivity? The Virtuous Cycle of Investment and Use in Enterprise Systems. *MIT Center for Digital Business Working Paper*, October, 2006.

Bakos, J. Yannis (1997). Reducing Buyer Search Costs: Implications for Electronic Marketplaces. *Management Science* 43, no. 12: 1676-1692.

Barua, Anitesh; Kriebel, Charles H. & Mukhopadhyay, Tridas (1995). Information Technologies and Business Value: An Analytic and Empirical Investigation. *Information Systems Research* 6, no. 1: 3-23.

Brun, Alessandro; Corti, Donatella & Cozzini, Silvia (2004). Value assessment of e-procurement projects: a modular methodology. *Production Planning & Control* 15, no. 7: 742–760.

Brynjolfsson, Erik (1993). The Productivity Paradox of Information Technology. *Communications of the ACM* 36, no. 12: 67-77.

Brynjolfsson, Erik & Hitt, Lorin M. (1998). Beyond the Productivity Paradox: Computers are the Catalyst for Bigger Changes. *Communications of the ACM* 41, no. 8: 49–55.

Byrd, Terry Anthony; Thrasher, Evelyn H.; Lang, Teresa & Davidson, Nancy W (2006). A process-oriented perspective of IS success: Examining the impact of IS on operational cost. *Omega* 34, no. 5: 448-460.

Carman, Rick & Conrad, Susanne (2000). Key Performance Indicators: Putting the Customer First. *Supply Chain Management Review* 4, no. 5: 90-95.

Chang, Yoon; Markatsoris, Harris & Richards, Howard (2004). Design and implementation of an e-Procurement system. *Production Planning & Control* 15, no. 7: 634-646.

Cotteleer, Mark J.; Cotteleer, Christopher A. & Prochnow, Andrew (2007). Cutting Checks: Challenges and Choices in B2B E-Payments. *Communications of the ACM* 50, no. 6: 56-61.

Cronk, Marguerite C. & Fitzgerald, Edmond P. (1999). Understanding "IS business value": derivation of dimensions. *Logistics Information Management* 12, no. 1/2: 40–49.

Davenport, Thomas H. (1993). Process Innovation: Reengineering Work Through Information Technology. *Harvard Business Press* ISBN 0875843662.

Dedrick, Jason; Gurbaxani, Vijay & Kraemer, Kenneth (2003). Information technology and economic performance: A critical review of the empirical evidence. *ACM Computing Surveys* 35, no. 1: 1-28.

Dehning, Bruce & Richardson, Vernon J. (2002). Returns on Investments in Information Technology: A Research Synthesis. *Journal of Information Systems* 16, no. 1: 7-30.

Epstein, Marc J. & Rejc, Adriana (2005). How to measure and improve the value of IT. *Strategic Finance* 87, no. 4: 34-41.

EuropeanCommission (2007). European Electronic Invoicing (EEI) final report, available on-line http://ec.europa.eu/information_society/eeurope/i2010/docs/studies/eei-3.2-e-invoicing_final_report.pdf, accessed 29.11.2008.

EU (2006) The Helsinki Manifesto, available on-line http://elivinglab.org/files/Helsinki_Manifesto_201106.pdf, accessed 29.11.2008.

Galliers, R. (1991). Choosing Appropriate Information Systems Research Approaches: A Revised Taxonomy, In *Information Systems Research: Contemporary Approaches and Emergent Traditions* (Eds, Nissen, H., Klein, H. and Hirschheim, R.) Elsevier Science Publishers (North-Holland).

González-Benito, Javier (2007). Information technology investment and operational performance in purchasing. *Industrial Management & Data Systems* 107, no. 2: 201-228.

Guan, Sheng-Uei & Hua, Feng (2003). A Multi Agent Architecture for Electronic Payment. *International Journal of Information Technology & Decision Making* 2, no. 3: 497-522.

Gulledge, Thomas & Chavusholu, Tamer (2008). Automating the construction of supply chain key performance indicators. *Industrial Management & Data Systems* 108, no. 6: 750-774.

Jiang, Wei; Au, Tom & Tsui, Kwok-Leung (2007). A statistical process control approach to business activity monitoring. *IIE Transactions* 39, no. 3: 235-249.

Johnson, P. Fraser; Klassen, Robert D. (2005). E-Procurement. *MIT Sloan Management Review* 46, no. 2: 7-10.

Jonsson, Patrik; Lesshammar, Magnus (1999). Evaluation and improvement of manufacturing performance measurement systems - the role of OEE. *International Journal of Operations & Production Management* 19, no. 1: 55-78.

Jolly, Hubert (2008). Winning vendors over to e-payments. *Journal of Payments Strategy & Systems* 2, no. 2: 175-181.

Kaplan, Robert S. & Norton, David P. (1996). Strategic learning & the balanced scorecard. *Strategy & Leadership* 24, no. 5: 18-24.

Lynch, Richard L. & Cross, Kelvin F. (1995). *Measure Up! Yardsticks for Continuous Improvement*. Cambridge, MA : Blackwell.

Maskell, B. (1989). Performance measures of world class manufacturing. *Management Accounting* 67, 32–33.

Melville, Nigel; Kraemer, Kenneth & Gurbaxani Vijay (2004). Information technology and organizational performance: An integrative model of IT business value. *MIS Quarterly* 28, no. 2: 283-322.

Neely, Andy; Gregory, Mike & Platts, Ken (1995). Performance measurement system design. A literature review and research agenda. *International Journal of Operations & Production Management* 15, no. 4: 80-116.

Penttinen, Esko (2008). *Implementing electronic invoicing and getting the most out of IT – Case city of Tampere.* Wednesday, September 10, 2008

Penttinen, Esko (Ed.) (2008). *Electronic Invoicing Initiatives in Finland and in the European Union – Taking the Steps towards the Real-Time Economy*. Contributors Dorota, K., Harald, B., Hyytiäinen, M., Kuivalahti, T., Penttinen, E., Poteri, J. and Turunen, T. Helsinki School of Economics series B-95.

Penttinen, E. and Hyytiäinen, M. (2008). The Adoption of Electronic Invoicing in Finnish Private and Public Organizations. European Conference in Information Systems (ECIS), Dublin, Ireland, June 8-11 2008.

Pan-European Public Procurement Online (PEPPOL) Web (2008): http://www.peppol.eu/workpackages/wp4-eordering

Presutti Jr., William D. (2003). Supply management and e-procurement: creating value added in the supply chain. *Industrial Marketing Management* 32, no. 3: 219-226.

Raja, J. & Velmurgan, M. Senthil (2008). E-payments: Problems and Prospects. *Journal of Internet Banking & Commerce* 13, no. 1: 1-17.

Ray, Gautam; Muhanna, Waleed A. & Barney, Jay B. (2005). Information Technology and the Performance of the Customer Service Process: a Resource Based Analysis. *MIS Quarterly* 29, no. 4: 625-652.

Reunis, Marc R.B.; Santema, Sicco C. & Harink, Jeroen H.A. (2006). Increasing e-ordering adoption: A case study. *Journal of Purchasing & Supply Management* 12, no. 6: 322-331.

Salerno, Lynn M. (1985). What Happened to the Computer Revolution? *Harvard Business Review* 63, no. 6: 129-138.

Silvius, A. J. G. (2006). Does ROI Matter? Insights into the True Business Value of IT. *Electronic Journal of Information Systems Evaluation* 9, no. 2: 93-104.

Solow, Robert M. (1987). "We'd better watch out," *New York Times Book Review*, (July 12) :36.

Southhard, P. & Siau, K (2004). A survey of online e-banking initiatives. *Communications of the ACM* 47, no. 10: 99–102.

Supply Chain Management Portal (2008): http://scm.ncsu.edu/public/hot/hot031022.html

Tallon, Paul P.; Kraemer, Kenneth L. & Gurbaxani, Vijay (2000). Executives' Perceptions of the Business Value of Information Technology: A Process-Oriented Approach. *Journal of Management Information Systems* 16, no. 4: 145-173.

Yin, R. (1994). *Case Study Research: Design and Methods*. Sage Publications, Thousand Oaks, CA.

Exhibits

Exhibit 1: Order-to-payment process

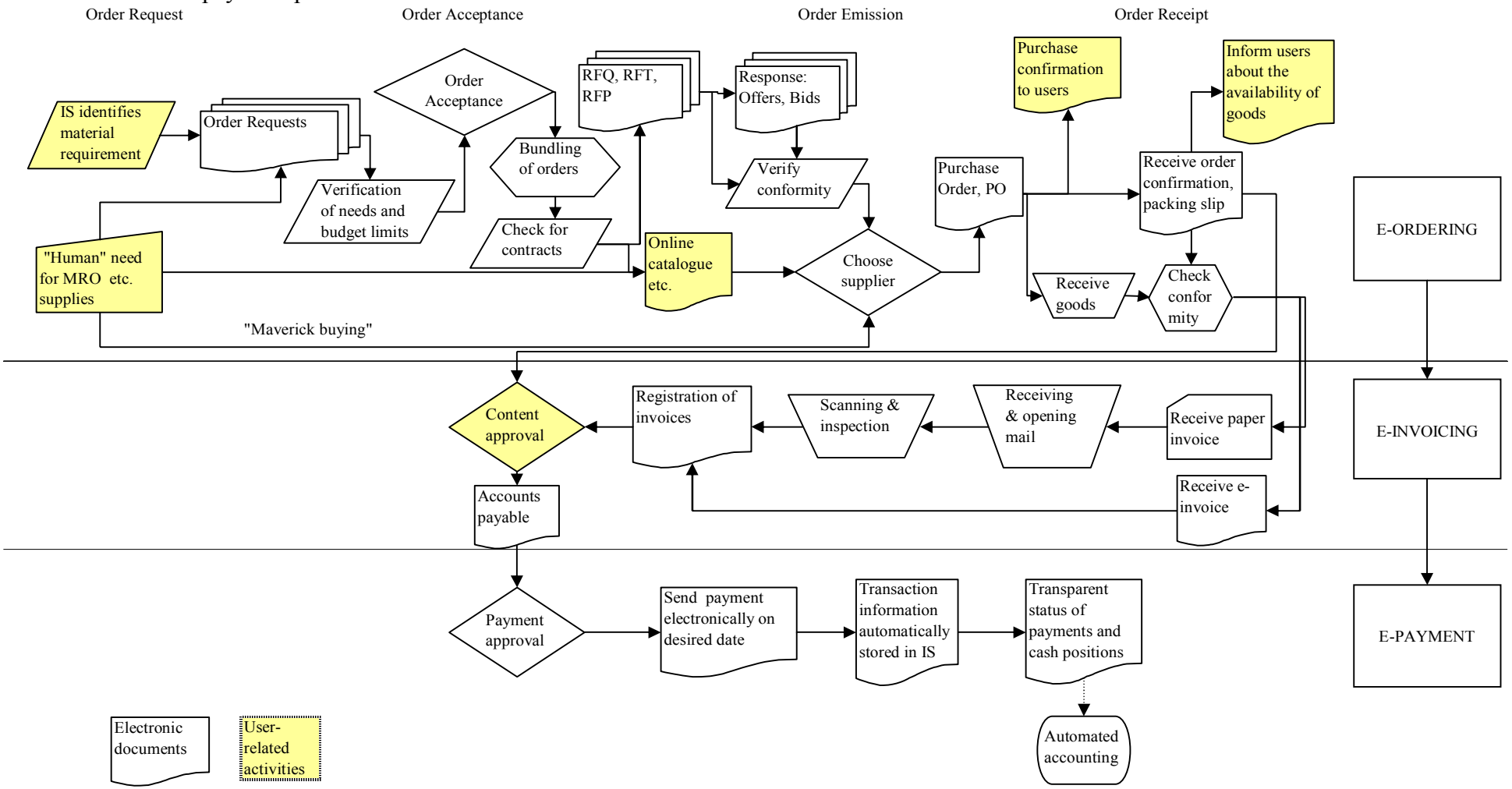


Exhibit 2: E-ordering impacts and metrics

E-ordering

Perceived benefits	*Description*	*Source*	*Proposed metrics*
Reduction in time-to-market of existing products	Getting existing products to market faster boost revenue through more market share	*Presutti (2003)*	Time-to-market of existing prod
Lower transaction costs	Due to reduction in labour costs in the purchasing process, among other things		Non-value added manual work Order processing time
Lower inventory level	Improved visibility of orders allows reducing safety stock etc.		Inventory level
Reduced cycle times	Reduction in the time from user order request until user goods receipt		E-ordering cycle time
Fewer RFPs that elicit no bids	Fewer Request for Proposals elicit no bids when using e-coordination technologies	*Johnson & Klassen (2005)*	RFP response rate %
Cost savings from process improvements	Costs savings from reduced manual order processing and rework due to mistakes etc.		Total e-ordering costs Number of errors
Lower purchase prices	Due to aggregated orders, increased price competition among suppliers e.g. PEPPOL		Purchase price
Greater visibility of orders	Order information visible in the system and accessible to all (production, sales, invoicing and payment)		Visibility of order information
Enhanced inventory accuracy	Less human mistakes in storing goods		Inventory accuracy
Improved inventory turnover	Due to lower inventory levels		Inventory turnover
Reduce obsolete inventory	Lower inventory level prevents holding obsolete items	*Brun et al. (2004)*	Obsolete inventory costs
Extra-costs due to useless purchased goods	Lower transaction costs due to returns		Costs due to useless purchases
Reduced paper and phone costs	Due to automation, less manual work is needed and thus less paper and telephone costs		Paper and phone costs
Reduced inventory holding costs	Accurate and timely information of orders allows keeping stock levels down		(Safety) inventory holding costs
Less stock outs	Users get accurate, real-time info about availability of goods -> less stock outs and lost sales		Stock out occasions
Less errors due to data duplication	All data is stored in one system, less double orders etc.		Errors due to data duplication
Lower inventory mgmt costs	Automated orders save inventory management costs		Inventory management costs
Flexibility in changing orders already released	Due to faster information exchange, orders can be changed after emission		Flexibility in changing orders already released
Improved mix and quantity flexibility	People tend to order even numbers; 5, 10 or 1 box... IT orders according to exact requirements		Mix and quantity flexibility
Lower non-conformity management costs	Less time spent on solving disputes due to less mistakes		Non-conformity management costs
Improved internal users' level of satisfaction	Reduced unnecessary work and better functionality increases user satisfaction		User satisfaction

Exhibit 3: E-invoicing impacts and metrics

E-invoicing

Perceived benefits	*Description*	*Source*	Proposed metrics
Less errors in the invoice handling process	The amount of errors in the invoice handling process has decreased considerably	*Penttinen (2008)*	Number of processing errors
Free up resources	Resources can be better utilized in more productive work areas - sales, customer service etc.		Value added per employee
Improve organization image	Being able to attract more young professionals to work for the company		Employer image
Cut cost in the invoice handling process	An incoming paper invoice costs 30-50 €; e-invoice can cut up to 80% of handling costs		Invoice processing costs Non-value added manual work
Work morale benefits	Processing of e-invoices rather than paper documents seems reasonable for the invoice handlers		User satisfaction
Decreasing circulation time	Invoice processing time has decreased on average two days, even excluding mail delivery time	*Penttinen (Ed.) (2008)*	Invoice handling time E-invoicing cycle time
Increased transparency	Allows enhanced visibility of invoices, payments and hence the financial state of the company		
Enable real-time reporting	Invoicing data is directly transferred to accounting (the next step of RTE program)		
Less interest on overdue payments	When process cycle time decreases, more invoices are handled and paid on time		Interest on overdue payments
Environmentally friendly	By getting rid of paper bills in Europe would save 400.000 tons of paper, 12 million trees etc.	*Penttinen & Hyytiäinen (2008)*	Customers' perception of quality Consumption of materials and energy

Exhibit 4: E-payment impacts and metrics

E-payment			
Perceived Benefits	*Description*	*Source*	*Proposed metrics*
Offer direct savings vs. paper-based check processin	The direct cost per transaction decreases for e-payments compared to paper payments Due to potential financial, human resources and time savings along with streamlined processes	*Cotteleer (2004)*	Payment processing costs E-payment handling time E-payment cycle time Number of errors #
Facilitate reconciliation and dispute management	Finding and retrieving data is simplified in e-payment systems		Payment data availability Average time spent on solving disputes
Provide global coverage	Payments can be sent outside the domestic market SEPA: domestic and foreign (euro) payments go through in same time (max 3 days)		Unplanned payment delays in days
Reduce fraud and credit loss potential	Payments are sent through a secure and reliable global network		Losses due to security issues
Increase visibility of cash requirements	(Payees) can see scheduled payments and anticipate cashflows		Visibility of cash requirements
Possess remittance data	The system is able to handle detailed purchase information		
Integrate data and payment information	Payments are bundled with transaction data for simplified integration into accounting systems		
Improve control of payment timing and cash flow	Payment is initiated and sent at precisely the time the business intends		Cash position control
Cash flow forecasting more accurate	Due to greater transparency of payment transaction	*SEPA white paper (2008)*	Cash flow forecasting accuracy
Cash can be drawn down at better rates	Taking advantage of prime rate changes is possible due to accurate cash control and forecasting		Interest paid on cash loans
Decrese the opportunity cost of cash	Excess cash can be used elsewhere to gain more profit		Opportunity cost of cash
Early payment discount possibilities	Use of e-payments lets buyers take advantage of possible vendor discounts for early payments	*Jolly (2007)*	Discounts on early payments
Lower bank transaction costs	Bank charges for paper cheques range from $0,75 to $2 compared to less than $0,15 on e-payments SEPA: same bank fees for domestic and euro area payments		Bank transaction costs

Exhibit 5: Other proposed metrics

Other

Impact	*Description*	*Source*	*Proposed metrics*
Invoicing	How many electronic invoices (EDI/XML) vs. paper invoices	Martti From/Tieke	E-invoice penetration
Invoicing	Better (human) resource planning is possible because incoming invoice volume is visible in advance	Pirjo Ilola/FKL	Resource planning accuracy
Invoicing	How long does individuals linger before approving invoices for payment	Emilia Pelkonen/Marimekko	Approval delays
Ordering	How long does it take to receive offers from suppliers after RFQ, RFP	Tapani Turunen/Tieto	Tendering response time
Ordering	Purchasing has traditionally relied on personal contacts and special discounts	Pirjo Ilola/FKL	Users' attitude towards e-buying
Ordering, invoicing, payment, order-to-pay	Increased number of documents flow through without human intervention	Jyrki Poteri/Tieto	Level of automation %
Order-to-pay; inter-process linkages	What is the maximum level of specification understood by IT systems	Pirjo Ilola/FKL	Number of specifications per order
Order-to-pay; inter-process linkages	More direct interoperability leading to lower reformatting costs as well as other benefits	*Penttinen (Ed.) (2008)*	Standard invoices %
Order-to-pay	How many process instances until a certain time compared to usual	Pekka Brusila/Tieto	Throughput/time interval
Order-to-pay	Enhanced cycle times, accuracy and agility allows delivering customers the right stuff at the right time	*Lynch & Cross (1994)*	On-time delivery %
Order-to-pay	Aggregate process-level measure of costs		Total order-to-pay costs
Company short term	Includes inventory turns, cycle times, human and financial capital elements	*Presutti (2003)*	Asset utilization
Company short term	Aggregate company-level measure of costs		Costs
Company short term	Being able to be "green" and deliver on time results in customer satisfaction leading to higher revenue.		Revenue
Company long term	A comprehensive measure which takes into account asset utilization, cost and revenue components.		Economic value added (EVA)

Exhibit 6: End-to-end structure of order-to-payment cycle measures

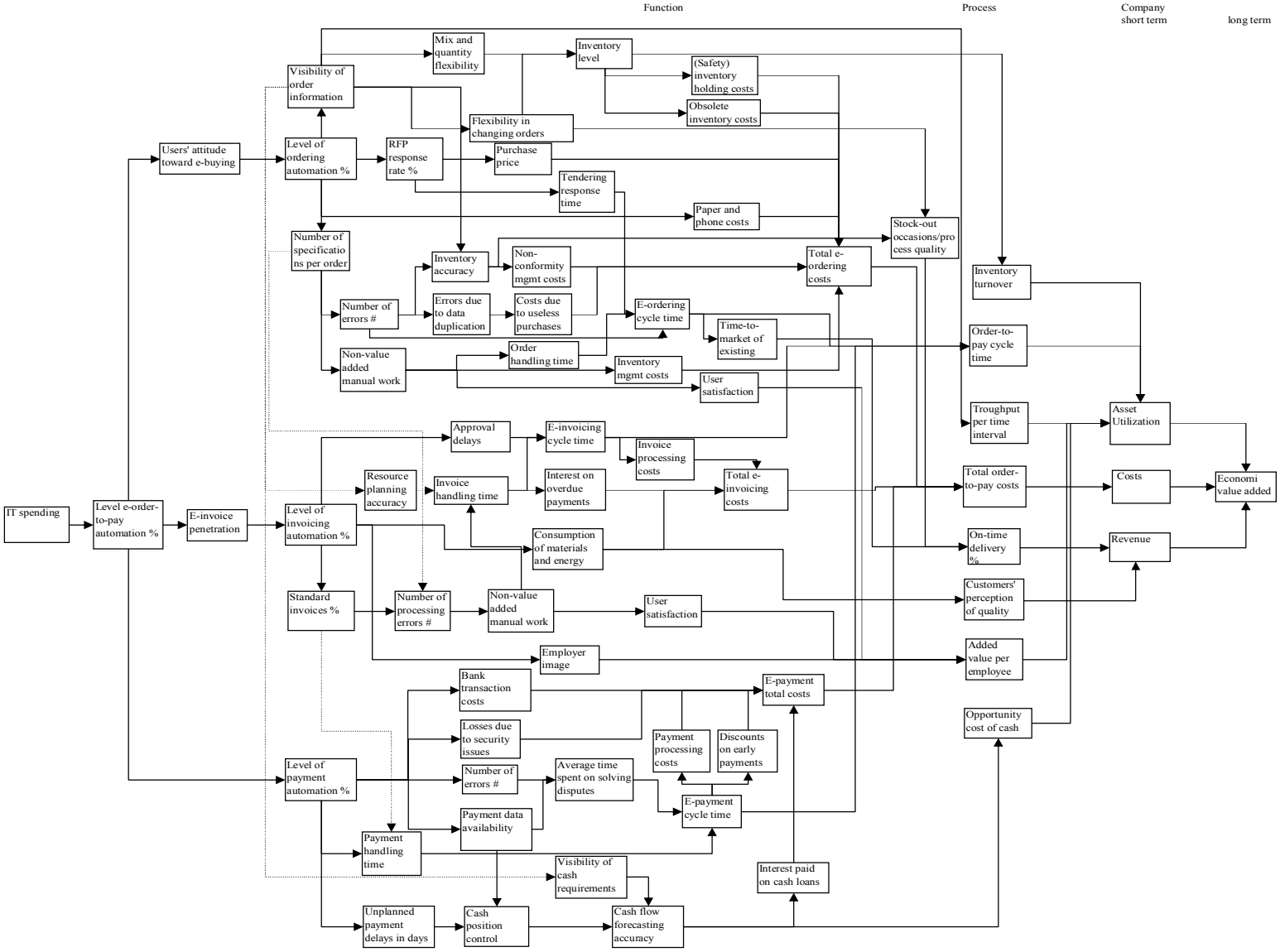


Exhibit 7: Marimekko order-to-payment process description

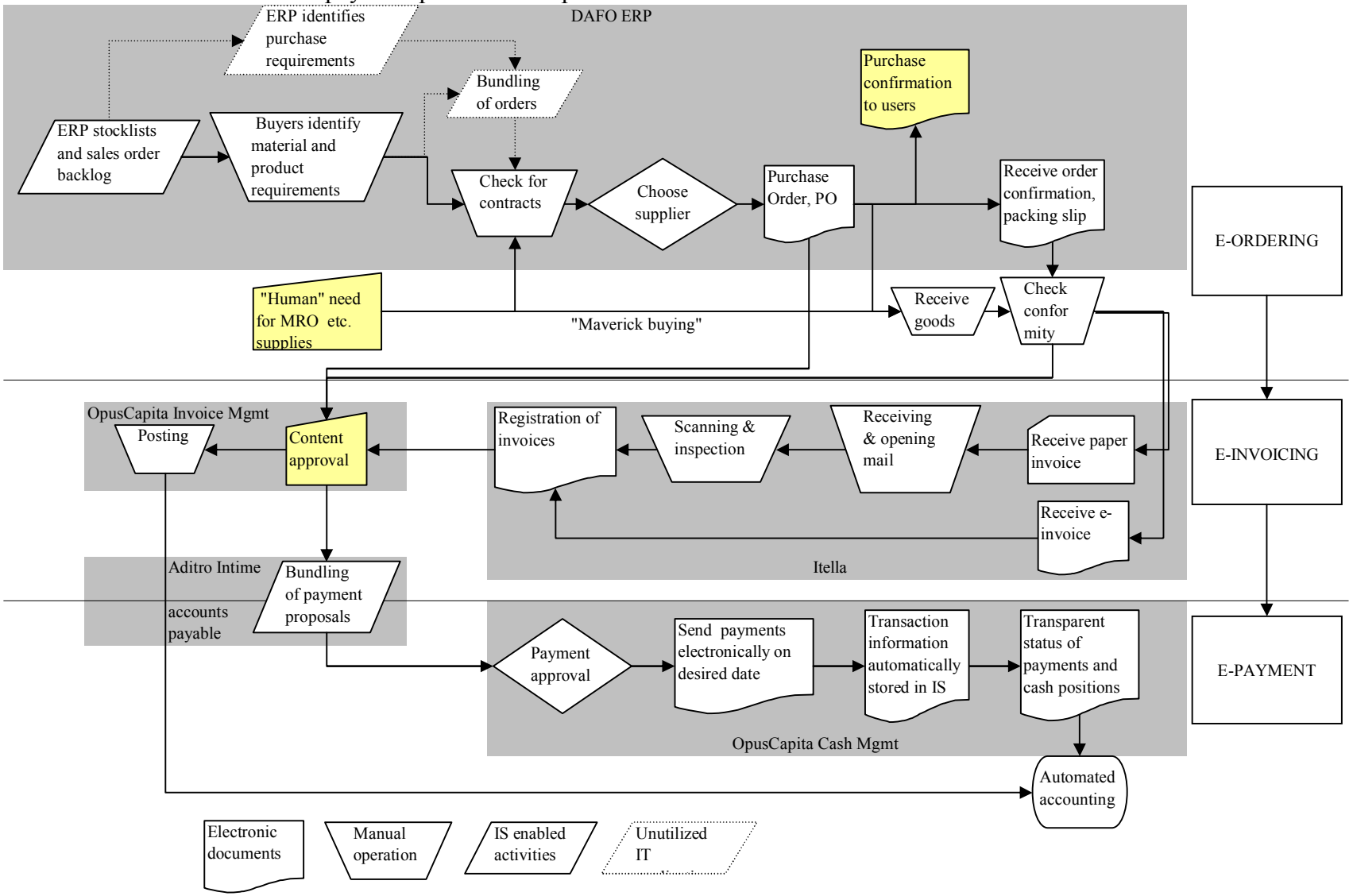


Exhibit 8: E-ordering measures by significance (Marimekko)

E-ordering	*Reetta Thurman*	*Buyer Interior Decoration*	*Leena Lammassaari*
			IT system development
Proposed metrics	*Importance*	*Notes*	*Notes*
Time-to-market of existing products	medium	This depends on supplier delivery times, not so much on process efficiency	However, enhanced dialogue between purchasing and sales could improve it
Non-value added manual work	high	Particularly due to high inventory mgmt costs	
Order handling time	medium	Actual order processing isn't that important due to relatively low volume	
Inventory level	high	Marimekko holds substantially large inventories	
E-ordering cycle time	medium	Only partly due to process improvements and faster information exchange	
RFP response rate %	low	Marimekko doesn't use e-marketplaces for buying They have well-established relationships with suppliers	
Total e-ordering cots	high	Reduction in total costs was seen to be important	
Number of errors	medium	Reduction of human mistakes was seen to be important, but not necessarily critical	Mistakes: human lead time estimate -> higher risk of giving inaccurate
Purchase price	low	Only one buyer orders particular products and there is no opportunity to bundle orders nor use e-marketplace driven competition to decrease purchase prices	information to customers. If buyer fails to identify requirements. => these reflect to customer satisfaction which is important to MM
Visibility of order information	high	Purchase information is visible for sales and invoice handling	If a product is sold through IS, then it has to be purchased via IS as well
Inventory accuracy	medium	This is quite well under control. Raw material inventory is the most inaccurate but only because it is physically difficult to measure.	
Inventory turnover	high	Better asset utilization due to lower inventory levels	
Obsolete inventory costs	high	Due to seasonality, unsold items and unused material often becomes obsolete	Purchases are often made at risk and some customers can't pay for their advance orders. Obsolete products are sold on discount
Costs due to useless purchases	low	Since one buyer orders particular products -> small risk for over lapping orders	
Paper and phone costs	low	Not too specific due to relatively small number of orders	
(Safety) inventory holding costs	high	Identified as very important because they wouldn't have to keep safety inventory if order and sales data was better integrated.	
Stock out occasions	low	Stock-outs also depend mainly on supplier lead times	
Errors due to data duplication	low	Since most of the information is stored in IS, and only one buyer orders one particular product	
Inventory management costs	high	Buyers spend most of their time manually identifying purchase requirements from stock lists. Also when orders are received, data is manually entered into ERP	
Flexibility in changing orders already released	medium	Orders can be changed before order confirmation comes in. Electronic information exchange is rapid and therefore improves flexibility here.	However, the changes can't be done through ERP but e-mail instead
Mix and quantity flexibility	medium	Automated ordering systems could improve this up to a point	
Non-conformity management costs	high	Order information is easily found in IS thus enabling enhanced dispute mgmt	
User satisfaction	high	Less manual processing increases job satisfaction for the interviewee	Also frees up resources for more important work areas

Exhibit 9: E-invoicing measures by significance (Marimekko)

E-invoicing	*Emilia Pelkonen System developer, financial administration*	
Proposed metrics	*Importance*	*Notes*
Number of processing errors	high	E-invoices are error free, however since part of invoices are still scanned, electronic processing is seen to create more errors compared to fully manual processing
Value added per employee	high	The nature of work for the invoice handlers is changed and now only 60% of their time is spent on invoice processing-> frees up resources for "invoice management"
Employer image	low	Adopting electronic solutions has been motivated by internal efficiency rather than external image and is thus not articulated outside
Invoice processing costs	medium	
Non-value added manual work	high	60% of time goes to routine work when it use to be more or less full time
User satisfaction	medium	Reduction in manual work has improved satisfaction, however due to changed "job description" other unsatisfying duties have emerged
Invoice handling time	medium	Due to small volumes, larger time and costs savings come from circulation time
E-invoicing cycle time	high	Due to electronic information exchange
Interest on overdue payments	low	This isn't a major financial problem
Customers' perception of quality	low	The company is preparing a report on environmental issues including this aspect
Consumption of materials and energy	high	16 000- 17 000 bills per year (+copies) saves a lot of paper and even archiving space

Exhibit 10: E-payment measures by significance (Marimekko)

E-payment	*Suvi Salonen*	*Business Controller*
Proposed metrics	*Importance*	*Notes*
Payment processing costs	high	E-payments offer dramatic savings in terms of handling and cycle time as well as error reduction which lead to lower costs
E-payment handling time	high	
E-payment cycle time	high	
Number of errors #	high	
Payment data availability	high	Payment data is easily found from IS which makes dispute mgmt more efficient
Average time spent on solving disputes	high	
Unplanned payment delays in days	high	E-payment systems allow cutting delays, especially in international payments
Losses due to security issues	low	Security issues were not considered critical in this case
Visibility of cash requirements	medium	This information isn't visible to the cashier but in fact to accounts payable
Cash position control	medium	Cash flow control and forecasting is done mainly on the income side. However, information visibility could be utilized due to automated invoice handling and ordering
Cash flow forecasting accuracy	medium	
Interest paid on cash loans	medium	
Opportunity cost of cash	medium	Data for this is available, but it is not utilized
Discounts on early payments	medium	Does not depend on cycle time as much as it depends on technical restrictions in the IS
Bank transaction costs	high	E-payment allows cutting bank fees dramatically

Exhibit 11: Other measures by significance (Marimekko)

Other			
Proposed metrics	*Importance*	*Notes*	*Source*
E-invoice penetration	high	E-invoices offer direct savings in form of less Itella scanning charges. Also, information included in e-invoices is always correct and compatible with IS, less rework due to errors	Emilia Pelkonen
Resource planning accuracy	low	Not important in this case, they buy large quantities but volume of invoices is quite low	Leena Lammassaari
Approval delays	high	The largest challenge regarding circulation time is how long invoices linger on at each person responsible for approving them	Emilia Pelkonen
Tendering response time	low	Marimekko does not use e-marketplaces for buying so this is not too significant	Reetta Thurman
Users' attitude towards e-buying	low	All buyers are already used to buying through IS. Attitude problems in MM relates to people not being thorough in approving invoices. Hence, invoicing cycle time increases	Leena Lammassaari
Level of automation %	high	The importance of automation was articulated by all interviewees	All
Number of specifications per order	medium	The problem is more on standardizing the form of order confirmations to begin with	Leena Lammassaari
Standard invoices %	high	Errors in the invoice handling process are mainly due to unstandardized bills which are uncorrectly reformatted into e-form.	Emilia Pelkonen
Throughput/time interval	low	due to seasonality and large order size, difficult to observe "average" throughputs	Mari Lindström
On-time delivery %	medium	If the "dialogue" between purchasing and sales could be improved through IS, Marimekko could deliver better on-time to their customers	Leena Lammassaari
Total order-to-pay costs	high	Cost avoidance was mainly the intuitive choice for IT business impact in this case. It also feels measurable and can be used as argument for IT spending	Mari Lindström
Asset utilization	high	Derived from related process-level measure significance	
Costs	high		
Revenue	medium		
Economic value added (EVA)			

Exhibit 12: Analysis of electronic order-to-payment impacts at Marimekko – the critical paths

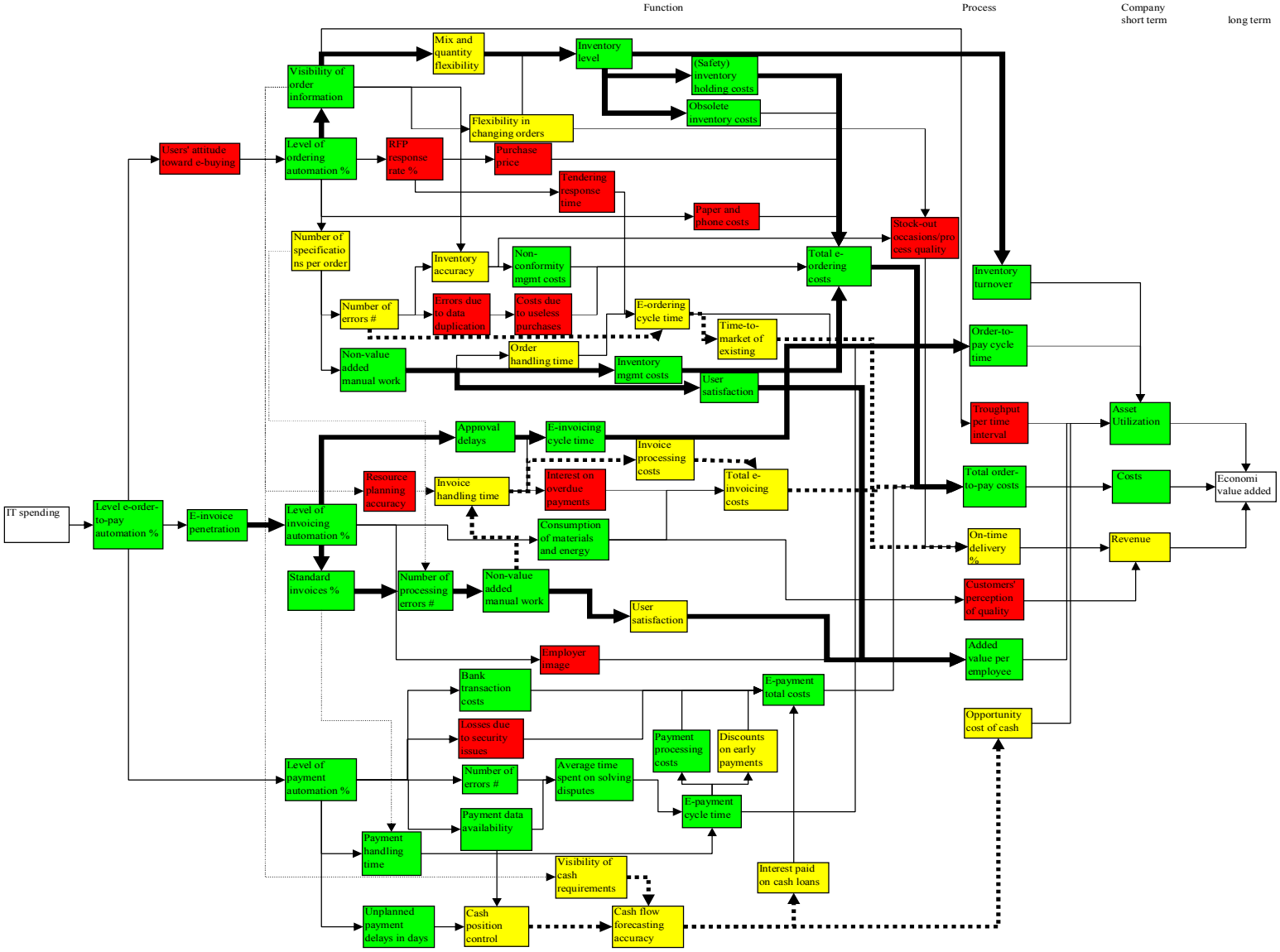


Exhibit 13: Example of constructing metrics for e-ordering and e-invoicing measures

E-ordering	********** EXAMPLE **********	
What to measure?	*How to measure?*	*Whom to ask?*
PROPOSED MEASURES	METRICS	SOURCE
Time-to-market of existing products	Average lead time in sales	Sales/ERP
Non-value added manual work	€ Labour costs in purchasing	Accounting/Income statement
Order processing time	Estimated time spent on manual processing at each phase	Purchasing
Inventory level	€ Value of inventory	Accounting/Income statement
E-ordering cycle time	Time from order request to goods receipt	Purchasing/ERP
RFP response rate %	% Estimated share of RFP:s that elicit bids	Purchasing/ERP
Total e-ordering costs	€ Sum of all cost factors (vs. costs assigned to purchasing)	Accounting
Number of errors	# of error messages	ERP
Purchase price	€ Material costs	Income statement
Visibility of order information	% ERP mediated orders (vs. phone, fax, e-mail etc.)	Purchasing
Inventory accuracy	% Estimate of inventory accuracy	Purchasing
Inventory turnover	Inventory turnover "sales/inventory"	ERP
Obsolete inventory costs	€ Obsolete inventory written down	Accounting
Costs due to useless purchases	€ Costs caused by returning useless goods	Purchasing
Paper and phone costs	€ Paper and phone costs in purchasing	Accounting
(Safety) inventory holding costs	€ Inventory holding costs	Accounting/Income statement
Stock out occasions	% Availability	Sales
Errors due to data duplication	Estimated number of double orders	Purchasing
Inventory management costs	Estimated time spent on inv. mgmt * labour cost €	Purchasing
Flexibility in changing orders already released	Estimated % share of approved rush orders in purchasing	Purchasing
Mix and quantity flexibility	Average number of extra items per order due to rounding	Purchasing
Non-conformity management costs	Estimated time spent on non-conformity mgmt * labour cost €	Purchasing
User satisfaction	Number of sick days or user estimate (questionnaire)	Purchasing

E-invoicing	********** EXAMPLE **********	
What to measure?	*How to measure?*	*Whom to ask?*
PROPOSED MEASURES	METRICS	SOURCE
Number of processing errors	# of error messages	ERP
Value added per employee	€ Revenue/employee	Income statement
Employer image	Field experiment, Likert 1-7 or # of applications/opening	Staff Manager
Invoice processing costs	Handling time * labour cost €	Accounting
Non-value added manual work	€ Labour costs in purchasing	Accounting/Income statement
User satisfaction	Likert 1-7 estimate by users	Invoicing
Invoice handling time	Estimate or ERP data; reported time spent on invoice processing	Invoicing/ERP
E-invoicing cycle time	Time from receiving an invoice until transfer to accounts payable	Income statement
Interest on overdue payments	€ Interest paid for late payments	Accounting
Customers' perception of quality	Field experiment, Likert 1-7 or repeated orders from customers	Sales
Consumption of materials and energy	Paper and energy costs in invoicing	Income statement

Exhibit 14: Example of constructing metrics for e-payment and other measures

E-payment	********** EXAMPLE **********	
What to measure?	*How to measure?*	*Whom to ask?*
PROPOSED MEASURES	METRICS	SOURCE
Payment processing costs	Handling time * labour cost €	Accounting
E-payment handling time	Estimated time spent on payment processing	Payment
E-payment cycle time	Time from payment proposal to pending payment	Payment/ERP
Number of errors #	# of complaints from suppliers	Payment
Payment data availability	% payment transactions stored in IS	Payment
Average time spent on solving disputes	Estimated time spent on solving disputes	Payment
Unplanned payment delays in days	Payments late on average (in days)	Accounting/ERP
Losses due to security issues	€ Losses due to fraud	Accounting
Visibility of cash requirements	% of purchase information stored in IS	Payment/ERP
Cash position control	Amount of cash "safety stock"	Payment
Cash flow forecasting accuracy	Estimated probability of coming short of cash	Payment
Interest paid on cash loans	€ Interest expenditure of short-term credit	Accounting
Opportunity cost of cash	e.g. ROI %	Income statement
Discounts on early payments	€ Discounts earned from early payments	Accounting
Bank transaction costs	€ Bank transaction costs	Accounting

Other	********** EXAMPLE **********	
What to measure?	*How to measure?*	*Whom to ask?*
PROPOSED MEASURES	METRICS	SOURCE
E-invoice penetration	% Incoming e-invoices vs. paper invoices	ERP/Invoicing
Resource planning accuracy	Estimated accuracy of resource allocation	Invoicing
Approval delays	Invoice approval cycle time	ERP/Invoicing
Tendering response time	Average time to receive a bid	ERP
Users' attitude towards e-buying	ERP % in purchasing	ERP/Purchasing
Level of automation %	% Process instances that require no human intervention	CIO
Number of specifications per order	Number of specifications attached to an ordered item	Purchasing
Standard invoices %	% Invoices in a standard format	Invoicing
Throughput/time interval	Number of process instances completed until a predetermined time	ERP
On-time delivery %	% sales orders delivered on-time to customers	Sales/ERP
Total order-to-pay costs	Sum of e-ordering, e-invoicingand e-payment costs	Measurement Tool
Asset utilization	Sum of all underlying asset-related metrics	Measurement Tool
Costs	Sum of all underlying cost-related metrics	Measurement Tool
Revenue	Sum of all underlying revenue-related metrics	Measurement Tool
Economic value added (EVA)	Sum of asset utilization, cost and revenue business impacts	Measurement Tool