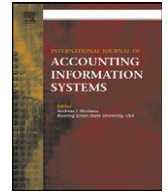




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A conceptual framework for valuing IT within a business system

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ABSTRACT

Evaluation of IT value is challenging due to the complex nature of IT impacts and multifaceted interpretations of value. We introduce a conceptual framework for tackling the complexity of IT value evaluation within the scope of a single company. Our study applies design science research with analysis of experiences from five cases. The conceptual framework covers perspectives: 1) analysis levels for varying stakeholder views on value, 2) valuing logics for different interpretations of value, and 3) evaluation views for understanding systemic value. Together these perspectives create a basis for evaluating and communicating multifaceted IT value, and help to understand what kind of specific value information can serve the needs of IT-related decision making.

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1. Introduction

Today information technology (IT) is a prevalent subject of decision-making in companies, as more and more development and investment initiatives include specific IT elements, either in an enabling or supporting role. IT evaluation supports decision-making by establishing the value or contribution made by a particular IT investment (Andresen, 2001). IT evaluation aims to understand the IT impacts towards the investment goals, and IT value is a concept for explicating these impacts in a useful way for decision making.

However, evaluation of IT value is a challenging task (Melville et al., 2004; Barclay, 2008). There are two tightly coupled sides in this challenge: 1) describing and understanding IT impacts in a business system, and 2) multifaceted interpretations and meanings of value. Together these sides and especially their intersection – judging the goodness i.e. valuing of IT impacts – forms our research problem. When approaching this problem from the IT impacts' perspective, the current literature recognises issues like multilevel goals and broad impacts of IT, intangible and delayed impacts, numerous complementary factors affecting the impacts, and indirect attributability of economic paybacks (Devaraj and Kohli, 2000; Stockdale and Standing, 2006; Marthandan and Tang, 2010). Despite the extensive research on evaluation principles and conceptualisations (e.g. Gunasekaran et al., 2006; Urbach et al., 2009), the theoretical basis is scattered and complex to utilise for the purposes of practical evaluation solutions (Melville et al., 2004; Chaysin et al., 2016).

The other side of the problem – the concept of value – is something that has intrigued philosophers, researchers and practitioners for more than two millennia (Ng and Smith, 2012), but still it remains a fertile ground for misinterpretations and overloaded meanings. The conceptual field can be overwhelming, as value is defined for example, either as a synonym for a utility

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or benefit towards goals (Ragowsky et al., 1996; Ramirez, 1999), as a relation of utility and costs (Walters and Lancaster, 1999), or business value of IT as an umbrella term for the contribution of IT to company performance (Mukhopadhyay et al., 1995; Tallon et al., 2000). In addition to utilitarian views, also phenomenal and hedonic value foundations are applied especially on an individual level of analysis (e.g. Kujala and Väänänen-Vainio-Mattila, 2009).

Within the IT/IS field, IT value is approached from multiple levels of analysis, for example, whether and how much IT affects productivity or performance in organisational, industry or national levels (Brynjolfsson and Hitt, 1998; Barua et al., 1995; Dedrick et al., 2003). Within our scope of analysis, on a level of an individual company evaluating the value of a specific IT system, it is widely agreed that traditional financial measures alone are problematic for valuing modern IT (e.g. Martinssons et al., 1999; Marthandan and Tang, 2010). It seems that integrative and multilevel evaluation is required for understanding IT impacts (Seddon et al., 1999; Melville et al., 2004), but the corresponding holistic value conceptualisation is missing.

The purpose of this paper is to clarify the complex phenomenon of IT value evaluation by answering the research question “How to conceptualise IT value for evaluation purposes within a business system?”. The business system is a socio-technical whole covering the company purpose, goals, organisation, processes, people and technology. IT - as a target for evaluation and investment decisions - covers a specific IT system and its usage as an element of the business system.

We propose a conceptual framework (from here on referred to as **Conceptual Framework**) for understanding the valuing of IT. During the overall evaluation process, Conceptual Framework should facilitate shared comprehension of different but complementary meanings of value and its evaluation between stakeholders. Stakeholders include the performers and facilitators of the evaluation, those who use the results of the evaluation and all actors providing value perceptions or other information for the evaluation. The mutual understanding of IT value concept should help focus evaluation activities, selecting evaluation methods and operationalising value constructs as feasible measures.

Conceptual Framework applies widely recognised principles of multilevel analysis (Seddon et al., 1999; Davern and Kauffman, 2000; Chan, 2000), balanced view on business system performance (Martinssons et al., 1999; Marthandan and Tang, 2010), and the lifecycle view on IT evaluation (Willcocks and Lester, 1996; Davern and Kauffman, 2000). A systemic approach with systems thinking (e.g. Gharajedaghi, 2011; Meadows, 2008) as an underlying philosophy is utilised for integrating the multilevel and multiperspective system inquiries. The value concept is applied from value creation and value determination perspectives (Gummerus, 2011), ensuring that the evaluation covers both the mechanisms affecting value and the outcomes of those value creating mechanisms.

Conceptual Framework has empirical roots in an industrial-research joint project. The project applied a design science approach (Hevner et al., 2004; Wieringa, 2014) in five case companies for creating Systemic Evaluation Approach. During the solution design and testing, it was realised that the meaning of value in practice was very much a ‘moving target’. All of the five cases shared the same driver for the evaluation: *to understand the value of a specific IT system, in order to make value-based decisions about the future of the system*. However, despite the common ground, the cases had diversified interpretations of value and different requirements for the content and form of useful value information. This observation from the practice – together with the scattered methodological basis mentioned in evaluation literature – motivated the formulation of Conceptual Framework as presented in this paper.

The structure of this paper is as follows: Section 2 presents related literature to our research problem, motivates and introduces the design goals for Conceptual Framework. Section 3 introduces the research setup and the assessment criterion for our contribution. Section 4 introduces Conceptual Framework in detail, Section 5 demonstrates how the constructs of Conceptual Framework appeared in our five study cases, and Section 6 evaluates Conceptual Framework against the assessment criterion. The paper is concluded by discussion and conclusions in Sections 7 and 8.

2. Background

In order to design a solution to a problem, the first thing is to understand the problem itself. This paper is dedicated for understanding the problem, namely the complex phenomenon of studying IT impacts and valuing those impacts. Our objective is to synthesise a conceptual framework that structures and characterises the phenomenon of IT value evaluation. This study is not about “how to evaluate?”, in a sense of tasks and methods. Instead, this study is about “how to conceptualise the phenomenon

Table 1
Challenges in IT value evaluation (applied from Töhönen et al., 2015).

Origin of challenges	Description
Focus of IT	Wide spectrum of possible purposes of IT
Nature of business system	Socio-technical system creates complexity
Volume of IT impacts	Wide spectrum of possible IT impacts
Complementarity	IT success depends on interactions with multiple factors
Traceability for causes and effects	Indirect and long causal chains from IT impacts to performance goals
Time and dynamics	Delays and evolving impacts
Observability and measurability	Intangible and hidden impacts
Accountability for business impacts	Wide impacts are hard to cover with existing business measures
Maturity of methods and theories	Theoretical basis of IT value evaluation is scattered
Maturity of practices	Inadequate evaluation practices and missing evaluation culture

we are going to evaluate?”. The knowledge generalised into Conceptual Framework should frame the actual evaluation activities in a specific evaluation context.

In the next chapters we present a brief background of IT evaluation challenges, varying approaches in evaluation solutions and diverse conceptualisations of value. We also shortly introduce the basics of systems thinking, as various systemic approaches are emerging in recent IT evaluation research and we aim to support this trend with Conceptual Framework. The literature review both motivates and gives the basis for the design goals of Conceptual Framework.

2.1. IT evaluation – challenges and solutions

The benefits and value of IT have been studied for decades (Hamilton and Chervany, 1981; Barua et al., 1995) but it is still a current and interesting topic (Melville et al., 2004; Chaysin et al., 2016). IT evaluation can be defined as a series of activities aimed at establishing the value or contribution made by a particular IT investment (Andresen, 2001, p. 7). IT evaluation is a complex undertaking in which the outcomes depend on various interrelated but incommensurable factors, and the diverse implications of IT are judged differently by different stakeholders (Klecon and Cornford, 2005). Several studies elaborate the nature and challenges of IT evaluation, for example Melville et al. (2004), Davern and Wilkin (2010), Marthandan and Tang (2010) among others. The recent paper of Töhönen et al. (2015) reviews IT/IS evaluation literature and categorises the challenges into ten issues (Table 1).

The challenges, especially the category ‘Maturity of methods and theories’, cover also to the issue of the definition of value. The unclarity of the value concept complicates the selection of IT evaluation solutions.

Despite the challenges, many principles for IT evaluation are widely agreed in literature. For example, value measurements should cover multiple organisational levels and utilise both qualitative and quantitative measures (Davern and Wilkin, 2010). Marthandan and Tang (2010) stress the importance of evaluation scope: identified stakeholder perspectives, clarified evaluation objectives and constraints, and recognised IT focus and use.

Plenty of research is devoted to frameworks and models defining generic structures and causalities of IT impacts, effectiveness, efficiency or success (e.g. Grover et al., 1996; Delone and McLean, 2003; Sugumaran and Arogyaswamy, 2003; Gable et al., 2008). IT related benefit and/or cost classifications and typologies can be used as a checklist in planning evaluation activities. Example classifications are cost taxonomies (Irani et al., 2006), benefit classifications (Simmons, 1996), IT type specific benefits (Gregor et al., 2006) and social subsystem benefits and costs in IT investments (Ryan and Harrison, 2000).

Above mentioned solution principles, constructs and checklists are not sufficient alone in practice, and therefore, guidelines for the execution of evaluation have been presented. For example, Stockdale and Standing (2006) guide evaluation process planning with their holistic CCP (Content, Context, Process) evaluation framework. Peppard et al. (2007) provide Benefits Dependency Network for linking IT enablers with business changes and investment objectives. Balanced scorecard based IS assessment frameworks (Martinssons et al., 1999; Bajaj et al., 2008) are examples for measuring and evaluating IT from multiple perspectives. However, BSD is suitable for relative and continuous performance monitoring of IT function, its processes and projects (De Haes and Van Grembergen, 2015, p. 80), instead of measuring or valuing individual IT systems.

2.2. Basics for systemic evaluation

During the last decades systemic approaches has received an increasing interest from several directions, including IS research (e.g. Tona and Carlsson, 2013; Burton-Jones et al., 2015; Ceric, 2015) and evaluation research in general (e.g. Midgley, 2006; Cabrera et al., 2008; Gates, 2016). On a practical level, system dynamics (SD) is one possible methodology for modelling, learning and simulating complex dynamic systems, and its potential is also acknowledged within IS research (e.g. Clark and Augustine, 1992; Wolstenholme, 1999; Georgantzas and Katsamakas, 2008).

We use ‘systemic approach’ as an overarching term to characterise the underlying philosophy applied in our efforts for valuing IT. The systemic approach relies on systems thinking. Within a generic problem-solving context, systems thinking stresses the significance of interdependencies of things and provides a means to cope with the complexity caused by this interconnectedness (Senge, 1990, p. 68; Sterman, 2000, p. 4). As systems thinking itself is a pluralist concept with varying emphasis and levels of abstractions (e.g. SOSM - System of Systems Methodologies, Jackson, 2006, p. 18), we introduce relevant aspects of systems thinking for our purposes of holistic inquiry about value.

2.2.1. System definition and business system

Many of the systemic characteristics are directly related to the definition of a system. A **system** is, as defined by Meadows (2008, p. 188): “A set of elements or parts that is coherently organized and interconnected in a pattern or structure that produces a characteristic set of behaviours, often classified as its ‘function’ or ‘purpose’”. Interconnections between the system parts are the central factor in diverse system definitions within the systems literature (Backlund, 2000).

System boundaries scope and focus systemic inquiries. A system, as a reflection (or a model) of its real-world subject, is always an abstraction. The use of system models - or the needs for systemic understanding in general - define the system boundaries and affect the required level of details in the models (Kim, 1992; Sterman, 2000, p. 98). Both the purpose and the boundaries of a system are dependent on observer’s viewpoints.

In this paper we are interested in a **business system**, which is an abstraction for a focal company enclosing a specific IT system under evaluation. A business system can be seen as a socio-technical system, consisting of technology, people, resources and

processes (Ryan and Harrison, 2000; Palvia et al., 2001). The boundaries of a business system – with its elements and their interconnections – define the playground for investigating how a specific IT system contributes to the business system's purpose.

2.2.2. Systemic characteristics

An open system has an environment. A system boundary is between the system and its environment, and an open system is in interaction with its environment (Ackoff, 1971). System elements interacting with each other create the behaviour of the system. **Systemic behaviour** is easy to perceive as counterintuitive. Causes and effects are commonly separated by time and space; there are delays and multiple levels of causes and effects, and because of circular connections (i.e. feedbacks or closed-loops) cause and effect can replace one another (Gharajedaghi, 2011, p. 48). **System state** at a moment of time is a snapshot of system behaviour, and the state represents the relevant properties which that system has at that time (Ackoff, 1971).

The concept of **emergent** property is central in systems thinking. A system's behaviour cannot be defined as the sum of the actions of its parts, but the behaviour is a product of interactions where parts together create the dynamic nature of the system (Gharajedaghi, 2011, p. 45). IT/IS research has identified many kinds of complementary or value-conversion contingency factors (e.g. Lee, 2001; Gregor et al., 2006) which together affect how well IT succeeds or creates value. Indeed, IT has no inherent value and is not used in a vacuum (Peppard et al., 2007). To phrase this same issue in a system's language: the success and/or value of IT is an emergent property of a system. Value is created through the synergy of IT and other system elements.

2.3. Value and valuing approaches

Value is a multifaceted concept with roots traceable to the beginning of Western philosophy (Ng and Smith, 2012). Regardless of its long philosophical history, value is still a vague and inconsistently used term (Bengtsson, 2004).

Modern philosophical foundations for value studies are distilled under the discipline of axiology. Traditional axiology is interested in understanding and explaining goodness: what things are good, how good they are, and how their goodness is related to one another (Schroeder, 2008). Many axiological questions are embedded as a background in modern economic and management research disciplines. For example, the questions 'why something is good' and 'is this goodness existing as an objective state of the world, or is it a subjective state of mind', have strongly affected the evolution of value definitions in marketing research (e.g. customer value dimensions by Holbrook (1994) and service-dominant logic by Vargo and Lusch (2004, 2008)). Why something is good is related to the debate over intrinsic and instrumental (or extrinsic) value. If something is intrinsically valuable, its value is in virtue of its intrinsic properties - it is valuable as-is (Schroeder, 2008). The chain of justification follows instrumental value leading to another valuable thing (Bengtsson, 2004), and only the system boundaries of our investigations can eventually set the end point.

Regarding the other central question about objective/subjective value, the historical atomistic view sees value as the essence of an object, while the modern phenomenal view argues that value is always created or experienced between subject and object. Phenomenal value is emergent and created as a result of interactions of subject and object in a dynamic context (Ng and Smith, 2012).

2.3.1. Multidisciplinary value approaches

Next we introduce different interpretations or logics for defining the concept of value. For our research, they provide the necessary elements for defining the systemic understanding of value.

Value in exchange. Traditional economic approaches consider value in the context of exchange between supplier and customer: an object's value stems from the utilities or satisfactions the object provides for the customer, and this value is represented by the price the consumer is willing to pay (Richins, 1994). According to this view, value is related to utility and to the power of exchanging this utility with other utilities. In marketing research, this value is called as value-in-exchange - "*value-in-exchange is the negotiated evaluation that buyers and sellers offer and receive among themselves.*" (Kowalkowski, 2011).

Value in use. Recent service management and marketing research, especially the service-dominant logic initiative, have emphasised the importance of value-in-use concept. Where value-in-exchange attaches value to an offering or a service, value-in-use lies in the use situations and experiences as perceived by the beneficiary. Value-in-use is phenomenal, experiential, contextual, and laden with meaning (Vargo and Lusch, 2008). Within sustainable business relationships between a supplier and a consumer, value-in-exchange is only possible if value-in-use is created (Grönroos, 2008). Value as experience includes both hedonic and utilitarian value (Gummerus, 2011, p. 25).

Net value. Value-in-exchange and value-in-use are abstract concepts aiding to understand the essence of customer value and value creation in general. The net value approach is a practical and well-known conceptualisation for value, and its main principle is familiar from economics and marketing. Net value is a trade-off of benefits or utility (i.e. positive consequences) and sacrifices or costs (i.e. negative consequences) (Ng and Smith, 2012; Khalifa, 2004; Walters and Lancaster, 1999). In customer value literature, net value is considered to be a preferential judgment of the customer (Ng and Smith, 2012).

Means-end. Another preferential judgment approach for value is means-end ladder theory (Gutman, 1982; Woodruff, 1997). In the means-end approach, value lies in the capabilities of offering's attributes to provide the desired consequences, i.e. to act as a means to an end. Within the net value approach value rests in an outcome evaluation, while in the means-end approach, value is an instrumental factor in achieving the outcome. These two approaches are not necessarily mutually exclusive and they are often considered simultaneously (Ng and Smith, 2012).

Value creation vs. value determination. Gummerus (2011) distinguishes between value creation and value determination. The value creation view focuses on processes and mechanisms, answering where and how value is created. Value determination answers whether and how much value exists. Value determination elaborates the outcomes of value creation, thus reflecting value snapshots and utilising varying value approaches (e.g. net value). Value creation and determination are closely interdependent, but the distinction of these two helps in the search for the root causes of value outcomes. Gummerus focuses on customer value, but the separation of value creation and value determination is also applicable in IT value evaluation, and for example, promotes the introduction of predictive measures in addition to backward-looking and lagging measures.

Systemic value. Systemic value is identified as complementary to objective, economic and rational value (Marchand and Raymond, 2008). Gharajedaghi (2011, p. 46) characterises systemic value as emergent, dynamic and reproduced continuously on-line in real time. Vargo et al. (2017) elaborate the systemic view on value in the context of service-dominant logic. Value is a multidimensional system level construct (i.e. an emergent property), that is co-created and phenomenologically experienced through complex interactions among multiple actors. The systemic view of value encompasses both value-in-exchange and value-in-use. Because value is phenomenological, multidimensional and emergent, the determination of value differs throughout an ecosystem (Vargo et al., 2017).

2.3.2. IT/IS value approaches

IT business value is traditionally used as an umbrella term for the contributions of IT on company performance (Barua et al., 1995; Mukhopadhyay et al., 1995; Tallon et al., 2000; Melville et al., 2004). Under this umbrella, value can mean direct economic performance or it can be interpreted as a bundle of benefits.

Direct economic performance is evaluated with financial measures like Return on Investment (ROI), net present value (NPV), profitability, cost reductions or an increase in sales. However, financial value interpretations face challenges accounting for IT's hidden, intangible and indirect impacts (Martinssons et al., 1999; Marthandan and Tang, 2010), and thus, these challenges are often considered a black box problem (Bengtsson, 2004; Lee, 2001; Chan, 2000).

The 'bundle of benefits' value approach opens the above mentioned black box by recognising beneficial IT impacts on different organisational levels (e.g. Mirani and Lederer, 1998; Ryan and Harrison, 2000; Gregor et al., 2006). Beneficial impacts are further valued by intermediate measures like perceived usefulness, employee productivity, process cost efficiency or IT's effectiveness in supporting decision making (Simmons, 1996; Venkatesh and Davis, 2000; Tallon et al., 2000).

Synergy views emphasise synergetic performance impacts as a result of alignment between IT, business goals and a variety of complementary organisational factors (e.g. Brynjolfsson and Hitt, 2000; Wiengarten et al., 2013; Hiekkanen, 2016). The issue of synergy is central when aiming for a holistic and integrative valuing of IT. Synergy leads us to consider value as an emergent property of a business system: value is created and affected as a result of synergetic interactions of the system elements (e.g. people, processes and technology). The forthcoming sections provide backgrounds for systemic approach, on which we rely for handling the complexities of synergy and emergency.

2.4. Motivation and design goals for Conceptual Framework

During the last decades, IT evaluation research has devoted itself to opening the 'black box' of IT impacts within a business system, thus emphasising multiperspective and integrative evaluation approaches (e.g. Marthandan and Tang, 2010). However, from the conceptual point of view, available definitions of value do not match the otherwise holistic and systemic perspective for IT impacts. Typically, the definition of value is implicit to the evaluation method or the IT value/IT business value is an encompassing term referring to a wide array of impacts on organisational performance. We argue that the scattered nature of the definition of value is complicating the selection of appropriate evaluation and valuing methods, and there is a need for integrative and practically relevant value conceptualisation in the context of IT evaluation.

Within design science the artifacts are designed and investigated in context, and conceptual frameworks in general set the basis for understanding the context and the overall problem domain the artifacts interact with (Wieringa, 2014). In our case, this means that Conceptual Framework should support IT evaluation in acknowledging and merging with the evaluation context. We arrange the design goals of Conceptual Framework around three contextual aspects:

1. IT evaluation purpose and process
2. Focus of IT and focus of decisions
3. Systemic nature of the problem domain

The first contextual design aspect builds on IT evaluation general purpose and process, the **purpose** stated as "establishing the value or contribution made by a particular IT investment" and a **process** view stated as a "series of activities incorporating understanding, measurement and assessment" (Andresen, 2001). These aspects cover identification of IT impacts, valuing those impacts (i.e. judging the goodness) and explicating the value.

The second aspect suggests Conceptual Framework to acknowledge varying purposes of IT (focus of IT) and different demands of IT decision making for the evaluation outcomes (focus of decisions). The **focus of IT** can be for example efficiency through automation, effectiveness through information, or new business through transformation (Andresen, 2001, orig. Remenyi et al., 1991). The focus of IT affects the evaluation approach, since no single method is suitable for all kinds of IT systems (Palvia et al., 2001). The focus of IT influences the scope and broadness of evaluation by indicating the relevant stakeholders, processes and goals of

the business system. The goals and their hierarchies within a business system are focal when further elaborating upon different meanings of benefits and value.

In many cases, IT evaluation should produce information for decision-making, thus the **focus of decisions** sets requirements for the expected evaluation outcomes i.e. value information. For example, the decisions can be about new investments that require absolute monetary estimates about the lifecycle costs of IT and expected benefits with their economic worth. In another case, there is a need to improve existing IT application alignment through organisation, thus the evaluation should provide relative information for prioritising improvements within the business system. As the different decisions require different kinds of supporting information, evaluation should be able to provide different abstractions to the IT value information, for example either absolute or relative, quantitative or qualitative. Even different forms of valuing logic are required to produce the desired value information.

The third aspect recognises the **systemic nature** of the problem domain. As the IT value evaluation is a complex socio-technical phenomenon, Conceptual Framework should prepare for handling the issue of complexity and the need for integrating multiperspective and multidimensional meanings of value with a systemic approach.

The pursuit for value information can be operationalised via value questions, which frame the evaluation context and guide the evaluation activities (Fig. 1). The value questions elaborate the different viewpoints and abstractions for value. Conceptual Framework binds value questions logically together and at the same time proposes concepts and guidelines for answering the questions.

3. Methodology

The contribution of this paper is a conceptual framework. Within design science research, conceptual frameworks have a central role as an element in theory building, as well as a basis for designing solutions for practical problems. According to Wieringa (2014, p. 43), conceptual framework is used "to frame a research problem, describe phenomena, and analyze their structure". Conceptual framework can be a set of multifaceted constructs for defining and understanding the phenomenon and constructed artifacts related to the phenomenon in a specified problem context (Wieringa, 2014, p. 73).

3.1. Design science as a research approach

Our research follows a case-based design science approach. The general purpose of design science is twofold: 1) to solve construction or improvement problems in a given context, and 2) to generalise design knowledge about the solutions in context (Hevner et al., 2004; Wieringa, 2014). Design science contributions are artificial constructions - artifacts - including constructs, models and methods. Artifacts are instantiated (i.e. realised) in the problem environment as new innovations or an improved state of affairs (March and Smith, 1995). From a scientific point of view, artifacts both represent and are the source for generalised knowledge contributions that for example identify essences and relationships in the research territory (i.e. conceptual knowledge), describe and explain things (i.e. descriptive knowledge) or prescribe how to achieve desired ends (prescriptive knowledge) (Iivari, 2007). Knowledge contribution is the distinctive research element that separates design science from mere one shot problem solving activity (Hevner et al., 2004).

The core process of design science is a build-and-evaluate loop, which covers artifact design and its utility evaluation. Knowledge contribution is also generated and evaluated through the build action (March and Smith, 1995; Hevner et al., 2004).

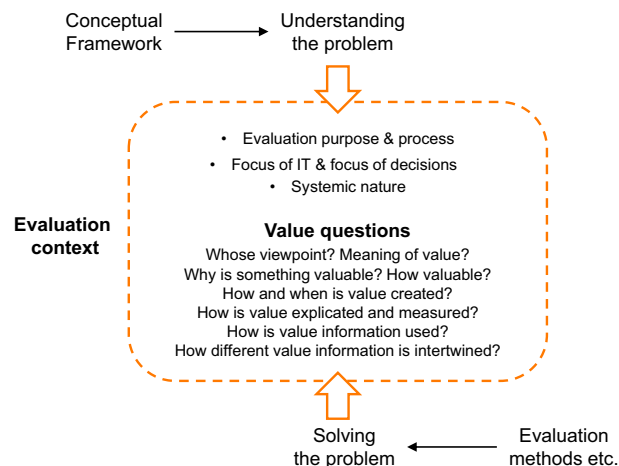


Fig. 1. Evaluation context and positioning Conceptual Framework in a continuum of understanding the problem of IT evaluation and utilising this understanding in evaluation solutions.

Together the construction-oriented problem solving and the seeking of generalisable knowledge form iterations of design and investigation (Wieringa, 2014).

In this paper we focus especially on the conceptual knowledge contribution (Iivari, 2007) and report a generalised understanding for the phenomenon of IT value evaluation. Our knowledge contribution is called as Conceptual Framework. The problem-solving iterations in the overall design science project concentrated on building and testing a solution artifact - Systemic Evaluation Approach - for IT value evaluation. Conceptual Framework is the part of Systemic Evaluation Approach,¹ which in this paper is only treated as a provider of case experiences for justifying and assessing the choices made with Conceptual Framework. By scoping out the prescriptive knowledge reporting of Systemic Evaluation Approach from this paper, we can assure proper space and quality for presenting and reasoning Conceptual Framework.

3.2. Case descriptions and data analysis

All the five case companies (Table 2) were customers of an IT service provider, hereafter called 'Host Company'. Aalto University research group has been doing research co-operation with Host Company's service development since 2012, and the first Case A started in spring 2013. Data from the last Case E was collected on spring 2015. The first implementation of Systemic Evaluation Approach with initial versions of Conceptual Framework was developed in Case A and the implementations were tested and further developed in the following cases.

All the cases had a specific – existing or future – IT system under evaluation, whose value and value creation mechanism was the topic of interest. The overall workflow in all cases followed the steps: get familiar with the evaluation topic, set up an evaluation team, clarify the evaluation goals, model value creation and define metrics for explicating the value. Work methods utilised workshops, interviews, document analysis and system modelling/simulation with system dynamics.

From a research methods point of view, the first three Cases A to C followed action research approach. In Case A, the first author had a leading role in developing and using Systemic Evaluation Approach (Töhönen et al., 2014), while in Cases B and C the first author supported Host company participants in using and further developing the artifact. Rest of the cases D and E followed case study approach, where researcher participated in evaluation workshops and other activities as an observer and commentator. In all the cases, evaluation team members were interviewed after the case completion.

In addition to workshops and interviews, data was collected in the form of process descriptions and memos of working meetings. Written data together with transcribed workshops and meetings was combined, coded and analysed in Atlas.ti software.

Focal points for data analysis were: roles and responsibilities of evaluation stakeholders, individual, process and organisational goals and how IT was impacting those goals. Roles and responsibilities provided the first insights into multiple levels of analysis for IT value. Insights into the processes and their goals gave the backbone for linking individual goals into the organisational goals. In order to understand the organisational goals, explicit models for earnings logic per case were drafted. All the cases built a cause-and-effect value creation diagram(s) as an intermediary outcomes. These visual models combined the evaluation team's shared understanding of how different goals, IT impacts and several affecting (enabling, blocking or complementing) factors were linked together. These models were the primary source for identifying different valuing logics, abstraction levels and evaluation views for presenting the outcomes of valuing efforts.

The data analysis, combined with literature analysis for value and IT evaluation, evolved to the initial versions of Conceptual Framework. For the final version presented in this paper, two intermediary analysis tools were utilised. Appendixes A and B analyses and maps the cases with the constructs of Conceptual Framework. Snapshots from the Appendixes are used to demonstrate the utility of Conceptual Framework (Section 5). Appendix C contains criteria for building the mapping used in Appendixes A and B.

3.3. Methods for assessing Conceptual Framework

We utilise three sets of criteria for assessing² the relevance and utility of the presented Conceptual Framework (Table 3):

- 1) Assessment with respect to the design goals
- 2) Assessing the construct validity
- 3) Assessing new knowledge with respect to existing knowledge base

The design goals emphasise how Conceptual Framework should help in recognising the evaluation context. Design goals are elaborated under Background Section 2.4.

Construct validity "the extent to which an application of a construct to phenomena is warranted" (Wieringa, 2014, p. 90), is the principal assessment criteria for conceptual frameworks in general. We use retrospectively the artifact development cases for mapping the constructs of Conceptual Framework to the real life examples (Appendixes A and B). To assess the degree of construct validity, we apply the requirements formulated by Wieringa (2014), as described in Table 3.

¹ Systemic Evaluation Approach covers conceptual basis, methods basis and workflow basis.

² 'Evaluation' of research contributions is an elemental phase in Design Science research process (Peffer et al., 2007). However, throughout this paper, with regard to the evaluation of research contributions, we replace the term 'evaluation' with 'assessment'. By doing this, we use 'evaluation' only in the context of IT value evaluation, and avoid possible confusion and overloading of the term.

Table 2

The cases and their IT systems under evaluation.

Case	Domain	Target IT system
A	Gambling & gaming provider	Existing game management system (GMS)
B	Network service & infrastructure provider	Existing billing & ticketing system
C	Grocery retailing	Future Enterprise Resource Planning (ERP)
D	Computer & communications security	Existing travel expense management system
E	Communication networks & service provider	Future cloud-based product development & testing environment

The third line of assessment is common to all research. The knowledge contribution has to offer something new to the existing knowledge base and the contribution should be interesting (Hevner et al., 2004). As pointed out in the literature section, the novelty of our contribution leans on integrative and holistic approach for valuing IT within a business system. The degree of interest-ness is also assessed together with the relevancy of Conceptual Framework for the study cases as described in Appendixes A and B.

4. Conceptual Framework

In our approach IT value evaluation consist of two parts: identifying the impacts of IT and judging the goodness (i.e. valuing) of those impacts. Evaluation is always done in a context that is defined by the focus of IT under evaluation and the focus of decisions defining the purpose of required value information.

Conceptual Framework (Fig. 2) covers three perspectives: 1) the levels of analysis for investigating the value in a business system, 2) the valuing logics for defining the valuing mechanisms and the value concept itself, and 3) the evaluation views for systemic and operationalisation aspects over the lifecycle of value. Together these three perspectives aim to clarify and interlink the heterogeneous mixture of concepts for value creation, determination and presentation.

4.1. Analysis levels

The idea of multiple levels of analysis is the key to understanding the different interpretations of value at different positions of the organisation. Different interpretations and reasons about what is considered valuable form a starting point for systemic understanding about the business system. According to Gharajedaghi (2011, p. 93) we can apply the iterative process of holistic thinking for understanding complexity. The cyclic process elaborates a system's function (what does it do), structure (what are its components), and process (how does it work) at the different levels of organisation. Each round of these questions gives insights into a subsystem's goals, as well as to the structures and processes as a means for reaching those goals. IT impacts can be valued directly against the goals or valued at a means level, i.e. evaluating what the degree of IT's support or fit for the means in reaching the goals is. From the overall business system point of view, goals and means form chained cause-and-effect structures. These multilevel cause-and-effect structures are the target for multiple levels of analysis, and form the basis of systemic understanding.

Our scope of evaluation is on a single company that is analysed as a socio-technical business system. We propose three initial levels as a basis for analysing IT impacts: organisational, process, and individual users. This set of levels preserves Conceptual Framework simple enough for general applicability while still granting practical granularity for finding initial touchpoints for analysis. The touchpoints should help in finding the business system's overall goals (organisational level analysis), system's structure and functions (process level analysis) and users' subjective perceptions about IT impacts (individual level analysis).

Organisational level analysis focuses on the total impacts of IT to the company or business unit performance (Barua et al., 1995; Marthandan and Tang, 2010). This level of analysis is typically operationalised, for example, as profitability, Return on Investment (ROI) or Net Present Value (NPV)-type financial measures (e.g. Seddon et al., 1999; Martinssons et al., 1999; Petter et al., 2008). Organisational level analysis is driven by both operational and strategic business goals, which are further propagated downwards to guide the goals of process and individual levels. The goals identified from the organisational level should also act as a proxy towards the environment (i.e. markets with customers, partners and competitors) of the business system. By excluding the markets outside the business system boundaries, we deliberately limit the scope of evaluation and assume that organisational goals are aligned with the current environment.

Table 3

Assessment criteria for Conceptual Framework.

Design goals (Section 2.4)	Construct validity (Wieringa, 2014, p. 88)	Knowledge (Hevner et al., 2004)
-IT evaluation general purpose and process	-Explicit definitions	-Contributions are new
-Focus of IT, focus of decisions	-Unambiguous classification of the instances of the concepts	-Contributions are interesting
-Systemic approach	-Indicators and capturing of the intended meaning of the constructs	
	-Avoiding bias in measurements of the indicators	

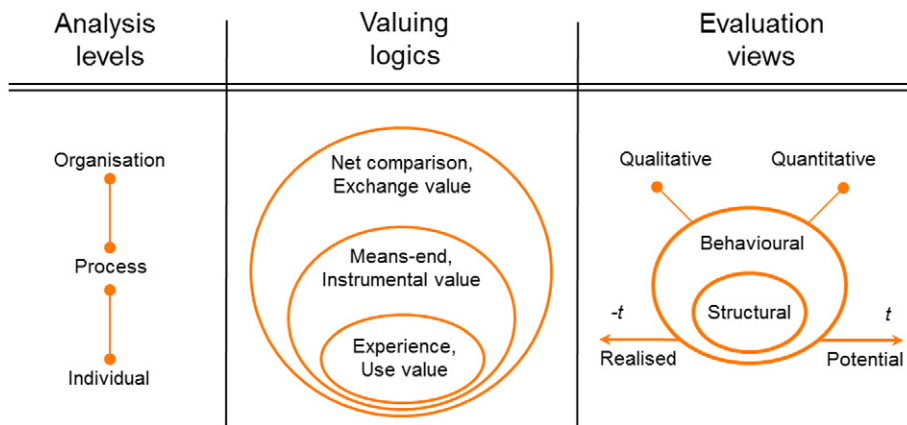


Fig. 2. Conceptual Framework with three perspectives for valuing IT.

Process level is argued to be the location where the first-order impacts of IT investments occur and the benefits for the organisation are realised (e.g. Barua et al., 1995; Tallon et al., 2000; Melville et al., 2004). A business process turns organisational resources and investments into business value (Davern and Kauffman, 2000) and IT improves individual business processes and/or interprocess linkages (Tallon et al., 2000). Examples of business processes are inbound logistics, manufacturing, sales, distribution and customer service, and their success is operationalised through measures of operational efficiency, flexibility or customer service (Melville et al., 2004).

Even though the process level is the primary locus for analysing IT's organisational impacts, **individual** users are in many cases the first interface between the IT and the enclosing business system. Users provide data and information into information systems and exploit the information processed and distributed by IT. Individual users act as an important mediating factor between the IT impacts and organisational net benefits (e.g. Tallon et al., 2000; Delone and McLean, 2003; Gable et al., 2008). Users' perceptions about the IT's usefulness and ease of use affect intentions to use IT (Venkatesh and Davis, 2000). Individual users can provide rich and meaningful diagnostic assessment of the contributions of IT to the business, without the problems of time lags, noise and overly broad measures (Davern and Wilkin, 2010).

4.2. Valuing logics

This part of Conceptual Framework covers three general approaches for defining the value. The approaches differ in how they emphasise either outputs of value determination, explication of value creation mechanisms or raw perceptions in use situations. Together these valuing logics acknowledge both value affecting factors and the results of those factors within a business system. This kind of systemic view to valuing is not limited to only short-term value snapshots, but also recognises the rationales for long-term trends.

Net comparison logic focuses on explicit value determination by comparing the difference between benefits and sacrifices. Value is an output of conscious judgment. This logic combines the purpose of exchange value, broadly defined as "goodness for exchange with something" (Ng and Smith, 2012), with the mechanisms of net value approach. The net value approach always has two value-driving elements, as it is defined as the trade-off in positive consequences (benefits) or desired outcomes and negative consequences (sacrifice) or costs (e.g. Wiseman, 1992; Walters and Lancaster, 1999; Khalifa, 2004).

Net comparison logic is not tied to any specific level of analysis, even though many financial value statements at an organisational level are the result of net comparison logic. For example, at an organisational level of analysis, net comparison can produce an overall value for IT investment based on the estimated monetary value of benefits minus estimated costs during the investment time horizon. The resulted information is used to decide whether the investment is accepted or not. In a process level example, we can compare the IT-enhanced process productivity changes with the IT's purchase and maintenance costs. This information is further used to decide a budget for improving the process and IT alignment. At the individual level, an employee can, for example, compare the effects of IT to her task performance with the additional work required by the IT, and based on this feeling she decides to use an old workaround or invest more time in practicing the usage of IT.

Means-end logic puts focus on the mechanisms of value creation instead of the actual value outcome. In this paper, we parallel value creation with a network of cause-and-effect patterns. Network of causes-and-effects originates from the first order IT impacts at an individual level, through the processes to the organisation's performance.

We apply a means-end chain as a general building block in understanding systemic structures for value creation. Means-end chains form the hierarchies of goal structures – sequences of subordinate and superordinate goals (Pieters et al., 1995). These hierarchies can be used to link together the varying goals of different stakeholders within a business system. The linked goal structures (built from means-end chains) can be seen as value creation mechanisms, where IT impacts are traced and linked with consequences. Within value creation mechanisms, IT has instrumental value – value reflects IT's abilities to enable or facilitate achieving the desired goals.

Another way to clarify the differences between net comparison and means-end valuing logics is to consider their operationalising into different objectives and measurements through summative and formative evaluation approaches. According

to Hamilton and Chervany (1981), summative evaluation determines whether the system has achieved desired objectives. Instead, formative evaluation assesses the development process or means undertaken to accomplish the objectives. Summative evaluation corresponds with net comparison logic while formative evaluation resonates with means-end logic. Summative evaluation is operationalised as effectiveness-oriented objectives like improved inventory control and improved customer satisfaction. Formative evaluation emphasise efficiency-oriented objectives like resource consumption, production capability and resource investment.

Experience logic focuses on individuals' perceptions about how the IT impacts are realised in use context. Value is defined as a phenomenological practice of value creation from movement of actions, practices and processes within a dynamic constructed context (Ng and Smith, 2012). Value is something experienced, not something explicitly judged by comparing or evaluating pros and cons. The raw experience is often just a glimpse, before other valuing logics take over and develop on the memories of the experience. More time and space consumed between the experience (the actual value creating moment) and the moment of determining the value out from the experience, more possibilities there are for different interpretations, biases, measurement errors, and other 'noise' factors.

The reasons for recognising experiences worth its own valuing logic are the same as already presented with individual level of analysis. The value analysed from the individual level – both as experienced and further determined with perceptual or independently observable measures – serves as a starting point for the other valuing logics. As such, experience value reflects individuals' intention to use IT, that is an important complementary factor for IT's capabilities to meet the desired investment goals.

4.3. Evaluation views

This part of Conceptual Framework proposes closely coupled views for elaborating systemic nature of value, value lifecycle over time and the explicitness of measuring and analysing value. Evaluation views are applied when modelling real world issues (interesting from the value creation and determination point of view) into evaluation models, and when analysing and extracting outcomes from the evaluation models.

A structural view for the business system is the basis for elaborating value, and all other evaluation views build on structural understanding. From a systemic perspective, structural view provides the understanding of value creating/affecting elements and their interconnections within a business system. These elements can represent different functions, processes, inputs and outputs of functions/processes, IT's impacts on these inputs/outputs or different complementary factors related to IT's impacts. Also metrics can be treated as system elements, especially if they control other elements or relationships. Another group of control-oriented elements are different goals of system stakeholders. Examples of structural view value statements are: "*This benefits us and this hinders the benefits*", "*This is valuable because it allows us to...*" or "*These issues affect our success*".

A behavioural view enriches structural understanding and gets the system 'alive' by acknowledging the interactions of structural elements over time. Behavioural view provides insights into the business system state, and gives answers to the questions like "*How much value?*", "*Is value increasing or decreasing?*" or "*What is the rate of change for value?*". In general, time is the factor that separates the behaviour from the system structure: as soon as we consider a system in respect of time, we are considering system behaviour. Together system structure and behaviour form the basis for systemic value understanding, which in turn links different valuing logics and stakeholder perspectives to support each other and for common goals.

Behaviour of value elements and the overall system can be static or dynamic. Static value elements remain constant over time or their state changes are not related to the system history. For example, fixed software licence costs (a sacrifice) and a steady flow of processed transactions (a benefit) are examples of static value creating/affecting elements. Dynamic value changes over time and the behaviour is a function of a system's (or an element's) earlier state. Dynamic behaviour is already implicated on a structural system view by feedback relationships and accumulative type of elements (i.e. stocks or buffers). Feedbacks and buffers are sources for delays, which can cause counterintuitive effects on value. In general, overall value creation behaviour of a business system is dynamic by nature.

Time and the system behaviour are mediating factors between **potential** and **realised value**, which together form the continuum of value lifecycle. Potential value is the expected value in future, while realised value is something already happened and existing. Uncertainty about the system behaviour is the risk towards value realisation. Wiseman (1992) emphasises this risk of value realisation by calling potential benefits as benefit statements. Separation of benefit statements and realised benefits (cost or sacrifice statements respectively) pinpoints the importance of identifying the moderating or complementary factors affecting the value realisation. Together potential and realised value views create a temporal continuum that can cover the whole lifecycle of IT investment, from preparations of investment decisions to ensuring and improving paybacks of running IT system.

Structural and behavioural understanding for value creation and determination is operationalised into explicit knowledge through **qualitative** and/or **quantitative** views. Operationalisation can be targeted to value composing elements (e.g. benefits, sacrifices), value creating mechanisms (e.g. cause-and-effect relationships), outcomes of those mechanisms (e.g. net value) or other complementary factors for value creation (e.g. enablers, blockers). Qualitative-quantitative views can be applied to the different abstraction levels of value and value evaluation: to the type of measurements/data and to the type of systemic analysis.

Measurements provide data about the 'real world' issues under evaluation. These issues cover the IT impacts and other value affecting factors that feed value evaluation. The issues can be intangible, soft, or subjectively perceived impacts and factors like improved reporting or better flexibility in operations. The issues can also be characterised as tangible, hard and independently observable, like release of manual work or decreased number of production defects (e.g. Anandarajan and Wen, 1999; Ward et al., 2008). When measured, the issue is operationalised as a variable with a measurement scale. Nominal scales have no numerical or quantitative properties while ordinal, interval and ratio scales allow quantitative measurements. Quantitative

measurements provide quantitative data as an output, they allow, for example, talking about amounts of variables (Cozby and Bates, 2011, p. 105–109). Qualitative measurements with nominal scales or other investigation methods like interviews, can produce qualitative data about the issue under evaluation, covering for example IT benefit categorisations or narratives of opinions and feelings about the IT impacts.

The systemic analysis for understanding value builds on either qualitative or quantitative data/measurements, or it mixes both. The analysis provides the evaluation outcomes, i.e. the answers for the case-specific questions about IT value. For characterising the overall systemic value understanding, we take the qualitative–quantitative analysis views from the field of system dynamics. Qualitative–quantitative views describe the overall extent of systemic understanding (Wolstenholme, 1999). Qualitative understanding gives the first insights to the system structures and interactions. This kind of information is useful in learning different views of stakeholders and creating a mutual awareness of the system, e.g. what is valuable, why it is valuable and how to affect its value. Quantitative understanding covers the mathematical representation of the system behaviour and state: numerical data and equations defining the scores and relationships of system variables and constants. As an evaluation outcome, this kind of information covers numerical facts or estimates, either absolute or relative, potential or realised. From a value operationalisation perspective, a qualitative system view identifies the ‘placeholders’ for the issues to be observed (i.e. metrics to be measured) while quantitative view attaches the instance data with equations and state information for the placeholders.

5. Demonstrating Conceptual Framework

Next, we demonstrate how the constructs of Conceptual Framework help in understanding the phenomenon of IT value evaluation in our study cases. We use Case A as a continuous example covering all the parts of Conceptual Framework, and complement the presentation with samples from other cases. Case A involved a gaming operator and a legacy Game Management System (GMS). GMS was used for managing the lifecycle of various gaming products, from planning the gaming content, opening the games for public, closing the games, and to publishing game results.

5.1. Samples for analysis levels

In the beginning of the evaluation process, analysis levels reminded to identify system stakeholders and their goals. The goals set the baselines for valuing various forms of IT impacts.

In Case A data was gathered from all three levels. The evaluation team had participants representing different stakeholders related to GMS. Stakeholders were interested in different impacts of GMS:

- **Organisational level** was represented by gaming product owners. Their primary focus was on gaming revenue.
- **Process level** was represented by gaming operators and game designers. They focused on gaming process throughput, quality and the attractiveness of gaming content.
- Both organisational level and process level stakeholders represented also **individual level** view as GMS users. They focused on routine task efficiency, minimization of human errors, and to the time saved for planning gaming content and improving overall work environment.

Multilevel analysis promoted a shared understanding between stakeholders and provided a ‘common language’ for business and technology people. The Case A team noted that the existing ‘enterprise architecture’-style documentation had failed in creating proper common understanding.

Process level was the only analysis level clearly present in all cases. For example, in Case C (ERP), direct organisation and individual level analysis were missing. IT and business architects were used as proxies for organisational performance through merchandising and procure-to-pay business use cases. However, by the end of evaluation phase, the importance of linking the analysis more directly with marketing and sales goals increased.

In cases C and E (cloud based development environment) explicit individual level analysis was missing. One reason for this was the extent of the studied IT systems within the business system, causing that most analysis efforts were spent in elaborating process or organisation levels.

5.2. Samples for valuing logics

Identifying different valuing logics helped in composing stakeholder’s different value conceptualisations into a meaningful whole, instead of competing with each other. The cases introduced how value can be goodness in experiences, goodness of means in achieving goals or relative comparison with resources or sacrifices required to achieve the goodness.

In Case A, **net comparison logic** was used to calculate GMS impact on gaming turnover: $impact\ on\ turnover = (gaming\ turnover\ with\ GMS - gaming\ turnover\ without\ GMS) - GMS\ costs$. **Means-end logic** was used to demonstrate GMS importance as an enabling factor for gaming turnover. Several impact chains (called as value paths) from the GMS usage towards gaming turnover were identified, e.g. through *work efficiency* → *gaming content* → *gaming volume*, or *content & process quality* → *gaming quality* → *brand image*. **Experience logic** was used to demonstrate how the users perceived GMS automation relieving their time from repetitive routine tasks to more intelligent gaming content planning.

In overall, net comparison was used only in Case A. There were several reasons for that:

- Benefits or costs were identified separately, and they did not form 'natural' counterparts with each other for net comparison.
- Benefits or costs identified were valued as means for achieving higher level goals, in other word, means-end logic was common in all cases.
- Evaluation goals were satisfied with structural information about the factors affecting net value. Evaluation goals did not yet require hard budgeting information.

Means-end logic was used in all cases. All the cases utilised structural cause-and-effect analysis for relating multilevel goals and IT impacts within the business system, and means-end valuing logic was a natural counterpart for that approach.

Experience logic was not applied in those cases where individual level analysis was not applied (ERP and Cloud development/test environment cases).

5.3. Samples for evaluation views

First, evaluation views suggested structural and behavioural viewpoints as a systemic glue for integrating different value conceptualisations. Secondly, qualitative-quantitative operationalisations for value supported evolutionary and incremental approach for IT evaluation. This means that intangible and complex IT impacts are not rejected from value evaluation just because they are hard to quantify, but their inclusion encourages for gradual improvements of measurements and quantification of soft value elements. It is also acceptable that evaluation provides at the same time both qualitative and quantitative value information.

In Case A, **structural view** revealed the impact chains (called as value paths), which visually showed how GMS was interconnected with several areas of the gaming process, and how these process areas were linked to the earnings logic of the gaming business.

Selected parts from the structural view were further evaluated by modelling their **behaviour over time**. For example, GMS impacts on manual workloads were visualised using qualitative causal-loop and stock-and-flow diagrams. The **qualitative** workload models revealed the value creation dynamics of the system and pinpointed value measures. The qualitative understanding was further enriched by adding mathematical equations and estimated workload data into the models. This enabled **quantitative simulations** for **potential value**: effects of saved work time to the overall gaming content and further to the gaming volume. The **realised value** of GMS was also quantitatively estimated by comparing current GMS enabled gaming volumes with simulated volumes where GMS automation was replaced by manual work.

In general, the structural view was present in all cases, as it was the basis for understanding value affecting factors and their relationships. The structural view was the starting point for identifying both qualitative and quantitative measures. Measures reflected both value creation mechanisms and determination of value outcomes.

Behavioural view was used to explain the value creation mechanism of both realised and potential value. All cases were interested in dynamic behaviour, while static value elements were mostly trivial and only components in more complex structures for dynamic value. Behaviour was elaborated either on qualitative level by adding stock-and-flows to causal loop models, or on quantitative level by adding equations and data to the models.

6. Assessment

In this section, we assess the relevance and utility of Conceptual Framework according to the criterion summarised in [Table 3](#) of [Methodology](#) section.

6.1. Design goals

IT evaluation general purpose. The purpose of IT evaluation is “*establishing the value or contribution made by a particular IT investment*” (Andresen, 2001). Conceptual Framework advances this purpose with 1) analysis levels perspective that supports identification of different stakeholder views on value – what is considered valuable and why so, and with 2) valuing logics perspective that introduces alternative ways for defining the meaning of value regarding IT's contributions. In general, Conceptual Framework encourages us to open up the black box of IT investment into specific IT impacts, and to make value judgments by comparing these impacts on a business system's multilevel goals.

IT evaluation purpose, the process perspective. IT evaluation can be seen as a “*series of activities incorporating understanding, measurement and assessment*” (Andresen, 2001). For the sake of understanding, Conceptual Framework structuralises multifaceted value interpretations and dimensions into three distinctive but interlinked perspectives. Together these perspectives provide a conceptual map for reducing the real-world complexity of identifying and valuing the IT impacts. Conceptual Framework is visually organised (when read from left to right) for promoting a goal-oriented approach for the actual evaluation process. The process should start from understanding the business system with different stakeholders and their goals in order to set the baseline for valuing various forms of IT impacts. The process continues by investigating the mechanisms of interlinking IT impacts with value creation and value determination, while adjusting the evaluation efforts and methods so that the needs of the IT decision-making are satisfied.

Understanding can be made explicit through measurements. Conceptual Framework sets both value creation mechanisms and the outcomes of those mechanisms as possible targets for measurements. Conceptual Framework recognises both qualitative and quantitative measurements and value analysis as a means to explicate value information for different decision-making purposes.

Focus of IT and focus of decisions. Examining how IT meets its intended purpose, and providing relevant information for decision-making are specific goals for IT evaluation. The focus of IT should be aligned according to the business system's goals. Conceptual Framework promotes the identification of a different level of goals and linking these goals with business system's overall purpose. Recognising the means-end valuing logic together with structural valuing view supports especially the evaluation of IT systems having broad and widely spread impacts intertwined with complimentary factors and networked goal hierarchies. Regarding focus of decisions, Conceptual Framework supports evaluation of both existing IT investment and future investment. Actually the time horizon of the evaluation is not restricted at all, together potential and realised evaluation views support lifecycle approach covering past, present and future. Indirectly, Conceptual Framework endorses evolution of incremental decisions. Decisions can be linked, meaning that in the first phase elements affecting value creation - on system's structural level of analysis - are identified and prioritised. Priority decisions guide further actions like collecting hard/quantitative facts for previously intangible/qualitative value affecting factors. Next round of decisions can be made with quantitative value estimations based on net comparison valuing logic.

Systemic approach. Conceptual Framework supports holistic analysis of business system by identifying multiple levels of analysis. Identification of means-end valuing logic encourages for seeking causal relationships between different levels of organisational goals. Constructs presented in Conceptual Framework are applicable with practical systems thinking methods like system dynamics. For example, qualitative/quantitative and structural/behavioural views are compatible with respective analysis views of system dynamics. Conceptual Framework supports analysis of IT impacts from structural cause-and-effect viewpoint, as well as from temporal and behavioural views. Interplay of these views is the cornerstone of systemic understanding. Another crucial concept for systemic understanding is the idea of feedbacks, which is closely related to the cause-and-effect analysis. Circular feedbacks or causal loops are not explicitly noted (only more general causal chains noted) in Conceptual Framework but they should be recognised within the actual evaluation methods utilising Conceptual Framework. For example, in system dynamics, feedbacks are elementary as the name of causal-loop diagram (CLD) suggest. CLD is one of the primary tools in system dynamics.

6.2. Construct validity

Construct validity assesses how well the defined constructs reflect the actual phenomenon they are supposed to touch. 'How well' is a matter of degree, and construct validity is a matter of degree (Wieringa, 2014). Findings of case samples representing the constructs of Conceptual Framework are demonstrated in Section 4 and as a whole in Appendixes A and B. Mapping between the case samples and Conceptual Framework constructs was based on construct indicators presented in Appendix C. The fact that we were able to formulate meaningful indicators for the constructs and the indicators were able to classify case specific instantiations for the constructs, sets the basis for construct validity. However, there are few interesting construct validity issues worth discussion.

Separation of experience based valuing logic from the other two logics poses a threat of construct confounding and mono-operation bias. It might be hard to classify whether a certain experience about an IT impact's value is purely an experience in phenomenological sense or whether the value experience already has an unconscious means-end or even net comparison judgments behind it. In this case, the same valuation phenomenon is possibly identified from three different perspectives. But from the practical point of view, it is the very purpose of different valuing logics to lead towards conscious reasoning for value and to be able to interlink the different reasonings, including both tangible and intangible value elements.

Another possible ambiguity lies in the nested nature of three levels of analysis. The valuing phenomenon can be analysed from an individual's point of view, but at the same time the phenomenon is also visible on a process level. For example, the individual employee executes a specific process part with the help of IT, and the various forms of impacts are also visible on an organisational level as the output of the process directly influences the company's cash flow or number of paying customers. On the other hand, seeing the nested nature of the phenomenon is exactly the purpose of multilevel analysis, in order to trace the IT impacts throughout the business system.

Regarding the constructs of evaluation views, we utilised qualitative-quantitative views in two meanings, namely for characterising the type of measurement/data, and type of overall systemic analysis. The description of qualitative systemic analysis is very closely related with system structural view. The system structure pinpoints the value elements and their relationships, and according to our definitions, this structural knowledge also represents qualitative analysis for value. However, qualitative analysis can also cover the system behaviour, resulting for example knowledge about direction of value changes and whether there are delays or not. Thus, qualitative system analysis is a broader concept than a system-wide structural view.

6.3. Knowledge contribution

As presented in this paper, value is one of the oldest research topics, studied under many disciplines but still it is vague at its worst and multifaceted at its best. The recent literature offers no right or wrong value conceptualisations, but different conceptualisations are valid and useful in their specific context of application. The context of IT evaluation, as observed within a business system, is such a versatile platform that no single value conceptualisation is comprehensive enough. Plenty of useful perspectives and interpretations are available in the literature, for example in the forms of IT business value (e.g. Barua et al., 1995; Melville et al., 2004), various operative IT benefits (e.g. Simmons, 1996; Mirani and Lederer, 1998; Ryan and Harrison, 2000) or generic multifaceted/multidimensional value interpretations (e.g. Sánchez-Fernández and Iniesta-Bonillo, 2007; Woodall, 2003) but the field is scattered and the maturity of methodological basis for evaluating a specific IT system leaves room for improvements. Conceptual Framework fills this gap by reasoning how selected value interpretations and characteristics together form a conceptual toolbox for understanding IT's contributions to a business system. Conceptual Framework endorses systemic inquiry (Gharajedaghi, 2011, p. 89) about the evaluation target and the context, thus avoiding too narrow and short-sighted views on value.

Systems thinking and system dynamics form a recognised basis for IT evaluation (e.g. Clark and Augustine, 1992; Georgantzis and Katsamakos, 2008) but according to our knowledge, previous studies conceptualising value with a systemic approach are rare. Service science offers an exception, albeit they are not discussing value in IT evaluation scope (Maglio and Spohrer, 2008; Vargo et al., 2017).

The compilation of Conceptual Framework is rooted in both literature and empirical cases. Existing literature is used to recognise IT evaluation challenges, widely proposed solution principles (e.g. Marthandan and Tang, 2010; Davern and Wilkin, 2010) value theories (e.g. Gutman, 1982; Ng and Smith, 2012). The initial need and design goals of Conceptual Framework emerged during the design and testing of a specific IT evaluation solution. This strong grounding with empirical cases increases the practical relevancy of our contribution.

7. Discussion

To answer our research question “*How to conceptualise IT value for evaluation purposes within a business system?*”, we have formulated Conceptual Framework, which promotes systemic evaluation for IT impacts against business system goals and interpreting the resulted understanding as a systemic value of IT. According to systemic value approach, there is no single dominating and right definition for value, but together different interpretations draw an overall picture of value from business system’s perspective.

The position of Conceptual Framework is on the ‘interface’ of evaluation (*how* - means to understand value) and the concept of value (*what value is* - as a target of evaluation). This focus of Conceptual Framework brings the rich multidisciplinary value conceptualisations into the field of IT evaluation. Conceptual Framework prepares the actual IT evaluation to be an integrative activity combining different viewpoints, interpretations and varying abstractions of value.

As a practical contribution, Conceptual Framework is not a process description or a step-by-step method for guiding the evaluation activities, but it is rather a conceptual checklist for pinpointing the most important evaluation emphasis and relevancies for the unique situations. Conceptual Framework guides evaluation by raising questions like: value for whom, meaning of value, how value is created and how value is explicated. The concepts and mental models of Conceptual Framework provide also a basis for answering these questions - for instrumenting IT value. Systemic mental models create a cognitive basis for understanding complex and dynamic interdependencies within a socio-technical business system, thus opening the ‘black box’ of IT value. This kind of conceptual basis can be utilised for selecting, modifying and using the actual evaluation methods, and for roadmapping incremental development of continuous IT evaluation programs. As such, Conceptual Framework promotes for seeing the big picture around the IT and for avoiding the risks of too narrow meanings and sub-optimisation of value.

When considering how well Conceptual Framework characterises the phenomenon of IT value evaluation, there is not a single ‘truth’ about the possible combinations of different dimensions and meanings of value. However, the combination presented by Conceptual Framework is a plausible one as we have grounded it in the related literature and we have demonstrated its mapping to the real cases. Our work continues in testing and reporting case experiences with Systemic Evaluation Approach, an implementation of a specific evaluation solution utilising the concepts and mental models manifested in Conceptual Framework. As a further research, it would be interesting to study how other researchers and practitioners manage to utilise and develop Conceptual Framework. A possible direction is to map Conceptual Framework with a broad spectrum of existing IT evaluation solutions (e.g. Andresen, 2001). The evaluation solutions could be reflected against Conceptual Framework by asking, for example, the following questions:

- *What kind of implicit/explicit value conceptualisations exist and are they new to Conceptual Framework?*
- *What value views are supported or emphasised and are they new to Conceptual Framework?*
- *What kind of IT systems and decisions are in focus?*

This kind of mapping would help practitioners in selecting the specific evaluation methods.

8. Conclusions

Evaluation of IT value is an effort for understanding the systemic impacts of technology, people and processes for the performance of the focal company. This understanding can have many forms of explicitness, comparability and awareness for time horizons.

In this study, we propose Conceptual Framework for converging and explaining essential constructs as a basis for IT value evaluation. Systemic approach is used as a glue for integrating different valuing logics and meanings for value. According to a systemic approach, value is an emergent result from the complex interactions of the business system elements. Valuing is always done in respect to varying IT purposes and different decision-making situations. Conceptual Framework supports this varying context by promoting multilevel value analysis, identifying multiple valuing logics and different evaluation views.

Conceptual Framework is a potential tool for IS researchers as a basis for studying and synthesising value-based IT evaluation methodologies. For practitioners Conceptual Framework offers a vocabulary for creating a shared understanding of multifaceted value and various perspectives to its evaluation. Systemic approach stresses how different views together provide a balanced and sustained understanding of value.

Appendix A. Case occurrences for the constructs of CF

Table A1

Case descriptions and mapping with Conceptual Framework.

The context			Mapping the case samples with Conceptual Framework												
Business domain & topic of IT	Focus of IT ¹	Evaluation purpose & focus of decisions	Analysis levels			Valuing logics			Evaluation views						
			Organisation	Process	Individual	Net	Means-end	Experience	Structural	Behav.		Operat.		Lifecycle	
										Static	Dynamic	Qualitative	Quantitative	Realised	Potential
Case A Gambling & gaming provider; Existing Game Management System (GMS)	Transactional - efficiency through automation	- Explicating GMS business impacts - Decisions about GMS further development investments	X	X	X	X	X	X	X	o	X	X	o	X	o
Case B Network service & infrastructure provider; Existing Billing & Ticketing systems	Transactional/informational - efficiency through automation/effectiveness through information	- Explicating the value of billing process & invoicing system - Providing metrics for value creation within the billing process - Providing improvement ideas - Decisions about choosing improvement targets	X	X	X		X	X	X	o	X	X	o	X	o
Case C Grocery retailing; Future Enterprise Resource Planning (ERP)	Informational/strategic - effectiveness through information	- Creating a value-based selection criteria for a new ERP - Decisions about selecting the solution with best value creation potential	o	X			X		X	o	X	X			X
Case D Computer & communications security; Existing	Transactional - efficiency through automation	- Explicating the business impacts of travel expense	X	X	X		X	X	X	o	X	X	o		X

(continued on next page)

Table A1 (continued)

The context			Mapping the case samples with Conceptual Framework															
Business domain & topic of IT	Focus of IT ¹	Evaluation purpose & focus of decisions	Analysis levels			Valuing logics			Evaluation views									
			Organisation	Process	Individual	Net	Means-end	Experience	Structural		Behav.		Operat.		Lifecycle			
									Static	Dynamic	Qualitative	Quantitative	Realised	Potential				
travel expense mgmt system		process & implementation - Providing metrics for value creation - Providing improvement ideas for the process and implementation - Decisions about choosing improvement targets																
Case E Communication networks & service provider; Future Cloud-based product development & testing environment	Transactional/informational/strategic - efficiency through automation/effectiveness through information/business transformation	- Explicating the business impacts of R&D cloudification - Providing metrics for value creation - Decisions about focusing benefit management activities	X	X		X			X		o	X		X				X

Mapping key: X – A Conceptual Framework construct clearly present and valid within a case; o – A Conceptual Framework construct was not in focus but still recognised within a case.

Note 1 - The 'Purpose of IT' column applies IT type classifications into functional types of 1) transactional, informational, strategic, transformational (Gregor et al., 2006) and for seeking 2) efficiency, effectiveness, or business transformation (Andresen, 2001).

Note 2 – Cases B, D and E shared the goal for identifying measures that could be used in continuous performance monitoring solution.

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Appendix B. Descriptions for the construct mappings

Table B1

Descriptions for the case mappings with the constructs of Conceptual Framework.

Case	Mapping descriptions and examples		
	Analysis levels	Valuing logics	Evaluation views
A	<ul style="list-style-type: none"> - Organisation – product owners: effects on gaming sales turnover - Process – game mgmt. & operations: effects on gaming volume, quality and throughput, - Individual – GMS users: task efficiency and quality of gaming content 	<ul style="list-style-type: none"> - Net comparison: increased gaming turnover minus GMS costs - Means-end: GMS impact chains through gaming volume and quality to brand image and sales - Experience: monotonous and manual work reduced - > less errors and extra time available for game planning & development 	<ul style="list-style-type: none"> - Structural: positioning GMS within business system and modelling impacts chains to several benefit and cost elements. Causal loop diagrams applied. - Behavioural: identifying and modelling the dynamics of sales targets-gaming throughput-resource allocations by stock-and-flow diagrams. The model included both static (e.g. maintenance costs) and dynamic (e.g. gaming revenue) value elements. - Lifecycle: estimating how existing GMS affected realised value through automation. - Operationalisation: identifying qualitative value elements and relations like company image and employee satisfaction. Quantitative metrics and their value estimates for saved working hours and increased gaming revenue.
B	<ul style="list-style-type: none"> - Organisation – financial administration: cash flow mgmt, - Process – sales & project managers: effects on resourcing, task mgmt and billing - Individual – financial administrators, project managers, project members 	<ul style="list-style-type: none"> - Net comparison: NOT applied - Means-end: impact chains to billing workload, billing errors and capacity for sales efforts, and work satisfaction - Experience: ease of use & automation for creating reliable billing data 	<ul style="list-style-type: none"> - Structural: positioning billing & ticketing system within service/project sales and management system. Causal loop diagrams applied. - Behavioural: identifying static (constant) effects on workload and billing errors, and dynamic effects on sales efforts and customer satisfaction - Lifecycle: focusing on understanding the effects on realised value, but also estimating effects on billing cycles and delays to cash flow. - Operationalisation: focusing on qualitative value elements and their relationships, but also simulating quantitative effects on cash flow by optimising billing cycles.
C	<ul style="list-style-type: none"> - Organisation – NOT applied directly - Process – IT & business architects as proxies for merchandising and Procure-to-Pay business use cases - Individual – NOT applied 	<ul style="list-style-type: none"> - Net comparison: NOT applied - Means-end: ERP linkage to systemic value loops e.g.: marginal profit ↔ prices & discount prices, sales volumes ↔ store size & number of stores - Experience: NOT applied 	<ul style="list-style-type: none"> - Structural: mapping the retailing system and positioning ERP with value creating loops like inbound purchases-variety of offering-attractiveness-sales volume. - Behavioural: identifying dynamic material and information flows, and accumulations related to benefits and costs within retailing system. - Lifecycle: estimating potential value creating mechanisms. - Operationalisation: identifying qualitative measures and units of value (e.g., sales per store space (euro/-m³)), but no numerical quantitative data applied or produced.
D	<ul style="list-style-type: none"> - Organisation – financial administration: effects on handling travel expenses - Process – managers and travelers: effects on workload and quality of expense claims - Individual – travelers: perceived usability 	<ul style="list-style-type: none"> - Net comparison: NOT applied - Means-end: impact chains to expense claim process efforts, accuracy, time frame and user satisfaction - Experience: ease of use & minimum effort 	<ul style="list-style-type: none"> - Structural: positioning travel expense management system within travelling and administration processes by causal loop diagrams. - Behavioural: identifying value creation dynamics for example with usability, user efficiency and the overall work load of cost claim process. - Lifecycle: identifying potential value for the IT and process improvements. - Operationalisation: focusing on qualitative value elements, their relationships and measures, but also simulating quantitative effects of alternative work division scenarios.

(continued on next page)

Table B1 (continued)

Case	Mapping descriptions and examples		
	Analysis levels	Valuing logics	Evaluation views
E	<ul style="list-style-type: none"> - Organisation – Product development & quality assurance stakeholders as proxies for Business unit level effects - Process – development, integration & testing managers: product development cycle - Individual – NOT applied 	<ul style="list-style-type: none"> - Net comparison: NOT applied - Means-end: impact chains of virtualised development & testing environments to e.g. project lead times, waste, work load and costs - Experience: NOT applied 	<ul style="list-style-type: none"> - Structural: mapping the value creation elements and relationships in cloud-based product development and testing environment. Causal loop diagrams applied. - Behavioural: identifying value creation mechanisms, including both static (e.g. number of development teams) and dynamic (e.g. waste) value elements. - Lifecycle: focusing on potential value creation mechanisms of cloud-based development and testing environment - Operationalisation: identifying qualitative measures and units of value e.g. amount of customer trouble reports for measuring product quality

Appendix C. Indicators for capturing construct instances from the cases

Table C1

Indicators for capturing construct instances from the cases.

Analysis levels	Valuing logics	Evaluation views
Organisation <ul style="list-style-type: none"> - The evaluation is contributed by business owners or other stakeholders with direct visibility to the organisation's business performance - The <i>IT impacts - earnings logic/business model</i> connection is traceable in the evaluation outcomes 	Net comparison <ul style="list-style-type: none"> - There is at least one element (a node) in the value creation model, which combines benefit and sacrifices/cost causal chains - AND IT impacts can be traced to either or both benefit and sacrifices/cost causal chains 	Structural view <ul style="list-style-type: none"> - Evaluation produces a model of value creation mechanism with value affecting elements and their relationships within a business system - AND IT impacts are part of the value creation mechanism
Process <ul style="list-style-type: none"> - The analysis is contributed by process owners or experts with direct visibility to the process level performance (e.g. business, production or support processes) - The <i>IT impact - process performance</i> connection is traceable in the evaluation outcomes 	Means-end <ul style="list-style-type: none"> - IT impact can be traced to some benefit through causal chains in the value creation model 	Behavioural <ul style="list-style-type: none"> - The structural description of value creation mechanism is enhanced with information that gives insights to value realisation over time, - AND whether changes occur (dynamic) or no changes (static) over time
Individual <ul style="list-style-type: none"> - The analysis is contributed by users or employees with tasks or responsibilities, which are directly impacted by IT - The <i>IT impacts - individual experience</i> connection and further linkage to process and/or organisation levels is traceable 	Experience <ul style="list-style-type: none"> - IT impact can be traced to some individual experience in the value creation model 	Lifecycle <ul style="list-style-type: none"> - Value creation model estimates future potential structures and/or their value creating behaviour, with qualitative and/or quantitative views - AND/OR value creation model estimates existing realised structures and/or their value creating behaviour, with qualitative and/or quantitative views
NOTES: <ul style="list-style-type: none"> - Earnings logic = How the company yields a profit from its operations (Nenonen and Storbacka, 2010) - IT = IT system or application under evaluation 	NOTES: The <i>value creation model</i> is a system model with cause-and-effect causal chains and loops. Value creation model can consist of several abstraction layers. Value creation model was one of the outcomes of Systemic Evaluation Approach utilised in the cases.	Operationalisation <ul style="list-style-type: none"> - Evaluation pinpoints perceptions/soft indicators or placeholders with units of value for demonstrating how well the value creation mechanism is working or what is the value outcome – qualitative view - AND/OR Evaluation pinpoints tangible/hard metrics indicating how well the value creation mechanism is working or what is the value outcome – quantitative view

References

- Ackoff, R., 1971. Towards a system of systems concepts. *Manag. Sci.* 17 (11), 661–671.
- Anandarajan, A., Wen, H.J., 1999. Evaluation of information technology investment. *Manag. Decis.* 37 (4), 329–339.
- Andresen, J.L., 2001. A Framework for Selecting an IT Evaluation Method - In the Context of Construction. PhD, Technical University of Denmark, Denmark.
- Backlund, A., 2000. The definition of system. *Kybernetes* 29 (4), 444–451.
- Bajaj, A., Bradley, W., Cravens, K., 2008. SAAS: integrating systems analysis with accounting and strategy for ex ante evaluation of IS investments. *J. Inf. Syst.* 22 (1), 97–124.
- Barclay, C., 2008. Towards an integrated measurement of IS project performance: the project performance scorecard. *Inf. Syst. Front.* 10 (3), 331–345.
- Barua, A., Kriebel, C.H., Mukhopadhyay, T., 1995. Information technologies and business value: an analytic and empirical investigation. *Inf. Syst. Res.* 6 (1), 3–23.

- Bengtsson, D., 2004. Pleasure and the phenomenology of value. In: Rabinowicz, W., Rønnow-Rasmussen, T. (Eds.), *Patterns of Value*. Lund University Press, Lund.
- Brynjolfsson, E., Hitt, L.M., 1998. Beyond the productivity paradox. *Commun. ACM* 41 (8), 49–55.
- Brynjolfsson, E., Hitt, L.M., 2000. Beyond computation: information technology, organizational transformation and business performance. *The Journal of Economic Perspectives* 14 (4), 23–48.
- Burton-Jones, A., McLean, E.R., Monod, E., 2015. Theoretical perspectives in IS research: from variance and process to conceptual latitude and conceptual fit. *Eur. J. Inf. Syst.* 24 (6), 664–679.
- Cabrera, D., Colosi, L., Loddell, C., 2008. Systems thinking. *Evaluation and Program Planning* 31 (3), 299–310.
- Ceric, A., 2015. Bringing together evaluation and management of ICT value: a systems theory approach. *Electronic Journal of Information Systems Evaluation* 18 (1), 19.
- Chan, Y.E., 2000. IT value: the great divide between qualitative and quantitative and individual and organizational measures. *J. Manage. Inf. Syst.* 16 (4), 225–261.
- Chaysin, P., Daengdej, J., Tangjitprom, N., 2016. Survey on available methods to evaluate IT investment. *Electronic Journal Information Systems Evaluation* 19 (1), 71–82.
- Clark, T., Augustine, F., 1992. Using system dynamics to measure the value of information in a business firm. *Syst. Dyn. Rev.* 8 (2), 149–173.
- Cozby, P.C., Bates, S.C., 2011. *Methods in Behavioral Research* (No. 150.72 C6). 11th ed. McGraw-Hill, New York.
- Davern, M., Kauffman, R., 2000. Discovering potential and realizing value from information technology investments. *J. Manage. Inf. Syst.* 16 (4), 121–143.
- Davern, M., Wilkin, C., 2010. Towards an integrated view of IT value measurement. *Int. J. Account. Inf. Syst.* 11 (1), 42–60.
- De Haes, S., Van Grembergen, W., 2015. *Enterprise Governance of Information Technology: Achieving Alignment and Value*, Featuring COBIT 5. 2nd ed. Springer.
- Dedrick, J., Gurbaxani, V., Kraemer, K., 2003. Information technology and economic performance: a critical review of the empirical evidence. *ACM Comput. Surv.* 35 (1), 1–28.
- Delone, W., McLean, E., 2003. The DeLone and McLean model of information systems success: a ten-year update. *J. Manage. Inf. Syst.* 19 (4), 9–30.
- Devaraj, S., Kohli, R., 2000. Information technology payoff in the health-care industry. *J. Manage. Inf. Syst.* 16 (4), 41–67.
- Gable, G., Sedera, D., Chan, T., 2008. Re-conceptualizing information system success: the IS-Impact Measurement Model. *J. Assoc. Inf. Syst.* 9 (7), 377–408.
- Gates, E.F., 2016. Making sense of the emerging conversation in evaluation about systems thinking and complexity science. *Evaluation and Program Planning* 59, 62–73.
- Georgantzias, N., Katsamakos, E., 2008. Information systems research with system dynamics. *Information Systems Research with System Dynamics*. 24 (3), 247–264.
- Gharajedaghi, J., 2011. *Systems Thinking: Managing Chaos and Complexity: A Platform for Designing Business Architecture*. 3 ed. Elsevier.
- Gregor, S., Martin, M., Fernandez, W., Stern, S., Vitale, M., 2006. The transformational dimension in the realization of business value from information technology. *J. Strateg. Inf. Syst.* 15 (3), 249–270.
- Grönroos, C., 2008. Service logic revisited: who creates value? And who co-creates? *Eur. Bus. Rev.* 20 (4), 298–314.
- Grover, V., Jeong, S.R., Segars, A.H., 1996. Information systems effectiveness: the construct space and patterns of application. *Inf. Manag.* 31 (4), 177–191.
- Gummerus, J., 2011. *Customer Value in e-Service: Conceptual Foundation and Empirical Evidence*. PhD, Hanken School of Economics, Finland.
- Gunasekaran, A., Ngai, E.W., McGaughey, R.E., 2006. Information technology and systems justification: a review for research and applications. *Eur. J. Oper. Res.* 173 (3), 957–983.
- Gutman, J., 1982. A means-end chain model based on consumer categorization processes. *J. Mark.* 46 (2), 60–72.
- Hamilton, S., Chervany, N.L., 1981. Evaluating information system effectiveness—part I: comparing evaluation approaches. *MIS Q.* 5 (3), 55–69.
- Hevner, A.R., March, S.T., Park, J., Ram, S., 2004. Design science in information systems research. *MIS Q.* 28 (1), 75–105.
- Hiekkanen, K., 2016. *Exploring the Relationship Between IT Governance and Strategic Alignment*. PhD, Aalto University, Finland.
- Holbrook, M.B., 1994. The nature of customer value. In: Rust, R.T., Oliver, R.L. (Eds.), *Service Quality: New Directions in Theory and Practice*. Sage, Newbury Park, CA.
- Iivari, J., 2007. A paradigmatic analysis of information systems as a design science. *Scand. J. Inf. Syst.* 19 (2), 5.
- Irani, Z., Ghoneim, A., Love, P.E., 2006. Evaluating cost taxonomies for information systems management. *Eur. J. Oper. Res.* 173 (3), 1103–1122.
- Jackson, M.C., 2006. Creative holism: a critical systems approach to complex problem situations. *Syst. Res. Behav. Sci.* 23, 647–657.
- Khalifa, A.S., 2004. Customer value: a review of recent literature and an integrative configuration. *Manag. Decis.* 42 (5), 645–666.
- Kim, D., 1992. Guidelines for drawing causal loop diagrams. *The Systems Thinker* 3 (1), 5–6.
- Klecun, E., Cornford, T., 2005. A critical approach to evaluation. *Eur. J. Inf. Syst.* 14 (3), 229–243.
- Kowalkowski, C., 2011. Dynamics of value propositions: insights from service-dominant logic. *Eur. J. Mark.* 45 (1/2), 277–294.
- Kujala, S., Väänänen-Vainio-Mattila, K., 2009. Value of information systems and products: understanding the users' perspective and values. *Journal of Information Technology Theory and Application* 9 (4), 23–39.
- Lee, S., 2001. Modeling the business value of information technology. *Inf. Manag.* 39 (3), 191–210.
- Maglio, P.P., Spohrer, J., 2008. Fundamentals of service science. *J. Acad. Mark. Sci.* 36 (1), 18–20. <https://doi.org/10.1007/s11747-007-0058-9>.
- March, S.T., Smith, G.F., 1995. Design and natural science research on information technology. *Decis. Support. Syst.* 15 (4), 251–266.
- Marchand, M., Raymond, L., 2008. Researching performance measurement systems: an information systems perspective. *Int. J. Oper. Prod. Manag.* 28 (7), 663–686.
- Marthandan, G., Tang, C., 2010. Information technology evaluation: issues and challenges. *J. Syst. Inf. Technol.* 12 (1), 37–55.
- Martinsons, M., Davison, R., Tse, D., 1999. The balanced scorecard: a foundation for the strategic management of information systems. *Decis. Support. Syst.* 25 (1), 71–88.
- Meadows, D.H., 2008. *Thinking in Systems*. Earthscan, London.
- Melville, N., Kraemer, K., Gurbaxani, V., 2004. Information technology and organizational performance: an integrative model of it business value. *MIS Q.* 28 (2), 283–322.
- Midgley, G., 2006. Systems thinking for evaluation. *Systems Concepts in Evaluation: An Expert Anthology*, pp. 11–34.
- Mirani, R., Lederer, A.L., 1998. An instrument for assessing the organizational benefits of IS projects. *Decis. Sci.* 29 (4), 803–838.
- Mukhopadhyay, T., Kekre, S., Kalathur, S., 1995. Business value of information technology: a study of electronic data interchange. *MIS Q.* 19 (2), 137–156.
- Nenonen, S., Storbacka, K., 2010. Business model design: conceptualizing networked value co-creation. *Int. J. Qual. Serv. Sci.* 2 (1), 43–59.
- Ng, I.C., Smith, L.A., 2012. An integrative framework of value. *Review of Marketing Research* 9, 207–243.
- Palvia, S.C., Sharma, R.S., Conrath, D.W., 2001. A socio-technical framework for quality assessment of computer information systems. *Ind. Manag. Data Syst.* 101 (5), 237–251.
- Peppers, K., Tuunanen, T., Rothenberger, M., Chatterjee, S., 2007. A design science research methodology for information systems research. *J. Manage. Inf. Syst.* 24 (3), 45–77.
- Peppard, J., Ward, J., Daniel, E., 2007. Managing the realization of business benefits from IT investments. *MIS Q. Exec.* 6 (1), 1–11.
- Petter, S., DeLone, W., McLean, E., 2008. Measuring information systems success: models, dimensions, measures, and interrelationships. *Eur. J. Inf. Syst.* 17 (3), 236–263.
- Pieters, R., Baumgartner, H., Allen, D., 1995. A means-end chain approach to consumers' goal structures. *Int. J. Res. Mark.* 12 (3), 227–244.
- Ragowsky, A., Ahituv, N., Neumann, S., 1996. Identifying the value and importance of an information system application. *Inf. Manag.* 31 (2), 89–102.
- Ramirez, R., 1999. Value co-production: intellectual origins and implications for practice and research. *Strateg. Manag. J.* 20 (1), 49–65.
- Remenyi, D., Money, A., Twite, A., 1991. *A Guide to Measuring and Managing IT Benefits*. Blackwell Publishers Ltd.
- Richins, M.L., 1994. Valuing things: the public and private meanings of possessions. *J. Consum. Res.* 21 (3), 504–521.
- Ryan, S.D., Harrison, D.A., 2000. Considering social subsystem costs and benefits in information technology investment decisions: a view from the field on anticipated payoffs. *J. Manage. Inf. Syst.* 16 (4), 11–40.
- Sánchez-Fernández, R., Iniesta-Bonillo, M.A., 2007. The concept of perceived value: a systematic review of the research. *Mark. Theory* 7 (4), 427–451.
- Schroeder, M., 2008. Value theory. In: Zalta, E.N. (Ed.), *The Stanford Encyclopedia of Philosophy*.
- Seddon, P.B., Staples, S., Patnayakuni, R., Bowtell, M., 1999. Dimensions of information systems success. *Communications of the AIS* 2 (20), 2–39.
- Senge, P.M., 1990. *The Fifth Discipline: The Art & Practice of the Learning Organization* (Doubleday/Currency).
- Simmons, P., 1996. Quality outcomes: determining business value. *IEEE Softw.* 13 (1), 25–32.
- Sterman, J.D., 2000. *Business Dynamics: Systems Thinking and Modeling for a Complex World*. McGraw-Hill, Boston.

- Stockdale, R., Standing, C., 2006. An interpretive approach to evaluating information systems: a content, context, process framework. *Eur. J. Oper. Res.* 173 (3), 1090–1102.
- Sugumaran, V., Arogyaswamy, B., 2003. Measuring IT performance: “contingency” variables and value modes. *J. Comput. Inf. Syst.* 44 (2), 79–86.
- Tallon, P., Kraemer, K., Gurbaxani, V., 2000. Executives’ perceptions of the business value of information technology. *J. Manag. Inf. Syst.* 16 (4), 145–173.
- Töhönen, H., Kauppinen, M., Männistö, T., 2014. Evaluating the business value of information technology: case study on game management system. Paper Presented at the 2014 IEEE 22nd International Requirements Engineering Conference (RE). IEEE, pp. 283–292.
- Töhönen, H., Itälä, T., Kauppinen, M., Männistö, T., 2015. Towards systemic evaluation of the business value of IT. Paper presented at the Business Modeling and Software Design. Scitepress, Milan, Italy, pp. 163–170.
- Tona, O., Carlsson, S.A., 2013. Information system evaluation through an emergence lens. *Electronic Journal of Information Systems Evaluation* 16 (1), 37.
- Urbach, N., Smolnik, S., Riempp, G., 2009. Information systems success - a review of existing multidimensional approaches. *Bus. Inf. Syst. Eng.* 1 (4), 315–325.
- Vargo, S.L., Lusch, R.F., 2004. Evolving to a new dominant logic for marketing. *J. Mark.* 68 (1), 1–17.
- Vargo, S.L., Lusch, R.F., 2008. Service-dominant logic: continuing the evolution. *J. Acad. Mark. Sci.* 36 (1), 1–10.
- Vargo, S.L., Akaka, M.A., Vaughan, C.M., 2017. Conceptualizing value: a service-ecosystem view. *Journal of Creating Value* 3 (2), 117–124.
- Venkatesh, V., Davis, F.D., 2000. A theoretical extension of the technology acceptance model: four longitudinal field studies. *Manag. Sci.* 46 (2), 186–204.
- Walters, D., Lancaster, G., 1999. Value and information - concepts and issues for management. *Manag. Decis.* 37 (8), 643–656.
- Ward, J., Daniel, E., Peppard, J., 2008. Building better business cases for IT investments. *MIS Q. Exec.* 7 (1), 1–15.
- Wiengarten, F., Humphreys, P., Cao, G., McHugh, M., 2013. Exploring the important role of organizational factors in IT business value: taking a contingency perspective on the resource-based view. *Int. J. Manag. Rev.* 15 (1), 30–46.
- Wieringa, R.J., 2014. *Design Science Methodology for Information Systems and Software Engineering*. Springer, Berlin.
- Willcocks, L., Lester, S., 1996. Beyond the IT productivity paradox. *Eur. Manag. J.* 14 (3), 279–290.
- Wiseman, D., 1992. Information economics: a practical approach to valuing information systems. *J. Inf. Technol.* 7, 169–176.
- Wolstenholme, E., 1999. Qualitative vs quantitative modelling: the evolving balance. *J. Oper. Res. Soc.* 50 (4), 422–428.
- Woodall, T., 2003. Conceptualising ‘value for the customer’: an attributional, structural and dispositional analysis. *Acad. Mark. Sci. Rev.* 1.
- Woodruff, R.B., 1997. Customer value: the next source for competitive advantage. *J. Acad. Mark. Sci.* 25 (2), 139–153.