A Review on Methods for the Assessment of Information System Projects

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Critical review

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Abstract: Recently, it is inevitable that businesses invest in many information system (IS) projects in order to gain a competitive advantage within the internal industry and global environment. The important point is the selection of the appropriate IS environment, hence the optimal IS investment methods with respect to changing technological needs. In this respect, both empirical and conceptual studies are reviewed to identify the relevant IS/IT investment methods. After an extensive literature review, 51 relevant articles are identified. The IS/IT investment methods studied in these articles are classified and examined within the three categories: financial, non-financial, and hybrid. The results reveal that most of studies focus on a mixed usage of financial and non-financial methods called hybrid methods, whereas financial methods are used more frequently when compared to non-financial methods during the selected research period. On the other hand, the usage of pure financial methods decreases in recent years, while the usage of hybrid and non-financial methods increases in the same period.

Keywords: IS/IT investment methods, IS/IT investment, financial methods, non-financial methods, hybrid methods.

Introduction

Businesses invest in assets and projects several times in order to gain competitive advantage in the global business environment. Most of the time, businesses invest in real estate and machinery, people and information systems (IS). Among those, investment decision for IS are the most complicated and require more sophisticated decision making processes.

Advances in information technologies (IT) catalyze new competitors to enter existing markets which has encouraged the paradigm of global competitiveness. Third platform solutions such as mobile, cloud, social business, big data analytics are reinventing and continuously transforming every major industry (IDC, 2014). In such environment, investments in IS projects play a key role in remaining competitive and surviving in the long term in the marketplace. At the same time, the expanded usage of the third platform solutions drive businesses to evaluate their IT operations and quantify IT benefits due to increasing economic pressures. There is a dilemma between business performances and IS expenditures. Business benefits, which are gained from IS investments do not increase with the same momentum of the increase in IS expenditures. Brynjolfsson's [10] productivity paradox which states that there is an apparent contradiction between measures of investment in IS and measures of output at the national level, gives reasonable explanations for this dilemma.

Although businesses invest largely in IS projects to improve business performance and to gain competitive advantage, researches reveal that selecting appropriate methods in decision making in which IS projects to invest, is not an easy task. Therefore, researchers have focused on the evaluation of IS investment methods for many decades. Nowadays, efficient IT investment methods gain a pace to rebalance strategic benefits and IT expenditures. The main challenges that decision makers face are avoidance of perceived risk, unavail-

ability of precise measurement methods and lack of detailed identification and assessment of the costs and benefits of IS project investments [25].

According to Karadag et al. [25], there are mainly two research trends related to IS investment decisions within the literature. While the first trend focuses on IT productivity and benefit measurement issues by empirical data gained from case studies from different industries, the second trend concentrates on literature reviews on evaluation methods and processes. This study follows the second trend and reviews the literature by evaluating and comparing different investment assessment methods for IS/IT projects.

The primary motivations of this study are the evaluation of the relevant studies on IS project investment methods, their assessment criteria, and in which decision environment to use a specific method. Moreover, this study identifies future research directions by elaborating each investment assessment method and showing the gap among different types of investment methods.

This paper is divided into three sections. The first section covers the methodology of the study. The second section deals with the results obtained from the literature review. The last section is the conclusion section which consists of the important and significant results of the study and future directions.

Methodology

In order to identify relevant studies, an electronic search is conducted and a number of index databases of academic journals is searched without any time limitation. Then, the titles and abstracts of the studies are investigated to identify more proper and relevant studies in the given field. The databases, which are included to the study are ABI/INFORM Complete and ScienceDirect. The keywords and phrases, which are used in the literature review are "IS/IT investment methodology/method" and "evaluation of IS/IT investment methodology/method". In addition to keyword searching, recommended articles based on research criteria by the given databases are also included in the study.

Out of 154 articles, 51 articles are selected as the most relevant papers from 2000 to December 2014. Within the scope of this study, both empirical and conceptual articles and other types of papers in English language are investigated. Inspired with the classification of the IS investment assessment methods stated in the book by the Schniederjans et al. [45] the paper analyzes these methods within three categories: (1) financial, (2) non-financial, and (3) hybrid.

Results

According to Bacon [6], IS/IT investment is defined as "cost incurred with any acquisition of computer hardware, network facilities, or pre-developed software or any in-house systems development project, that is expected to add to or enhance an organization's information system capabilities and produce benefits beyond the short term". Khallaf [26] states that IT investments are a collection of many components such as: IT personnel, system software, IT hardware, and application software. Realizing these sub components enlightens the nature of IS investment whether it is tangible or intangible and organizes each type of IS investment methods according to their performance measures.

After the definition of IS/IT investment, its assessment could be defined as the weighing up process of benefits and costs to rationally assess the value of any IS subcomponent acquisition, which is expected to improve the business value of an organization's information systems or decrease its operational costs [31]. According to literature, some businesses use financial, some non-financial, and others multicriteria approach as IS investment decision method. Table 1 and Figure 1 show the distribution of the studies on IS investment assessment methods based on three categories.

As seen in Table 1, hybrid methods are the most popular methods in the literature followed by financial and then non-financial methods. Most studies in the hybrid category realize a combination of financial and non-financial methods or propose a model which stems from financial and non-financial measures. According to Figure 1, it is obvious that hybrid methods gain acceleration in recent years.

Moreover, financial methods are more handled

than non-financial methods. Despite the common applications of financial methods, recently, many researchers claim that the intangible benefits/costs of IT should be also included in the decision-making process. As it can be seen in Figure 1, a positive trend is observed in the application of non-financial methods whereas there is a dramatic decrease in the application of pure financial methods. Besides, all IS/IT investment methods are mostly studied between 2004 and 2008.

Table 1. The summary of studies by method and year (n=51)

Years	Financial Methods	Non-financial Methods	Hybrid Methods	Grand Total by Year
2000	2	-	-	**2**
2001	-	-	1	**1**
2002	3	-	-	**3**
2003	1	1	1	**3**
2004	4	1	2	**7**
2005	-	2	4	**6**
2006	2	1	3	**6**
2007	-	1	-	**1**
2008	1	2	4	**7**
2009	-	-	3	**3**
2010	1	1	-	**2**
2012	-	1	1	**2**
2013	1	2	1	**4**
2014	1	1	2	**4**
Grand Total by Method	**16**	**14**	**21**	**51**

Table 2 points out journals which are mostly interested in IS/IT investment methods during 2000-2014 period.

Table 2. Mostly interested journals in IS/IT investment methods (n=51)*

Journal Name	Count of Studies
Information & Management	5
Decision Support Systems	4
International Journal of Production Economics	4
European Journal of Operational Research	3
International Journal of Information Management	3
Automation in Construction	2
Information Resources Management Journal	2
Journal of Information Science and Technology	2

**Journals, which publish only one study about IS investment methods from 2000 to 2014, are excluded from Table 2.*

Furthermore, it is concluded that studies on IS/IT investments are especially focused on technology, construction, manufacturing, finance, e-commerce, services, fast moving consumer goods (FMCG), government and healthcare sectors as can be seen in Figure 2. The size of the companies spans from small-medium enterprises (SME) to FTSE 500 companies.

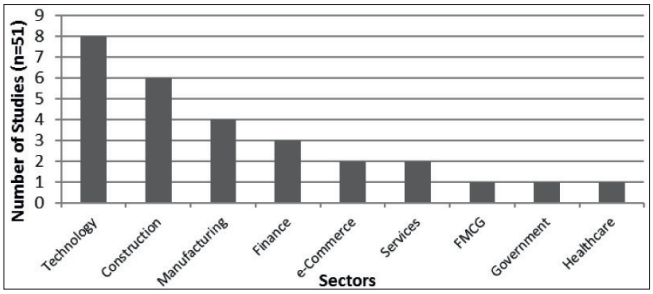

Figure 2. Number of analyzed sectors (n=51)

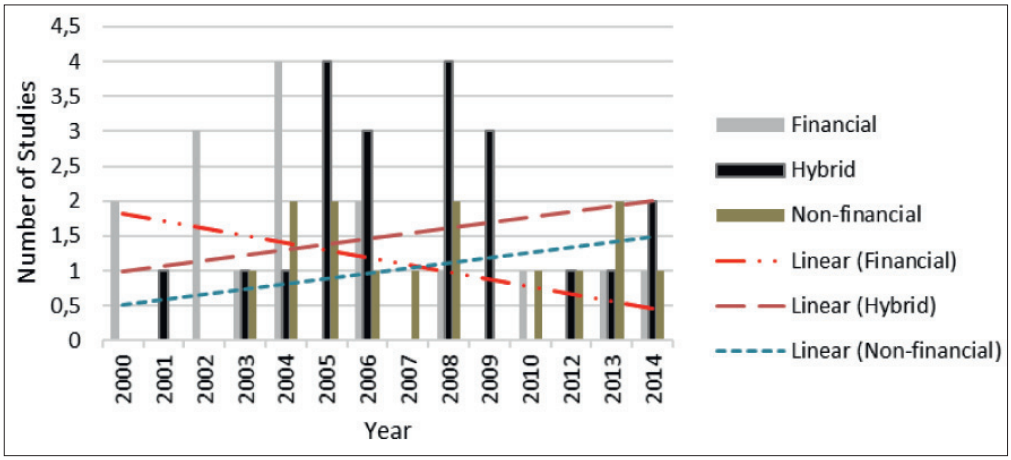

Figure 1. IS investment method trend by year (n=51)

Financial Methods

Schniederjans et al. [45] mention that financial methods are based on subject areas of finance and accounting. These methodologies are used in "capital budgeting decisions" traditionally for decades. Table 3 includes the list of financial methods and models that are used in the given studies. According to Table 3, the studies are mainly focused on real options theory, cost benefit analysis and data envelopment analysis.

Table 3. A brief summary of financial methods (n=51)

Method and Model Name	Frequency	Reference
Real options theory	4	Kim and Sanders, 2002; Li and Johnson, 2002; Wu and Ong, 2008; Dimakopoulou et al., 2014
Cost benefit analysis	4	Wang et al., 2003; Love and Irani, 2004; Lee and Lee, 2010; Huang and Behara, 2013
Data envelopment analysis	3	Shafe and Byrd, 2000; Shao and Lin, 2002; Chen et al., 2006
Growth in net sales	1	Stratopoulos and Dehning, 2000
Gross profit margin	1	Stratopoulos and Dehning, 2000
Operating profit margin	1	Stratopoulos and Dehning, 2000
Net profit margin	1	Stratopoulos and Dehning, 2000
Return on assets	1	Stratopoulos and Dehning, 2000
Return on equity	1	Stratopoulos and Dehning, 2000
Return on investment	1	Stratopoulos and Dehning, 2000
Fixed assets turnover	1	Stratopoulos and Dehning, 2000
Total assets turnover	1	Stratopoulos and Dehning, 2000
Return on security investment	1	Cavusoglu et al., 2004
Multivariate adaptive regression splines	1	Osei-Bryson and Ko, 2004
Option pricing model	1	Sing et al., 2004
Constant elasticity of substitution stochastic production frontier model	1	Lin and Shao, 2006
Mean variance model	1	Wu and Ong, 2008

Real options theory: Real options valuation or theory uses option valuation techniques to capital budgeting decisions. This concept consists of net present value (NPV), which considers future opportunities. Li and Johnson [30], Wu and Ong [56] and Kim and Sanders [27] state that this approach has a key role in a highly uncertain digital economy and involves many potential opportunities. Dimakopoulou et al. [17] also emphasize that IT investments have uncertain outcomes, so it makes real options approach appropriate method for IT investment decision making. Moreover, Wu and Ong [56] point out that real options approach can be beneficial for the evaluation of information technology projects which take long times for the implementation.

Cost benefit analysis: Cost benefit analysis compares indirect and direct costs and benefits of the technology [45]. In their studies, Wang et al. [53], Love and Irani [36], Lee and Lee [28], and Huang and Behara [21] apply cost benefit analysis for different industries and IS projects, while Wang et al. [53] focus on primary care and Love and Irani [36] concentrate on construction industry. On the other hand, Lee and Lee [28] only investigate the investment of RFID technology. All of the studies reveal the benefits and costs of IT investments for the given industries and technologies.

Data envelopment analysis: Shafe and Byrd [46], and Shao and Lin [47], and Chen et al. [12] apply data envelopment analysis which is a mathematical programming technique that empirically measures productive efficiency of decision making units. This technique is mainly used for the evaluation of efficiency of IS investments. In their study in order to measure the efficiency and effectiveness of IT, Shafe and Byrd [46] consider the overall spending on IS, organization's total processor value that indicates the organization's current IT status, and organization's willingness to train their IT stakeholders as inputs for applying data envelopment analysis. It is obvious that this methodology is flexible, because it only includes relevant inputs and outputs for a specific investment project. Shao and Lin [47] test the relationship between IT investments and technical efficiency in the firm's production process by applying this method. They find a positive relationship between them.

Other financial methods: Stratopoulos and Dehning [50]; Cavusoglu et al. [11], Osei-Bryson and Ko [40], Lin and Shao [35] and Wu and Ong [56] study different financial methods for the assessment of IS/IT investments.

Stratopoulos and Dehning [50] use the following methods in their study:

- Growth in net sales: It is determined by "net sales for the current period minus net sales from the prior period divided by net sales from the prior period".
- Gross profit margin: It stands for the gross profit divided by net sales.
- Net profit margin: It represents the income from ongoing operations divided by net sales.
- Operating profit margin: It represents the income from operations divided by net sales.
- Return on assets: It is calculated as income available to common shareholders from ongoing operation divided by average total assets.
- Return on equity: It is calculated as income available to common shareholders from ongoing operations divided by common shareholder's equity.
- Return on investment: It represents income available to common shareholders from ongoing operations divided by total invested capital.
- Fixed assets turn over: It is net sales divided by average property, plant and equipment.
- Total assets turn over: It represents net sales divided by average total assets.
- Inventory assets turnover: It is the cost of goods sold divided by average inventory.

On the other hand, Cavusoglu et al. [11] focus on return on investment from a different perspective. They investigate return on security investment. They state that defining the value of security investments is challenging. They point out that using risk analysis or cost effectiveness analysis are of limited value in an IT security setting due to that these analyses work with high level aggregate data. In order to overwhelm these problems, they propose a comprehensive model to only analyze IT security investments.

Osei-Bryson and Ko [40] define multivariate adaptive regression splines, which they apply as a financial method, as "highly adaptive and automatically selects locations and degree of knots. It builds a model in a two-phase process, using a forward stepwise regression selection and backwards stepwise deletion strategy."

Lin and Shao [35] use constant elasticity of substitution stochastic production frontier model which enables jointly and critically investigate the business value of IT investments, productivity paradox, and inputs substitutions by using the technical efficiency measures at three levels: firm, sector, and industry.

Lastly, Wu and Ong [56] deal with mean variance model which is a traditional financial theory that ranks assets with regards to returns and risks.

Non-Financial Methods

Non-financial methods are focused on broader issues of IS investment decision making area, such as larger portions or whole IS system. The main differentiation point of non-financial methods from financial methods is the scope of IS investment. Financial methods are focusing on one piece of IT or single system decision, whereas non-financial methods are considering indirect benefits/costs and strategic effects of investment, where the scope of evaluated system would be larger [45].

Non-financial methods, which are derived from the literature review, are agency theory model, business case, knowledge mapping, benchmarking, IT investment portfolio, and benefit/risk analysis as listed in Table 4. There are also six studies in the literature, which analyze IS investment methods, deploying case study, questionnaire and action research techniques for revealing the critical non-financial enablers of successful implementation of IS investment assessment methods.

Table 4. A brief summary of non-financial methods (n=51)

Method and Model Name		Frequency	Reference
IT investment portfolio		2	Gunasekaran et al., 2001; Bardhan et al., 2004
Agency theory based model		1	Khallaf, 2012
Business case		1	Berghout and Tan, 2013
Fuzzy expert system based knowledge mapping		1	Irani et al., 2014
Benchmarking		1	Alshawi et al., 2003
Benefit/risk analysis		1	Love et al., 2005
Investment spend optimization		1	Smith et al., 2010
Value analysis		1	Joshi and Pant, 2008
Studies about IS investment evaluation	Case study	2	Love et al., 2006; Lin et al., 2007
	Questionnaire Surveys	4	Love et al., 2004; Lin et al., 2005; Lin et al., 2007; Suh et al., 2013
	Action Research	1	Fox, 2008

The details of the non-financial methods obtained from literature review are as follows:

I*T investment portfolio*: Gunasekaran et al. [20] and Bardhan et al. [7] propose IT investment portfolio approach in order to justify IT project investments by examining benefits such as competitive advantage and securing future business by assisting appropriate management change. For valuation and prioritization decisions in IS/IT investments, project interdependencies and business value are considered, which provide the managerial flexibility to launch future projects.

Agency theory based model: Khallaf [26] proposes a framework that utilizes nonfinancial measures to link IT investments to their intangible benefits and applies the agency theory to examine the contribution of IT investments by tying managerial compensation to firm value.

Business case: Berghout and Tan [8] construct a theoretical model that suggests the impact of IT business case elements on the initial cost estimates of technological investments. Their findings indicate that the richness of business cases enables more initial costs to be identified in technological investments, by this means keeping resources for the organization through informed investment decisions.

***Fuzzy expert system based knowledge mapping*:** Irani et al. [23] state that a knowledge map will reveal the principal relationships and knowledge within IS/IT investment evaluation by a blend of managerial and user perspectives, by which knowledge, exploration in IS/IT investment evaluation process is enabled. This is realized through conceptualizing the explicit and tacit investment decision drivers.

Benchmarking: Alshawi et al. [2] deploy benchmarking method in order to reveal best practices in benefit extraction of IT investments focusing on true cost identification by considering socio-technical (human and organizational) dimensions associated with IT deployment. They suggest the alignment of IS/IT investment decisions to a corporate strategy and keeping the relevant people closely informed as to what and why an IT investment is needed.

Benefit/risk analysis: Love et al. [38] develop a pragmatic ex-ante IT evaluation framework based on benefit/risk analysis for evaluating and justifying IT investment decisions. Their framework considers strategic, tactical and operational benefits with relation of technology cost.

***Investment spend optimization*:** Smith et al. [49] focus on investment spend optimization, which is a "disciplined, business-driven, enterprise-wide approach to evaluating and managing IT investments". It has five steps which are strategic alignment of the IT development portfolio with enterprise objectives, rigor in the IT planning and business case processes, accountability for delivering value, transparency at all levels and stages of development, and collaboration and cross-group synergies.

Value analysis: Joshi and Pant [24] develop a framework to evaluate different IS/IT project investments through a mix of suitable methods. The non-financial one of these methods is value analysis. Value analysis is a detailed method comprised of eight

steps grouped in prototyping and surveying phases that is focused on assessing intangible benefits of IT on a low-cost, trial basis before deciding whether to commit to a larger investment in an IS/IT project.

After shedding light on critical non-financial methods, the studies that consider the enablers of those methods are explained in the following paragraphs.

Suh et al. [51] find that strategy integration with IT is positively related to IT investment decision. Fox [18] reports that disbenefits, reliability and utilization can be critical to the performance of investments in a new technology, so assessment of intangible benefits has become an explicit requirement of investment evaluation techniques. Love et al. [37] state that organization types are effective on strategic benefits and the monetary amount of IS investments; however user adaptation of IT investments are mostly effected by firm size. As a result of their study, it could be stated that non-financial criteria, namely organization type and size should be considered in IT investment evaluation methods. Love et al. [39] propose a conceptual IT evaluation framework that focuses on hidden or indirect costs and social considerations.

The study of Lin et al. [33] reveals that IS/IT investment evaluation methodology usage is relatively high, on the other hand usage of IS/IT benefits realization approaches is low in Taiwainese SME's. Lin et al. [32] work on IT investment evaluation and benefit realization methodologies and concluded that IT investment evaluation and benefits realization processes should be a part of overall strategy to elevate the importance of IT investments in supporting business processes.

Hybrid Methods

In this group of studies, while some of the papers deal with both financial and non-financial methods as summarized in Table 5, some of the articles also propose custom models.

Table 5. A brief summary of hybrid methods (n=51)

	Reference	Methods
Hybrid Methods	Angelou and Economides, 2009a	Real options theory; analytical hierarchy model
	Angelou and Economides, 2009b	Real options theory; analytical hierarchy model; game theory
	Karadag et al. 2009	Net present value; return on investment; payback period; cost saving analysis; best fit; previous contacts; new version; instruction from senior management
	Bojanc et al., 2012	Net present value; return on investment; risk analysis; internal rate of return
	Lee and Kim, 2006	Return on capital; return on equity; lag model
	Roztocki and Weistroffer, 2004	Activity based costing; value analysis
	Wang and Campbell, 2005	Cost benefit analysis; multi criteria decision making model
	Schniederjans and Hamaker, 2003	Goal programming
	Wernz et al., 2014	Multi criteria decision making model
	Ünal and Güner, 2009	Analytical hierarchy model
Custom Models	Derric Huang et al., 2008	Expected utility theory
	Ou et al., 2009	Model of Ou et al.
	Ahn and Choi, 2008	Simulation based AHP
	Chou et al., 2006	Fuzzy multi criteria decision model
	Demirhan, 2005	Demirhan's framework
	Dehning et al., 2005	Firm value framework
	Lin and Chuang, 2013	Time-varying stochastic CES production frontier
	Al-Yaseen, et al.,2006	Operational use (OU) evaluation
	Gunasekaran et al., 2001	Investment justification framework
	Roztocki and Weistroffer, 2005	Fuzzy activity based costing

The details of the studies are given in the following paragraphs:

Karadag et al. [25] focus on net present value, payback period, cost savings as financial methods and best fit, previous contacts, new version, and instruction from senior management methods as non-financial methods in their study. Karadag et al. [25] define net present value as a financial metric for investment evaluation. It is stated that net present value is used for long term projects and in capital budgeting. This method considers inflation and returns. On

the other hand, payback period shows the amount of time that it takes for an investment to recover its initial costs. Moreover, cost savings analysis is similar to cost benefit analysis but it only analyzes financial costs and savings. Furthermore, they investigate best fit to technical requirements in their study**.** This method includes previous contacts or track records of vendors/consultants approach, when a system's track record is with a particular vendor. New version is another method in their study. They conclude that new version approach is followed by an operator, if a new version of an IT application of a particular vendor is available. This approach is preferred because of higher vendor switching cost, or costs of re-training IT employees. Moreover, Karadag et al. [25] state that the usage of IT investment assessment method by affiliated properties is dictated by senior management.

Lee and Kim [29] study return on capital, return on equity, and lag model. Return on capital is calculated as after tax operated income divided by the book value of invested capital. Besides, they propose that businesses in the information intensive industries need to be more cognizant of performance factors when investing in IS/IT than in the low information intensive industries. A distributed lag model considers the time lag between IT investment and firm performance.

Bojanc et al. [9] focus net present value, return on investment, risk analysis, and internal rate of return methods. They state that internal rate of return "enables the calculation of the discount rate at which the NPV equals zero, or in other words, the discount rate at which the present value of inflows equals the present level of outflows." In addition, they propose a mathematical model for an optimal security-technology investment evaluation and decision-making process based on quantitative analysis of the security risks and digital-assets assessment in an organization.

Roztocki and Weistroffer [42] apply activity based costing method. They state that companies invest in IT in order to protect their cost advantages. This method identifies activities within the company and assigns the cost of each of this activity. In addition, they study on value chain analysis. They point out the usage of value chain model in IS/IT investment problems, which serves as a guide in identifying areas for improving profitability through lowering costs or increasing productivity.

Wang and Campbell [51] study cost benefit analysis and multi criteria decision making model. They put the strategic view at first in their proposal. These multiple criteria are considered with assigned weights in the IS/IT decision making.

Wernz et al. [55] also focus on multi criteria decision making model. They put cost-effectiveness as the most important criterion and three further objectives are as follows: technology leadership, profitability, and value for community.

In one of their studies, Angelou and Economides [4] study real options theory and analytical hierarchy model. In addition to this study, Angelou and Economides [5] focus on real options theory, analytical hierarchy model, and game theory together. This study combines these methods for ICT decisions analysis under the threat of competition. Game theory serves for studying uncertainty environments where a first mover may commit in order to prevent entry by a new comer. It shows the effects of incomplete information about demand on prevention and explored the tension between competitive pressure to invest in IS/IT.

Furthermore, Ünal and Güner [52] focus on analytical hierarchy model. Analytical hierarchy model handles both qualitative and quantitative multicriteria problems, organizes tangible and intangible factors in a systematic way, and provides a structured relatively simple solution to the decision-making problems.

Lastly, Schniederjans and Hamaker [44] concentrate on goal programming. They define goal programming as a deterministic and multi criteria satisfying methodology.

Furthermore, some papers propose their own custom models. Gunasekaran et al. [20] propose an investment justification framework. This framework deals with strategic, tactical, operational, tangible, and intangible considerations. They state that for in-

vestment justification return on investment are not sufficient. On the other hand, this framework also considers intangible, tactical, operational, and strategic measures.

In addition, Derric Huang et al. [16] apply expected utility method which concerns people's preferences with regard to choices that have unclear outcomes. Ou et al. [41] propose a framework for the investment of ATMs. They investigate investment from three different perspectives: scale, deposit service, and cost. They found the positive impacts of these perspectives on ATM investment.

Furthermore, Ahn and Choi [1] apply a simulation based analytical hierarchy model for ERP system selection. This model enhances analytical hierarchy model for a real problem. Selection criteria are functionality and coverage, supporting service, technology, total costs, and vendor credentials.

Chou et al. [13] identify 26 criteria for IT/IS investment based on following 5 domains: (1) External criteria, (2) Internal criteria, (3) Risk criteria, (4) Cost criteria, and (5) Benefit criteria. Their simple, cost-effective, and handy evaluation model considers the existing IT portfolio to address possible duplicate investment and compatibility issues, and is based on MS- Excel calculations.

Demirhan [15] proposes a conceptual framework considering both financial (e.g. IT cost decline, relative IT efficiency, switching cost) and non-financial (e.g. competition intensity, firm characteristics) measures.

Dehning et al. [14] framework recognizes the complex and diverse implications of IT investments on firm value. The implications of the firm value approach include forcing IT managers to think in terms of both industry and company-specific effects of IT investments, to consider both the magnitude and duration of competitive advantage due to IT investments, and the implications of the effect that IT investments have on risk and its relation to firm value**.**

Lin and Chuang [34] investigate the dynamic patterns of IT value over time in connection with the issues of inputs substitution and complement and the productivity paradox. Their approach represents a new contribution to the understanding of the dynamic influence of IT investments upon the value of IT over time by paying attention on IT capital, ordinary capital, and ordinary labor.

Al-Yaseen et al. [3] conduct a study in order to understand issues related to IT evaluation after project completion and suggest the usage of operational use (OU) evaluation for assessing deviations from IT investment plans. OU evaluation is based on criteria from system completion, system information, system impact, and other criteria domains; and compromises direct, indirect and hidden costs, tangible and intangible benefits, and performance and security aspects of technology.

Roztocki and Weistroffer [43] apply fuzzy activity based costing analysis. In other words, they integrate activity based costing method. They create fuzzy set membership functions. They propose an approach which is suitable for businesses in emerging economies in where economic and political developments are particularly difficult to predict.

Conclusion

Although businesses invest largely in IS/IT projects to improve business performance and to gain competitive advantage, researches reveal that selecting appropriate methods in IS/IT investment decision making is a complicated task. The main challenges that decision makers face are unavailability of precise benefit/cost measurement methods, lack of detailed identification and assessment of the costs and benefits of IS project investments and avoidance of perceived risk [25] In order to find a solution to this problem, researchers propose different IS/IT investment assessment frameworks, which could be organized under three categories, namely financial, non-financial and hybrid.

In this study, a comprehensive literature review is performed by evaluating investment assessment methods for IS/IT projects, by revealing their assessment criteria, and by indicating in which decision environment to use a specific category. It is found that hybrid methods are the most popular methods

in the literature. Most studies in the hybrid category realize the combination of financial and non-financial methods or propose a model which stems from financial and non-financial measures. The expansion of hybrid methods could also be explained with the growth of technology expansion in every phase of business environment. It augments the scope of IS/IT projects, where the application of non-financial or hybrid evaluation methods are more appropriate.

Moreover, financial methods are more handled than non-financial methods. Despite the common applications of financial methods, recently, many researchers claim that the intangible benefits/costs of IT and its strategic alignment should be included in the decision-making process, so a positive trend is seen in the application of non-financial methods, where there is a dramatic decrease in the application of pure financial methods.

As a conclusion of this comprehensive literature review, it is recommended that hybrid investment evaluation frameworks should be expanded as a future research area since the competition in markets is getting tougher and grounded strategy is gaining more importance. Therefore one aspect to recommend might be the inclusion of every strategic view of business in the IS/IT investment evaluation framework. With the same strategic purpose, every direct/indirect/hidden costs and benefits might be included in the methods for making the right move according to chosen strategy. By this way, IS/IT could prevent its position as the most important enabler of the business strategy.

One different aspect on future research in IS/IT investment methods lies in user experience. IS/IT users are demanding simplicity in performing highly complicated tasks on computers. Therefore, in order to obtain effective and efficient IS/IT investment decision, users' opinions should also be considered besides all other criteria. Thus, incorporation between psychological studies about the user acceptance of technology and IS/IT investment decision methods might be another interesting topic to engage in future.

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