Approach for Information System Maturity Assessment

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Abstract. Nowadays, many organizations face the issue of information and communication technology (ICT) management. The organization undertakes various activities to assess the state of their ICT or the entire information system (IS), such as IS audits, reviews, IS due diligence, or they already have implemented systems to gather information regarding their IS. For the organizations' boards and managers there is an issue how to evaluate current IS maturity level and based on assessments, define the IS strategy how to reach the maturity target level. The problem is, what kind of approach to use for rapid and effective IS maturity assessment. This paper summarizes the research regarding IS maturity within different organizations where the authors have delivered either complete IS due diligence or made partial analysis by IS Mirror method. The main objective of this research is to present and confirm the approach which could be used for effective IS maturity assessment and could be provided quickly and even remotely. The paper presented research question, related hypothesis, and approach for rapid IS maturity assessment, and results from several case studies made on-site or remotely.

Keywords: information system maturity, information system due diligence, framework for information system due diligence, IS Mirror

1 Introduction

Information and communication technology (ICT) support most of the processes within the organization and therefore it is extremely important to manage this area. Information systems (IS) are much more than ICT, including the processes, data, documentation, and people - ICT professionals and end users as well. Stakeholders, management and owners often wonder whether their system has sufficient quality and efficiency to meet the objectives, allow end user quality support for their daily operation and provide the management with sufficient information to make the right decisions. In order to obtain an independent report about the status of their IS, some organizations perform different activities: IS audit, other audits, independent IS analysis and even IS due diligence. Each of these activities also identifies the presence or lack of certain controls, non-compliance or other findings. Some organizations have already introduced systems that they can answer to the above question. These systems are: a quality management system [1], the system of IT service management [2], Balanced Scorecard [3], an IS audit based on COBIT methodology [4, 5] and others. Top management requires the possibility to assess IS maturity level, benchmark

the results, define the target IS maturity level, include this target to their IS strategy and to periodically evaluate their IS maturity to defined goals. Based on our IS due diligence experiences we have upgraded the Framework for IS due diligence (FISDD) [6] with the IS maturity assessment approach. This approach for the IS maturity assessment is explained in details within this paper. The remainder of our paper is structured as follows. Next section introduces the description of scientific area and related problems. Then we present our motivation followed with a research hypothesis. Section five contains a literature review, followed by a description of our approach - evaluation and related methodology. Section seven presents the results followed by discussion, completed by concluding remarks.

2 Description of scientific area and related problems

There are different system, methods, approaches, standards and others to provide the answers to organization's owners, top management, and managers regarding the value of their IS. For the organizations' owners, top management and managers there is an issue how to evaluate current IS maturity level and based on assessments, define the IS strategy how to reach the maturity target level. The problem is, what kind of approach to use for rapid and effective IS maturity assessment, that could be regularly used to measure the IS maturity improvements. For better understanding of our approach, which will be later detailed description, there are two scientific areas to be explained into details - IS due diligence and IS maturity.

2.1 IS Due Diligence

The term "due diligence" usually refers to a specific activity during the merger and acquisition process. Due diligence is one method of getting the necessary information and knowledge of existing IS. There are several types of IS due diligence: initial, general, vendor, and technology. Bhatia [7] explained how important it is to follow a structured framework in IS due diligence activities. The IS field lacks a scientifically based analytical tool for rapid delivery of IS due diligence. Delak and Bajec [6] presented an approach – the FISDD, which includes four phases: preparation, realization/on-site review, analysis, and decision. Each of these phases involves specific activities and sub-processes.

The FISDD, due to some reasons, allows us to conduct the IS due diligence process in a relatively short period of time. The earlier mentioned reasons are: a structured and documented guided framework (specific documents include a sample list of requested documents, several questionnaires, and a sample of reports) and a better documented, formalized, and specified process which is presented in this framework. All phases, requested documents, questionnaires, decision models, and templates of reports are detailed described in initial paper [6].

2.2 IS maturity

Rosemann and de Bruin [8] explained the notion of "*maturity*' that has been proposed for other management approaches as a way to evaluate "*the state of being complete, perfect, or ready*" and the "*fullness or perfection of growth or development*". In 1984, the U.S. Department of Defense founded the Software Engineering Institute (SEI) to create a model of a more reliable software

development process. With considerable industry assistance, SEI developed the Capability Maturity Model (CMM). It was inspired by Total Quality Management, which is a means for improving personal effectiveness and performance and for aligning and focusing all individual efforts throughout an organization. It provides a framework within which you may continuously improve everything you do and affect [9]. CMM defines five progressively more "mature" forms of the software development process, from Level 1 – initial, through repeatable, defined, and managed, to Level 5 – optimizing [10].
The CMM is now one of the most popular means for improving software development [11]. Mettler argued that the purpose of maturity models is to give guidance through an evolutionary process by incorporating formality into the promising improvement activities. In order to measure dedicated aspects of 'maturity', a wide range of maturity models has been developed in the field of IS by both, practitioners and academics over the past years [12].

3 Motivation

Different types of IS audits and also miscellaneous IS due diligence requires human resources and the presence of experts at the client's location. With the objectives to carry out a brief but effective IS analysis of the inspected organization, we have prepared a special method for such an activity entitled it the IS Mirror method [13] based on the FISDD [6]. The FISDD as output provides information about the current status of IS within observed organization. The IS Mirror method could be part of FISDD or separate IS analysis, providing IS strengths and weaknesses of observed organization.
One of the objectives of each IS analysis could also be IS maturity level, which has not been integrated in existing FISDD [6] and also neither described in the paper describing IS Mirror method [13]. Our motivation is to upgrade IS Mirror and consequently FISDD with the IS maturity evaluation. Basic idea was to assess the IS maturity level from the data gathered from IS Mirror method via web questionnaire or manually through IS due diligence activities.

4 Research hypothesis

The research question is: "*How to quickly assess the IS maturity level*?". We intend to validate the research questions by confirming the approach to IS maturity assessment as a design research [14] and to evaluate and demonstrate this IT artifact by observational methods with case and field studies. Our hypothesis is:

> *The IS maturity level can be assessed through the data analysis obtained from the IS Strengths and weaknesses questionnaire.*

Hevner et al. [14] defined several guidelines for design-science research. We have adopted and applied these guidelines as follows in table 1.

Table 1. Design-science research guidelines

Guideline	Description
1. Design as an artifact	Section 6.1 presents the design and development of an approach.
2. Problem Relevance	The above presented hypothesis was formulated as the research question: *How to quickly assess the IS maturity level?*
3. Design Evaluation	Evaluation is presented in section 7.
4. Research Contribution	The proposed approach is a new method for assessing IS maturity level.
5. Research Rigor	The proposed approach is founded on research science guidelines [14].
6. Design as a search process	The proposed approach was applied to the traceable information on case studies described in section 6.2.
7. Communication of Research	The proposed approach is presented in this paper and further work described in section 8.4

5 Review of the literature

In the world there are no standard guidelines for the implementation of IS due diligence activities [15]. Bhatia [7] argued how important it is to follow a structured framework at IS due diligence activities. Delak and Bajec [6] presented an approach – FISDD. The presented framework is not a completely new method that they would like to put alongside others, but an attempt at creating a comprehensive synthesis method using existing approaches that show the individual fields and through extensive personal experience with their use. FISDD allows to deliver IS due diligence in a structured way and within a short period of time. One of the FISDD novelties is online FISDD's Strengths and weaknesses questionnaire, which is described in the paper titled "Novelties within the Framework for Information System Due Diligence" accepted by one journal and will be published in the second half of 2016. The IS Mirror method [13] upgrade FISDD with the online web based IS Strength and weakness questionnaire, and could be used as a standalone service for evaluating IS.

On the other hand, by reviewing certain scientific papers, the authors observed descriptions of the various methods for evaluating the effectiveness, quality, and benefits of IS. DeLone and McLean [16] developed the DeLone and McLean model of IS success based on six dimensions: system quality, information quality, users, user satisfaction, individual impact, and the impact on the organization. Sedera and Tan [17] pointed out that the satisfaction of end users is the most widely used dimension to ensuring the success of IS; their findings based on next characteristics: the quality of information, the quality of the system, the impact on the individual, and the impact on the organization. Fraser et al. [18] described that maturity models have been proposed for a range of activities including quality management, software development, supplier relationships, product development, innovation, product design, collaboration, product reliability, and knowledge management.

6 Approach

Hevner et al. [14] suggested several guidelines for design science. The FISDD is an IT artifact, since it describes a method for delivering IS due diligence [6]. The further development of this framework is based for a detailed description of the approach to evaluate the IS maturity level of observed organization. As mentioned in the motivation section, approach for IS maturity assessment upgrades IS Mirror method and consequently also FISDD. This approach has been evaluated by several case studies described in this section. Our approach to assess the IS maturity level of observed organization based on the FISDD [6] Strengths and weakness questionnaire and is a new analysis of the data gathered from this questionnaire.

6.1 Questionnaires and IS Mirror

The FISDD contains also a questionnaire to gather information on the pros and cons titled FISDD IS Strengths and weakness questionnaire. It consists of 58 questions within 8 groups: Productivity of the IS, Quality of the existing application system, Effective use of technology, Information security (confidentiality, integrity and availability of information), Usage of the advanced and modern technologies, ICT employees, Cooperation between end users and ICT, Participation of ICT in projects. The respondents are IS end users within the observed organization, and ICT specialist (either employed in the observed organization or external, when the observed organization outsource specific services). Each respondent gives a numerical value, which can be for "strength" from +5 [ideal / cannot be better] to +1 as the minimum strength. If the item is in a "weaker" estimates can be from -1 [minimal weakness] to -5 [worst / cannot be worse]. If the respondent does not have the experience or cannot answer a question, then give the mark 0 and comments it. The respondent can enter the reason for giving mark [for example: I cannot identify the answer, I do not have experience, I do not know the area]. The responses could be presented as enlarged Likert scale (table 2).

Table 2. Enlarged Likert Scale

Statement	Mark / numeric value
Absolutely agree	+5
Strongly agree	+4
Agree	+3
Somehow agree	+2
Minimally agree	+1
Neutral (*)	0
Minimally disagree	-1
Somehow disagree	-2
Disagree	-3
Strongly disagree	-4
Absolutely disagree	-5

** I cannot identify the answer, I do not have experience, I do not know the area*

At the beginning the FISDD Strengths and weaknesses questionnaire have been fulfilled manually through interviews. This process has been time consuming, as each interview took at least 45 minutes on average 60 minutes and the respondents' sample was low. One of the FISDD novelties is online FISDD Strengths and weaknesses questionnaire, which is described in the paper titled "Novelties within the Framework for Information System Due Diligence" accepted by one journal and will be published in the second half of 2016. The average time for respondents has been decreased and is 45 minutes, when most of respondents took 30 to 40 minutes to complete the questionnaire. Online questionnaire has for each question also "help" selection, assistance in order to provide more detailed explanation about the question.

This online questionnaire could be used also as standalone ICT artifact – IS Mirror [13]. There are no differences between both questionnaires. The major difference is that with an online questionnaire sample of interviews employees is several times higher. We have made analysis regarding the number of neutral (0) answers. The response rate is by manual questionnaire 100%, with online questionnaire is between 80 and 90%. Online questionnaire has less neutral marks as paper based questionnaires conducted through interviews. During the first standalone IS analysis by IS Mirror (in 2013), the clients requested to evaluate the maturity level. So we have developed an approach for IS maturity assessment, which is further described.

As there are several types of maturity levels and Wulf et al. [19] mentioned some of them – CMMI-SVC, COBIT 4.1, SPICE, ITIL v3, we have chosen COBIT 4.1 [20] maturity modelling, as we have experienced while we are daily using COBIT maturity modelling of the audit activities. Control Objectives for Information and Related Technology (COBIT) is a framework created by ISACA (Information System Audit and Control Association – www.isaca.org) for ICT management and ICT governance.

Table 3. Generic maturity model from COBIT

Level	Description
0 - Non-existent	Complete lack of any recognizable processes. The enterprise has not even recognized that there is an issue to be addressed.
1 – Initial / Ad Hoc	There is evidence that the enterprise has recognized that the issues exist and need to be addressed. There are, however, no standardized processes; instead, there are ad hoc approaches that tend to be applied on an individual or case-by-case basis. The overall approach to management is disorganized.
2 - Repeatable but Intuitive	Processes have developed to the stage where similar procedures are followed by different people undertaking the same task. There is no formal training or communication of standard procedures, and responsibility is left to the individual. There is a high degree of reliance on the knowledge of individuals and, therefore, errors are likely.
3 - Defined Process	Procedures have been standardized and documented, and communicated through training. It is mandated that these processes should be followed; however, it is unlikely that deviations will be detected. The procedures themselves are not sophisticated but are the formalization of existing practices

4 - Managed and Measurable	Management monitors and measure compliance with procedures and takes action where processes appear not to be working effectively. Processes are under constant improvement and provide good practice. Automation and tools are used in a limited or fragmented way.
5 – Optimised	Processes have been refined to a level of good practice, based on the results of continuous improvement and maturity modelling with other enterprises. IT is used in an integrated way to automate the workflow, providing tools to improve quality and effectiveness, making the enterprise quick to adapt.

Source: COBIT 4.1 (page 19) [20]

COBIT maturity modelling is a supporting toolset that allows [citation needed] managers to bridge the gap between control requirements, technical issues and business risks. Maturity modelling for management and control over IT processes is based on a method of evaluating the organization, so it can be rated from a maturity level of non-existence (0) to optimized (5). Table 3 presents all 6 maturity levels, the COBIT maturity model has.

The maturity level is calculated from the analysis outputs of the FISDD Strengths and weaknesses questionnaire collected either from interviews (manually) or by IS Mirror method analysis (web questionnaire). The main idea is to calculate the IS maturity based on the differences between end users answers/marks and ICT specialists' answers/marks. As much the answers are similar, more mature is the organization. For each of 8 groups of questions the maximal difference between the end users' average mark and the ICT specialists' average mark is identified. This value is compared with "the difference between" range value from table 4 and "weight" for each group of the questionnaire is chosen.

Table 4. Maturity weight index

The difference between	Weight
0,00 – 1,00	6
1,01 – 2,00	5
2,01 – 3,00	4
3,01 – 4,00	3
4,01 – 5,00	2
More than 5,01	1

This "weight" search is repeated for each of questionnaire groups. The final maturity level value is calculated by the next formula:

$$\alpha=((\sum_{k=1}^{n} x_k)/n)-1$$

Where:

α - is the maturity value,
n - is the number of questionnaire groups (in our case 8),
x - is the weight for each group of questions.

6.2 Case Studies

From 1998 to 2013, we conducted more than 45 general IS due diligence, more than 10 IS analysis and more than 25 initial IS due diligence in Central and Eastern Europe, mainly in developed countries but also in some transition economies. During these activities we have been collecting also the data from FISDD Strengths and weaknesses questionnaires, either manually collected or by IS Mirror. All these data have been used for the validation of the proposed approach. Table 7 in Appendix A presents within the column "case study" two types of data: either used old data, from the FISDD method databases – collected by manual questionnaires, and marked as "Old"; or data used for standalone IS analysis or from FISDD method – collected by IS Mirror method (online questionnaire) and marked as "C.S.". The purpose of the case studies was to verify the validity of the assessment of observed organizations IS maturity level.

Participants: For the case studies we have selected more than 30 different IS analysis, mainly IS due diligence activities from 12 countries from Central and Eastern Europe. Table 7 in Appendix A presents the industry; country; year of activity; task (general IS due diligence – General IS DD, initial IS due diligence – Initial IS DD, IS audit or IS analysis); a way of gathering the data (manually by interviews or by IS Mirror method with online questionnaire); case study initial data ("C.S." - Case Study, "Old" – old data means data collected through due diligence activities with the FISDD and stored in FISDD and IS Mirror method databases); and the assessed maturity level.
Procedures: The gathered data for the analysis have been collected either by IS audit (one case), IS analysis (six cases), general IS due diligence (ten cases) and initial IS due diligence (sixteen cases). The ways of fulfilling FISDD Strengths and weaknesses questionnaire are: manual (28 cases) and by IS Mirror method – online questionnaire (five cases).
Data analysis: All gathered data for each case have been input to the excel file. The maturity level is calculated within three steps. First with simple excel functions calculate average marks for IS end user side and average marks for ICT specialist side. Second the maximum difference from both sides for specific questionnaire subgroup has been identified and the level weight from table 4 has been selected. Third the above mentioned mathematical formula has been used to calculate IS organization's maturity level.

Table 5 presents an average marks form End users and from ICT Specialists gathered by one IS Mirror method analysis in 2014 at the "Hand Tool producer" organization. The IS maturity level for this case study was assessed to 2.75 transformed to the COBIT maturity level between 2 – "Repeatable but Intuitive" and 3 – "Defined Process".

Table 5. Sample by answering gathered by IS Mirror method for one case study from 2014

Questionnaire group	End Users Marks	ICT Specialists Marks	Maximum difference
Productivity of the IT	3.05	3.49	2.08
The quality of the existing application system	2.38	3.38	2.02
Effective use of technology	2.28	3.13	0.98
Information Security [confidentiality, integrity, availability information]	2.91	3.87	5.00
Using the advanced and modern technologies	0.00	1.09	4.17
Employees of the department of Informatics	3.05	3.27	1.60
Cooperation between users and employees in the department of Informatics	2.06	3.01	5.23
Participation of the department of Informatics at the projects	2.47	2.46	0.68
Average	2.28	2.96	

7 Results

This study attempts to identify relationships between data gathered by the FISDD Strengths and weaknesses questionnaire, either collected manually via interviews or by the IS Mirror method analysis (online questionnaire) and IS the maturity level of the observed organization.
The data used for the approach validation were from two sources: from case studies realized by IS Mirror method IS analysis (from 2014 to 2015, in table 7 marked as "C.S." within Case study column); and from data stored in database from earlier FISDD and IS Mirror method activities (from 2001 to 2013, in table 7 marked as "Old" within Case study column). The data for the approach validation have been gathered from 33 IS analyses within the time period of 14 years and from 12 countries from Central and Eastern Europe. Most organizations came from the finance industry (26 organizations of 33 cases – 78.79%). Time spent on analyses of IS maturity level, is divided into two parts: collecting the answers from either IS Strengths and weaknesses questionnaire (is correlated to the organization size and number of distributed questions, sample at the FISDD manually collection), or by IS Mirror method (online questionnaire) which has no influence to the size of observed and pure gathered data analysis.

The IS maturity level assessment can be done either manually or with an online questionnaire within two weeks, where the manually collection questionnaire sample is 10 – 15 times smaller. Table 5 presents online case studies within one organization "Hand tool procedures" with almost 2000 employees (20 ICT specialists and 400 IS users). Online questionnaire has been sent to 16 ICT specialists and 280 IS users. The questionnaire response rate for ICT specialist was 13 responses, which is 81,26% and for IS users was 252 responses, which is 90%). Table 6 presents the on site time saving at IS due diligence with IS Mirror compared the manual IS Strengths and weakness questionnaire, for the organization with up to 2000 employees.

Table 6. Comparison between manual questionnaires and online questionnaires

Size of the observed organization: from 750 up to 2,000 employees.	Questionnaire sample size	Time spent for data gathering	IS due diligence on-site time
FISDD with manual questionnaire	28 – 36	4 man days	8 man days
FISDD with IS Mirror	280 – 400	Few hours	4 man days

The assessed IS maturity levels from the case studies are in the range from 1.00 to 3.63 (see table 7 in Appendix A for the details). The average of the IS maturity level from all 33 cases is 2.42. IT Governance Institute (ITGI) [20] made a study with the objectives: a) Collect, process maturity data from a wide variety of enterprises to develop preliminary benchmarks for each maturity attribute/IT process combination and b) Collect IT demographics to perform an initial analysis of process maturity measures vs. IT demographics as a starting point for benchmarking profiles for different demographic combinations. The ITGI study covers 51 companies from 8 countries (Austria/Germany/Switzerland, Canada, Mexico, Philippines, Singapore and USA) and from five different industries. The ITGI study evaluates processes based on the COBIT 4.1 [20] process list within four domains: Plan and Organise domain, the median maturity levels range from approximately 1.7 to 2.7; Acquire and Implement domain, the median maturity levels range from approximately 2.4 to 3.0; Deliver and Support domain, the median maturity levels range from approximately 2.0 to 3.2; and Monitor and Evaluate domain, the median maturity levels ranges from approximately 2.0 to 2.2 [21]. The average of the IS maturity level in ITGI study is 2.4 which is comparable with average IS the maturity level of our case studies 2.44. These findings confirm our hypothesis that with our approach for IS Maturity assessment, we can assess IS the maturity level of IS within observed organization.

The the complete IS Mirror analysis last between one week to ten days, from the first e-mail to the selected respondents, and two reminders e-mails. The online questionnaire is open to the selected employees, who get invited to the online questionnaire by e-mail. The selection whom to invite is made by management. The online questionnaire is anonymous, only the team who made the analysis got respondents marks – answers. The management got only the response rate statistic and the final analysis within the IS Mirror report. A similar report is part of the FISDD report.

The ratio on "0" answers is at IS Mirror lower than with the FISDD Strengths and weakness questionnaire collected manually. One explanation is that IS Mirror has for each question – additional explanation by online questionnaire's "Help" functionality.

One identified IS Mirror shortcoming is the lack of visual contact with the questionnaire respondent. At manually collected data by FISDD Strengths and weakness questionnaire interviewer could evaluate also the respondent body language and made some comments on the strange respondent reaction.

During all 33 analysis, we have not identified scenario with majority of similar answers. So we can completed, that there was no pressure to the respondent by suggesting answers.

8 Discussion

The presence of ICT support within all organization's processes has expanded dramatically within the last two to three decades. Usage of technology improves the productivity, but the systems have to be accepted and used by the employees. Zviran and Erlich [22] wrote that the user satisfaction factor is an important criterion and the one most prevalent for measuring the success of IS. DeLone and McLean [16] within their model express user satisfaction as one of six model's dimensions. Sedera and Tan [17] argued that the satisfaction of end users is the most widely used dimension to ensuring the success of IS. We have not identified papers where ICT specialist satisfaction has been assessed or evaluated. With IS Strengths and weaknesses questionnaire, we do collect feedbacks from End users, but also from ICT Specialists - employees of observed organization.

On the other hand, concepts of process or capability maturity are increasingly being applied to many aspects of product / service development, both as a means of assessment and as a part of a framework for improvements [18]. In order to measure dedicated aspects of "maturity", a wide range of maturity models has been developed in the field of information systems by both, practitioners and academics over the past years [12]. Mettler [12] also argued that the popularity of maturity models was especially intensified by the introduction of the CMM. With COBIT 4.1, a generic definition is provided for the COBIT maturity scale, which is similar to CMM, but interpreted for the nature of COBIT's ICT management processes [20]. Our IS maturity assessment is based on COBIT maturity levels and its terminology. De Bruin [23] proposed a generic methodology for the development of maturity models in various domains. They also argued that the value in a generic methodology lies in the ability to develop a model that is highly generalisability and enables standardization. Our case studies show that our IS maturity level assessment is highly generalizable and the results are comparable ITGI research [21].

8.1 Interpretation of the findings

The data used for our case studies have been collected during several years from 2001 to 2015. In the beginning there was manual data gathering by the FISDD strength and weaknesses questionnaires. The web based questionnaire (IS Mirror method) has been used within the last three years (2013-2015). At the beginning the IS Mirror method has not generated IS maturity level assessment, but during the evolution of the method presented approach has been developed, verified and used.

The case studies organization sizes vary from 100 employees up to 2,000 employees. Within one financial institution, there were three independent IS analysis for three divisions (retail - front office, back-office and finance/accounting), the retail division IS maturity level mark was 3.17, the back-office's division IS maturity level was 3.14 and the finance/accounting's division IS maturity level was 1.29. That means also within one organization the IS maturity level between organization's parts could be different. Similar differences can be expected, when there will be IS maturity level for specific IS process, as it was identified within ITGI research [21]. The proposed approach can also evaluate ICT service clime, which have been already researched (e.g. [24]).

Interesting is that from the top ten organizations by IS maturity level, three organizations are coming from emerging economies countries (Bosnia & Herzegovina). Expected to be that the

highest IS maturity level will have most regulated organizations coming from the finance industry, but the highest IS maturity level mark is shared between financial organizations and manufacturing organization. This organization has many years of experience with managing innovation, patents and intellectual capital.

8.2 Implication of the Study

Zviran and Erlich [22] defined some conclusions and recommendations, we have tried to integrate in our approach to IS satisfaction evaluation, however, more about the pros and cons, evaluation from both IS sides, from IS End users and for internal IS service providers. Becker et al. [25] have stated several findings: "*Maturity models are a theme of growing importance in the IS discipline*" – within our paper and related case studies, we confirm that finding; "*Maturity and maturity models have rarely been conceptualised in detail and can be regarded as scientifically under-determined*" – with our paper we try to lower this gap. With the realization of describing case studies and used data gathered by IS strengths and weaknesses questionnaire collected either manually by FISDD face to face interviews or through the web questionnaire by IS Mirror method, we have verified the approach for IS maturity assessment and got the positive answer to our hypothesis: "*The IS maturity level can be assessed through the data analysis obtained from the IS Strengths and weaknesses questionnaire*". The presented approach could be available for further researches and analysis.

8.3 Limitation of the Study

Several factors should be considered before fully confirming this approach as a general approach to IS maturity level assessment. First, the case studies were released only in Central Europe. Second, we have not assessed the IS maturity level of observed organizations with other methodologies, tools, approaches or standards for IS maturity level assessment to compare the results. Third, the approach has been validated only in Europe and mostly in financial institutions, which are regulated by local central banks and several times per year controlled by different external audit activities and forth, the approach has been proven in the organization with up to 2,000 employees.

8.4 Conclusion

The purpose of this article was to explore an approach to assess IS maturity level in the observed organization. This article investigates the research question: "*How to quickly assess the IS maturity level.* The proposed approach is an IS artifact, and we have followed Hevner et al. [14] guidelines to validate the approach. Our approach is based on COBIT maturity level model [20]. ITGI has presented similar results [21] as we have gotten with our described case studies. Similar evaluation regarding Capability Maturity Model (CMM) and COBIT has been presented by Amid and Moradi [26]. We conclude that the data collected by IS Mirror method or manually by fulfilling the Framework for IS due diligence (FISDD) strengths and weaknesses questionnaire can effectively assess the IS maturity level within observed organization. Our research clearly shows that IS maturity level can be evaluated within a short period of time.

Our future research topic in this area will be to connect IS Mirror method to academic theories, and develop a theoretical foundation for this approach. Our additional future work includes some parallel analysis, IS Mirror method with other methods for IS maturity level assessment. Some researchers in Europe are currently upgrading FISDD with some other aspect for merger and acquisition and might further analyze usage of the IS Mirror method as well. The authors are planning to develop a web based FISDD to offer service for self-assessments where IS maturity level is only one domain.

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Appendix A: Case study details

Table 7. Details from Case Studies and maturity level results

Industry	Country	Year	Task / Activity	Gathering method	Case study	Maturity level
Hand tools producer	Slovenia	2015	General IS DD	IS Mirror	C.S.	2,75
Hydro institute	Slovenia	2014	IS analysis	IS Mirror	C.S.	1,13
Government organization	Slovenia	2014	IS audit	IS Mirror	C.S.	2,13
Manufacturing	Slovenia	2014	IS analysis	IS Mirror	C.S.	3,63
Electricity organization	Slovenia	2013	IS analysis	IS Mirror	C.S.	3,13
SW development & production	Slovenia	2012	General IS DD	Manually	Old	2,88
Financial industry	Bosnia & Herzegovina	2012	Initial IS DD	Manually	Old	3,63
Financial industry	Slovenia	2011	IS analysis	Manually	Old	1,29
Financial industry	Slovenia	2011	IS analysis	Manually	Old	3,14
Financial industry	Slovenia	2011	IS analysis	Manually	Old	3,17
Financial industry	Bulgaria	2008	General IS DD	Manually	Old	2,78

Financial industry	Serbia	2008	General IS DD	Manually	Old	2,50
Financial industry	Russia	2007	Initial IS DD	Manually	Old	3,13
Financial industry	Kosovo	2007	Initial IS DD	Manually	Old	3,13
Financial industry	Bosnia & Herzegovina	2007	Initial IS DD	Manually	Old	3,57
Financial industry	Serbia	2005	Initial IS DD	Manually	Old	1,71
Financial industry	Kosovo	2005	Initial IS DD	Manually	Old	2,75
Financial industry	Czech republic	2004	General IS DD	Manually	Old	3,14
Financial industry	Switzerland	2004	General IS DD	Manually	Old	2,50
Hospitality	Slovenia	2004	General IS DD	Manually	Old	1,50
Financial industry	Serbia	2003	Initial IS DD	Manually	Old	3,38
Financial industry	Austria	2003	General IS DD	Manually	Old	1,25
Financial industry	Bosnia & Herzegovina	2003	Initial IS DD	Manually	Old	1,29
Financial industry	Serbia	2003	Initial IS DD	Manually	Old	1,29
Financial industry	Montenegro	2003	Initial IS DD	Manually	Old	1,29
Financial industry	Serbia	2003	Initial IS DD	Manually	Old	2,43
Financial industry	Bosnia & Herzegovina	2003	General IS DD	Manually	Old	2,71
Financial industry	Bosnia & Herzegovina	2002	Initial IS DD	Manually	Old	3,38
Financial industry	Germany	2002	General IS DD	Manually	Old	3,50
Financial industry	Bosnia & Herzegovina	2002	Initial IS DD	Manually	Old	1,57
Financial industry	Bosnia & Herzegovina	2002	Initial IS DD	Manually	Old	2,43
Financial industry	Croatia	2001	Initial IS DD	Manually	Old	1,33
Financial industry	Bosnia & Herzegovina	2001	Initial IS DD	Manually	Old	1,00