Towards Transparent and Efficient Process Assessments for IT Service Management

Anup Shrestha, Aileen Cater-Steel, Mark Toleman, and Terry Rout

School of Management and Enterprise,
University of Southern Queensland
Toowoomba, Australia
{Anup.Shrestha,Aileen.Cater-Steel,Mark.Toleman,
Terry.Rout}@usq.edu.au

Abstract. IT service organisations recognise the value of conducting regular process assessments for continual service improvement. However lack of transparency and substantial costs deter industry adoption. We propose that the use of the international standard for process assessment ISO/IEC 15504 offers a transparent approach to address this challenge. Moreover, efficiency can be realized by a Decision Support System (DSS) tool to automate data collection and process capability calculations. This paper details a Design Science Research project to develop a software-mediated process assessment (SMPA) approach based on ISO/IEC 15504, ISO/IEC 20000 and the IT Infrastructure Library (ITIL®). We discuss the architecture of the SMPA approach and the role of ISO/IEC 15504 in the approach. This work contributes to practice as it may help IT managers to self-assess their processes using a standard model. The SMPA approach can also support assessors who perform formal assessments.

Keywords: ITSM Process Assessment, ISO/IEC 15504, automated process assessments, IT Service Management, Process Improvement.

1 Introduction

Research has shown that IT services account for 60-90 percent of the total cost of IT ownership [1]. The discipline of IT Service Management (ITSM) uses a process approach along with service-oriented thinking to manage IT in businesses. To provide guidance to implement the ITSM model, most organisations have chosen the IT Infrastructure Library (ITIL®) framework. ITIL was initially created by the UK government in the late 1980s [2]. The ITIL framework led to the creation of the international standard for ITSM: ISO/IEC 20000 [3]. The increasing role of ITSM in facilitating business requires continual improvement of IT service processes [4]. In the current ITIL framework, Continual Service Improvement (CSI) has been proposed as an important service lifecycle phase. CSI emphasises that there should be an ongoing effort to identify opportunities for improvement in ITSM processes [5]. The CSI concept further stresses that "continual assessment" is important to identify improvement opportunities for all processes [6].

A. Mitasiunas et al. (Eds.): SPICE 2014, CCIS 477, pp. 165–176, 2014.

In performing CSI activities many organisations have adopted process assessment techniques that employ a systematic measurement of processes [6]. The measurement results are then used to determine the capability of each process and monitor improvements. Process assessment, however, needs to be differentiated from audit: while the quality standard ISO 9001, for instance, can be used to conduct audits by checking conformance [7], process assessment goes one step beyond conformance checks and provides evaluation of process capabilities on a continuous scale [8].

Organisations would normally engage consulting firms to perform process assessments and to recommend on the ITSM areas requiring improvement [4]. However, qualified and experienced ITSM consultants can be scarce and expensive, particularly for small IT service providers. It is reported that process assessments are costly and time-consuming [6, 9]. In addition, assessment outcomes are often dictated by proprietary methods and tools employed by the assessors [5]. ITSM process assessment needs to be standardized in order to have any confidence in the assessment process and outcomes. Therefore, lack of transparency and increasing costs deter regular and consistent IT service process assessments.

An alternative to reliance on expensive consultants with proprietary process assessments is for the organisation to carry out a standard process assessment itself using software tools that may be integrated with a knowledge base of ITSM best practices. Risks of internal self-assessments include lack of objectivity, poor acceptance of findings and internal politics [6]. In order to mitigate these risks, during the assessment a decision support system (DSS) tool can facilitate a standards-based approach to collect data for process assessments and analyse process capabilities to recommend process improvements. This opportunity led us to develop a novel approach for ITSM: *Software-mediated Process Assessment (SMPA).* The SMPA approach is a standards-based process assessment approach by which organisations can self-assess their processes using a DSS tool to determine process capabilities.

To lend objectivity and consistency to the SMPA approach, its activities are aligned with the international standard for process assessment: ISO/IEC 15504 [10]. The application of the standard in ITSM is relatively new [11]. An exemplar process assessment model for ITSM has been published as a part of the international standard for process assessment [12]. This paper illustrates development of the SMPA approach using the process assessment model for ITSM.

A literature review on ITSM process assessment is presented next to articulate the research problem. Research methodology is then discussed before a detailed account of the design and development of the SMPA architecture. Finally the conclusion section discusses the role and value of the SMPA approach that is supported by the application of ISO/IEC 15504.

2 Literature Review

The literature associated with ITSM process assessment is rooted in the concept of service and quality. Existing work on IT service quality has looked to the service marketing literature and focused on adapting the SERVQUAL instrument [13] to the

context of IT service. Research on IT service quality has largely focused on user satisfaction measures while there is limited research related to processes [14].

While it is a widely-agreed concept that service quality is ultimately determined by what the customer perceives, service providers should also strive to improve their processes. Organisations can conduct customer satisfaction surveys to assess the outcome of the service provision. However this is unlikely to assist service providers in improving their processes [15]. There is a need for organisations to redefine their ITSM processes to manage IT service quality [14]. Existing literature on IT service quality in terms of processes has shown a lack of research on this topic [16].

Measuring IT services is a challenging feat that requires both quantitative and qualitative metrics based on diverse service quality measures such as IT service quality, information systems quality, process quality, customer satisfaction, service value and service behaviour [14]. Few studies provide methodological guidance on an approach to determine process quality measures. A self-assessment methodology based on business excellence models and Six Sigma process improvement techniques used ITIL maturity assessments [17] for several ITIL service delivery processes. However several critical flaws in the assessment approach were reported, such as surveys with compound questions that allowed only a "yes" or "no" response [18].

Using ITIL processes and the international standard for process assessment ISO/IEC 15504, evidence of repeatable and objective improvement in IT service quality has been reported [7]. Extensive work on the combination of ITIL and ISO/IEC 15504 led to the development of a popular ITSM process assessment approach called Tudor's IT Process Assessment (TIPA) [4]. TIPA has been promoted as a commercial framework for ITSM process assessment [19].

ITSM process assessment approaches are discussed as best practice guidelines in the IT industry. Many of the solutions offered for ITSM process assessment are commercially available (for example, ITIL assessment services or Pink Elephant). These services can be considered as a black box since the rationale behind the assessment activities is not fully disclosed. Moreover, due to proprietary assessment processes, inconsistent outcomes from different assessment services hinder comparisons. Non-ITIL approaches such as CMMI for Services or eSCM for service providers have transparent models and methods but lack DSS support in order to conduct process assessments.

Based on the academic literature review and existing industry practices, the two key problems of lack of transparency and lack of efficiency in ITSM process assessments are apparent. Addressing transparency and efficiency are two major challenges of process assessments [6]. These challenges are taken into account as important problems that must be solved by the SMPA approach. The research methodology used to develop the novel SMPA approach is discussed next.

3 Research Methodology

Design science research (DSR) is the underpinning research methodology applied for the development of the SMPA approach. The DSR approach [20] has the primary goal to develop a new artefact. DSR methodology is outcome-oriented and thereby

provides guidelines for development and evaluation of research artefacts that contribute to specific bodies of knowledge. The artefact, referred to as the SMPA approach in this paper, is a method for IT service process assessments using ISO/IEC 15504 and facilitated by a DSS tool.

In DSR projects, researchers are advised to use established kernel theories to inform and justify the research work [21]. Task-technology fit (TTF) theory [22] is presented as the kernel theory for the design process to advise how the task challenges of process assessment and technology requirements for a new DSS tool fit together to articulate SMPA design and development. The TTF theory from Zigurs and Buckland [22] was adopted since the DSS tool used in the SMPA approach shares similar technology dimensions as proposed in the theory, viz. communication support, process structuring and information processing.

The six DSR methodology steps [23] were followed in the research: problem identification and motivation, objectives of a solution, design and development, demonstration, evaluation, and communication. Problem identification and solution objectives have been discussed in the Literature Review section. Details of the design and development of the SMPA approach as the research artefact are discussed next.

4 Design of the SMPA Architecture

The existing challenges of lack of transparency and need for efficiency in process assessment have been discussed in the Literature Review section. The task challenges can be grouped as a typical "decision task" since process assessments are conducted to make informed decisions on improving processes. According to TTF theory, technology requirements for the challenges of a decision task must focus on "information processing" and "process structuring" dimensions of technology for enhanced performance [22].

In the context of this research, facilitation of ITSM process assessment represents process structuring. The SMPA approach must define a workflow by which the entire assessment is conducted as explicitly documented in the process assessment standard [10]. We considered the assessment workflow steps proposed in the TIPA framework that define a structure in the assessment activities: Definition, Preparation, Assessment, Analysis, Results Presentation and Closure phases [4]. Likewise, the ability to automate activities of process assessment is considered as the information processing requirement for the design of SMPA approach. The steps of assessment data collection and validation, process capability ratings and reporting of the assessment results require gathering, aggregating, evaluating and finally presenting information as listed in ISO/IEC 15504-2 [10].

After a careful analysis of the task challenges identified in the Literature Review and the technology requirements stated earlier, a fit profile between the task challenges and technology requirements was established to articulate the SMPA design architecture (shown in Table 1).

Table 1. Fit profile for design principles to develop the SMPA approach

Process Assessment (Task challenges)	Decision support system (Technology Requirements)	Design Principles
Transparency	Process Structuring	Facilitate Assessment Workflow
Efficiency	Information Processing	Automate Assessment Activities

4.1 Facilitate Assessment Workflow

Emergent from the task requirement of *transparency* and technology requirement of *process structuring*, it would be worthwhile to establish an ITSM assessment approach that uses the ISO/IEC 15504 standard as a matter of consistency and in order to establish norms for a transparent approach. The SMPA approach has been developed with this design principle.

In order to facilitate the assessment workflow, alignment with ISO/IEC 15504 is critical while developing the SMPA approach. A thorough review of the normative reference of the standard [10], the process reference model [24] and the process assessment model for ITSM [12] was conducted to develop the SMPA approach. Likewise, a top-down approach in ITSM process assessment ensured that the measurement follows a transparent workflow of assessment activities. This work was guided by the Goal-Question-Metric (GQM) approach [25]. The concept of GQM defines a process measurement model on three levels: goal (conceptual level), question (operational level) and metric (quantitative level) [25]. The GQM approach was applied to define the assessment workflow in the SMPA approach.

ISO/IEC 20000-4 defines a reference model where each process is defined in terms of its purpose and outcomes [24]. Attainment of the process purpose by meeting the outcomes defines achievement of capability level 1 (process performance) in the assessment. The goals for assessment of higher capability levels are specified in the process attributes provided in ISO/IEC 15504-8 [12].

To provide information that can drive improvement of IT service processes, the standard practices were mapped to a set of assessment questions for a sample of four ITSM processes: Service Level Management, Change Management, Configuration Management and Problem Management. A total of 46 specific questions for the four processes at PA1.1 and 127 general questions at PA2.1 to PA5.2 that applied to all processes was generated from 63 standard indicators.

Every question was measured using the scale: “Not” (N), “Partially” (P), “Largely” (L), “Fully” (F) and “Not Applicable” (NA) also referred to as the NPLF scale in ISO/IEC 15504-2 [10]. Rather than the assessment team making a subjective choice of the indicator rating, the SMPA approach objectively measures feedback from the relevant process stakeholders based on their responses to the assessment questions.

4.2 Automate Assessment Activities

Based on the task requirement of *efficiency* and technology requirement of *information processing*, automating the activities of ITSM process assessment was

necessary for cost-effective process assessments. The design principle of automation in assessment activities was adopted by developing a DSS tool. The lack of efficiency in the existing approaches is based on the time and resource requirements to organise process assessments. The SMPA approach has the potential to address this challenge since the use of a DSS tool can automate several assessment activities including assessment data collection, analysis and reporting.

The DSS tool in the SMPA approach allocates assessment questions to the survey participants based on three process roles: process performers; process managers; and external process stakeholders. The three process roles are confirmed as the norm for ITSM processes [4]. The approach of asking questions directly in a web-based survey represents a faster and more efficient data collection method compared to assessment interviews while maintaining the same level of rigour in service research [26].

The DSS tool determines a final process attribute score for each process. This is done by calculating the mean value of all the responses for every process attribute. The coefficient of variation (*CoV*) of all the responses is also computed by the tool: $CoV_x=\delta x/\ \overline{x}$ where CoV_x is the coefficient of variation, δx is the standard deviation and $\overline{x}$ is the mean value of x responses for a particular process attribute score.

The mean and the *CoV* are simple statistical measures to understand what the critical mass of assessment respondents think about the processes being assessed. The method of process capability determination and calculation of the reliability of the survey responses is a new feature of the DSS tool that is not explicitly stated in the ISO/IEC 15504 standard.

5 Structure of the SMPA Approach

The SMPA approach that is developed during the research project has four phases. During the first phase, preparation, information about processes to assess and assessment participants is captured using the DSS tool. The first phase represents the input in the SMPA approach as it demonstrates preparation to conduct assessments. The second and third phases survey the process stakeholders according to the process assessment model and measure process capability from the survey responses. The final phase produces a report with process improvement recommendations.

The structure of the DSS tool illustrated in Figure 1 facilitates the SMPA approach.

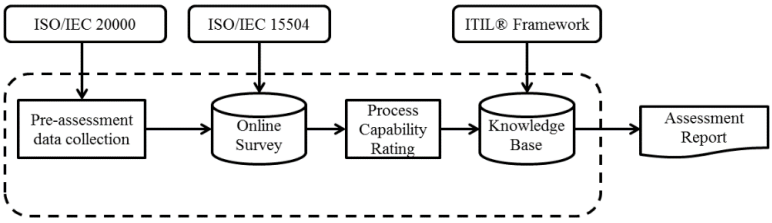

Fig. 1. Structure of the DSS tool for the SMPA approach

Phase 1 Preparation. Phase 1 represents preliminary data collection before the process assessment survey commences. The standard ISO/IEC 15504 [10] defines

four key scoping dimensions to prepare before the commencement of the process assessment: (a) organisation context for assessment, (b) organisation unit to be assessed, (c) highest capability level to assess, and (d) processes to assess. Since the first three dimensions depend largely on the specific organisational context, an organisation profile form was generated to capture that information. For the fourth dimension however, the SMPA approach developed a general method to select processes to assess and improve. The processes listed in ISO/IEC 20000 [3] were considered for the initial list to choose the ITSM processes to assess. A method to select critical ITSM processes to improve has been developed and [27].

Phase 2 Survey. The process assessment model for ITSM in ISO/IEC 15504-8 [12] provides a set of base practices to fulfil the process outcomes (level 1) and a set of generic practices for process management (level 2), standardisation (level 3), quantitative measurement (level 4) and innovation (level 5). In a formal ISO/IEC 15504 assessment, these practices would be used as indicators to enable a formal evaluation of the process capabilities. In the context of the SMPA approach, the emphasis is on providing information that can drive improvement of ITSM processes. These indicators were translated into a set of assessment questions for the survey.

There are a number of best practices that are designed to assess ITSM processes, such as the process assessment model (PAM) for ITSM from ISO/IEC 15504-8 and the ITIL process maturity framework [17]. However, existing ITSM process assessment approaches used assessment indicators that were not designed to act as a direct information gathering instrument for automated data collection. Instead all assessment indicators were designed for assessors to use during assessment interviews. In contrast, we developed assessment questionnaires for direct input from process stakeholders. The questionnaires map each of the standard assessment indicators from ISO/IEC 15504-8. The questions were then allocated to the three process stakeholder groups according to the relevance of each question to each process role. Assessment questions for the survey were generated by analysing all standard indicators in the process assessment model from ISO/IEC 15504-8 so as to construct singular, fine-grained and close-ended assessment questions.

The DSS tool ensures quality data is collected for measurement. The responsibility to provide information about process capability was transferred to the process stakeholders. This shift removes the need for assessors to ask open-ended questions during assessment and avoids subjective judgments on process capability. For example, an assessor's open-ended question for the problem management process based on the base practice "RES.3.1 Identify problems" could be "Can you tell me about recording of the problems?". Instead, assessment questions in the survey are formed such as "Do you know if identified problems are properly recorded?" in a close-ended format, so that the assessment facilitator can analyse survey responses objectively and generate reports based on a concrete set of answer options. The questions progress based on the process attribute indicators at each process capability level defined by the ISO/IEC 15504-2 standard.

The survey uses a cross-sectional, self-administered web-based questionnaire, offered online. The procedure and design of the survey was chosen to be online as it is low cost, easily accessible, provides a fast response, and data collected would be available in electronic format [28]. The survey questionnaire has specific questions

for each process for process attribute 1.1 (capability level 1) since this level relates to specific base practices (process dimension). The survey questionnaire has common questions for all the processes for process attributes 2.1 (level 2) to 5.2 (level 5) since these process attributes relate to generic practices (capability dimension).

Phase 3 Measurement. The assessment questions are grouped to determine process capability levels 1-5 and every question is rated using uniform answer options following the NPLF scale. This rating is a knowledge metric for ITSM process stakeholders to capture what they know about the process. Rather than the assessment team making a subjective choice of the indicator ratings based on objective evidence, the SMPA approach uses a coherent metric to collect and objectively measure feedback directly from the stakeholders.

Besides the four-point NPLF rating scale, every question also has a "Don't Know" (DnK) option and a "Don't understand the question" (DnQ) option. The DnK option suggests that the survey participant understands the question but there is a lack of communication and understanding in regard to the aspect of the process being questioned. The DnQ option is a metric to prompt the assessment facilitator to have a discussion about the question for clarity of the concepts. Every question also features a free text comment box to capture qualitative contextual data. Such textual information can be analysed by an assessor to validate responses and provide specific recommendations in the assessment report.

The ISO/IEC 15504-2 requirements were used for the calibration of process attribute ratings. Since the objective of our research project is to provide a transparent and consistent method to conduct process assessments, the final score of each process attribute is determined by calculating the arithmetic mean value of all the responses for all the questions belonging to a particular process attribute. Table 2 provides the rating scale defined by the ISO/IEC 15504-2 standard along with the mean value of the scale percentage that is used for score calculation. For example when an answer option is "Yes, most of the time", it corresponds to the "Largely" rating scale where the scale percentage is in the range 50 to 85%. Therefore, the score for that response is the average of 50 and 85 which is 67.5.

Table 2. NPLF rating scale based on the ISO/IEC 15504 standard

Answer Options	*Rating score*	*Scale %*	*Mean score value (x)*
No, never	N	0 - 15	7.5
Yes, but only sometimes	P	>15 - 50	32.5
Yes, most of the time	L	>50 - 85	67.5
Yes, always	F	>85 - 100	92.5

The coefficient of variation (*CoV*) is also computed to analyse the trustworthiness of the process attribute score based on data dispersion among the respondents. The algorithm used in the measurement of process capability is discussed next.

The process attribute scores are calculated based on the following steps:

1. Each one of the four valid answer responses (NPLF) is mapped to the rating scale and the mean value of each response (x) is determined based on Table 2.

2. For all m responses belonging to one question, the arithmetic mean of x is calculated (y). The reliability of the process attribute score increases when there is a larger value of m due to higher number of respondents representing a process.
3. y is normalised to the NPLF rating scale (f_{nplf}) defined in Table 2 (y').
4. For all n questions belonging to one process attribute, the arithmetic mean of y' is calculated (z).
5. z is normalised to the NPLF rating scale (f_{nplf}) as defined in Table 2 (z'). z' is the process attribute score for the process.

The calculation of process attribute reliability score follows five steps:

1. Each of the four valid answer responses (NPLF) is mapped to the rating scale and the mean value of a response (x) is determined based on Table 2.
2. For all p responses belonging to all questions of a process attribute, the arithmetic mean of x is calculated (μ_p). The reliability of the process attribute score increases when there is a larger value of p due to higher number of respondents representing a process.
3. For all p responses belonging to all questions of a process attribute, the standard deviation of x is calculated (σ_p). The standard deviation σ_p shows how much dispersion from the arithmetic mean μ_p exists. A low σ_p indicates that all responses are close to μ_p. A high σ_p suggests that the responses are spread over a wide range of answer options.
4. Coefficient of variation (CoV_p) is calculated from the σ_p and μ_p. CoV_p is expressed as an absolute value percentage (relative standard deviation) that can be analysed to determine trustworthiness of the process attribute score based on data dispersion of the responses. A lower CoV_p suggests low variability in the responses that boosts the degree of confidence of the process attribute score and vice versa.
5. The reliability score (CoV_p') is determined based on the percent value of CoV_p and the range of acceptable variation of responses as defined by a function (f_{hmp}). The logic of the function f_{hmp} groups the CoV_p value into one of three scores based on a scale of dispersion of responses. We considered the logic to cluster a CoV_p value of less than 30% to be a reliable score, CoV_p value of over 50% to be an unreliable score and anything in between to be a "moderate" score. Therefore, the following algorithm of the function f_{hmp} is determined.

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If CoVp < 30%, CoVp' = "HIGH"
If CoVp between 30% and 50%, CoVp' = "MODERATE"
If CoVp > 50%, CoVp' = "POOR"
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The final outcome is the development of an assessment process profile that includes all the process attribute scores and their reliability scores along with the rationale for the ratings [29].

The need to provide an explanation of the logic of process capability measurement is paramount, as one of the critical factors for assessors and process managers was openness and transparency of how the process capability scores are derived. Lack of transparency can be a barrier to adoption in the process assessment discipline as assessors and process managers must be able to justify the assessment and process improvement efforts by explaining the calculations on which the process capability results were based. An explanation of sound logic of the process measurement is

expected to lead to increased satisfaction and trust in the SMPA approach outcome by process managers. The provision of reliability scores provides confidence in accepting the assessment results. The consistency and simplicity of the process measurement ensures that the SMPA approach is flexible and easy to change in the event of alterations to the questions, standard measurement framework and/or calculation logic. This consideration is important in view of the anticipated change of the process assessment standard ISO/IEC 15504 to the ISO/IEC 330xx series.

Phase 4 Improvement. The SMPA approach not only provides assessment process profiles but also attempts to present process improvement recommendations. After each process questionnaire was formulated, knowledge items were generated for all questions based on the ITIL® framework. After conducting an assessment, a knowledge item for each question is extracted from the knowledge base and compiled in the assessment report when the normalized mean of all responses to the question demonstrates risks (i.e. a knowledge item score of Not or Partially).

Two aspects of a knowledge item for every assessment question are combined to generate a process improvement knowledge base: observation and recommendation. The observation component of a knowledge item lists the current state of the process capability. For instance, if a process is at capability level 2, observations provide an account of the current state of what is being done to ensure this capability level is maintained. This information is transformed from the relevant question itself. Likewise the recommendation component of a knowledge item for the process is based on the best practice guidelines from the ITIL® framework to achieve higher capability levels. To illustrate the generation of a knowledge item, a scenario can be considered. If a question asked "Do you know if X is performed?" the associated knowledge item may consist of two components: Observation: "X is not performed well"; and Recommendation: "According to ITIL®, consider doing Y to perform X". Based on the assessment question, an observation is formulated stating what needs to be done. To develop the recommendation component of a knowledge item, process metrics defined in terms of critical success factors and key performance indicators in the ITIL® framework were contextualised to the question. At PA1.1 the recommendations were specific to the process in question. From PA2.1 onwards, the recommendations were developed as general guidelines that may apply to any process. However specific examples were provided where applicable.

6 Conclusion

Lack of transparency and need for efficiency were recognized as two significant problems for ITSM process assessments. To address these problems, the SMPA approach was developed to assist organisations to self-assess their processes for improvement using a standard model. The SMPA approach incorporates a DSS tool that has four main areas of functionality: pre-assessment data collection, online survey for assessment questions, calculation of process capability score and generation of process improvement recommendations in an assessment report.

The SMPA approach was designed to work in an efficient and transparent manner for continual improvement of IT services. Evaluation of the SMPA approach is being undertaken at two case study organisations in Australia by determining the usability of

the DSS tool supporting the SMPA approach. The SMPA approach provides a new opportunity for automation and transparency in the way process assessments are conducted. Beyond the discipline of service management, the SMPA approach can potentially be applicable to other domains where a process assessment model is available. Using the SMPA approach, a compliant process assessment model can be used to develop survey questions. Likewise, process improvement recommendations can be generated based on industry best practice guidelines such as ITIL® in our case. With the expanding significance and reach of the ISO/IEC 15504 standard and the soon-to-be-published ISO/IEC 330xx series, the SMPA approach can be applicable for process assessments in any discipline that comprises a compliant assessment model.

The SMPA approach is not intended to replace a formal conformity assessment. However it is expected that organisations use this approach when the focus is not on the precision but on a consistent approach to measure process improvements. The SMPA approach can also be used by assessors in a formal appraisal environment as one of the evidence sources to determine process capability and maturity.

Acknowledgements. This work is supported by the Australian Research Council. We thank Mr. Paul Collins, Chief Technology Officer of Assessment Portal Pty Ltd. for his involvement and support in providing the platform to implement the DSS tool.

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