IQM-CMM: A FRAMEWORK FOR ASSESSING ORGANIZATIONAL INFORMATION QUALITY MANAGEMENT CAPABILITY MATURITY

(Research-in-Progress)

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Abstract:
Contemporary organizations are producing and storing more information then ever before in history. The resulting information overload, combined with the lack of quality assurance for information management, has led to a questionable state of information quality in many organizations. Furthermore, assessing, enhancing, and managing information quality has proven to be a notoriously difficult undertaking. This paper presents a capability maturity model approach for information quality management process assessment and improvement. The paper first presents a set of criteria, as identified from extensive literature review and exploratory case studies, which are thought to be of importance when considering a holistic approach for information quality management. The paper then presents the results of a Delphi study, which was used to validate those criteria and organize them into a staged capability maturity model – Information Quality Management Capability Maturity Model (IQM-CMM). The paper finally presents the preliminary results of a case study, where IQM-CMM was applied in a large Australian engineering asset management organization, and used as a comprehensive approach for evaluating their existing information quality management practices. As a result, it is believed that IQM-CMM may help organizations in assessing their existing information quality management practices, and in identifying potential gaps and improvement strategies.

Key Words: Data/Information Quality Management, Capability Maturity Model, Delphi Study, Case Study

INTRODUCTION

Information and Communication Technologies (ICTs) have been evolving at a very fast rate in the relatively recent times. Such a rapid progress has made the production, collection, and storage of information very efficient and inexpensive. Consequently, contemporary organizations are dealing with more information than ever before in history [1]. However, this information overload has among others led to a decrease in the quality of the available information. Information accuracy, completeness, timeliness, relevancy, and so on have proven to be notoriously difficult to assess and manage. Furthermore, even though quality assurance methodologies have played a crucial part in the software engineering and manufacturing industries for decades [2-5], Information Quality (IQ) assurance is only practiced in a minority of contemporary organizations [6]. This is despite the fact that many such organizations hugely depend on quality information for every-day business operations, and even their very survival in today's competitive business environments [7].

This paper contributes to Information Quality Management (IQM) research by presenting a set of factors, and a process for assessing IQM Capability Maturity, as identified from extensive literature review and exploratory case studies, which are thought to be of importance for IQM efforts. Next, the results of a Delphi study, which was used to organize those factors into staged capability maturity levels, are presented. Thus, the resulting Information Quality Management Capability Maturity Model (IQM-CMM) may aid in evaluating organizational IQM practices, and in developing IQM improvement strategies. The paper finally presents the results of a case study, where IQM-CMM was applied in a large Australian engineering asset management organization.

BACKGROUND

Quality management has been an integral component of software engineering and manufacturing industries for decades [2-5]. What's more, quality assurance has been described as being fundamental to organizational success and growth [8, 9]. The Total Quality Management (TQM) movement started with the development of the statistical control charts by Walter Shewhart in 1925 [10]. Since then, many researchers, whom we now call "quality gurus", including Juran [11], Crosby [12], Deming [13], and Ishikawa [14] have contributed enormously to quality management theories. Additionally many other researchers [15-23] have proposed a wide range of Critical Success Factors (CSFs) for TQM implementations. However, the Total Data Quality Management (TDQM) program at MIT has been instrumental in the adaptation of TQM theories to the area of Information Quality [24-26], by drawing the analogy between the manufacture of tangible products and Information Products (IP).

Crosby [12] was the first to propose the idea of quality management maturity. His ideas have since been adapted by IBM [27] and SEI [2, 3] to software engineering, and by several other researchers [28-31] to information management and information quality management. This paper further adapts Crosby's ideas to the development of an Information Quality Management Capability Maturity Model (IQM-CMM). Where most other IQM Maturity Models [28-31] were deductively proposed by researchers, the IQM-CMM presented in this paper was inductively built from exploratory case studies and Delphi surveys, thus combining numerous perspectives from IQ academics and practitioners.

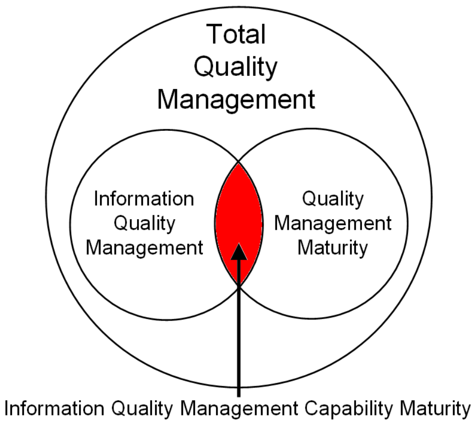

Figure 1 Developed by the Authors

RESEARCH METHODOLOGY

The IQM-CMM was developed in two stages. Stage one identified a range of Information Quality Management (IQM) Capability Maturity indicators, through exploratory case studies and extensive literature review. The maturity indicators were examined from three perspectives: Organizational, Social, and Technological.

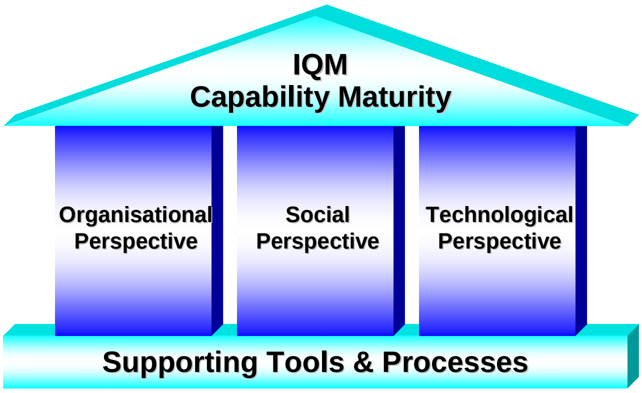

Figure 2 IQM Capability Maturity Framework (developed by the authors)

The Delphi Method

Stage two involved a four round Delphi Study, which was used to validate and group individual maturity indicators into staged levels. A number of additional Maturity Indicators were identified in the Delphi study as well.

The Delphi technique was developed in the 1950s by the Rand Corporation to forecast the impact of technology on warfare [32, 33]. The name itself refers to the Delphi Greek oracle Pythia, who forecasted future events from the temple of Apollo at Delphi [33, 34]. The Delphi method is a useful technique for discovering new issues and moving study participants towards consensus [35-37], and it is used to generate theories and hypotheses rather than to test them [38]. The method employs a series of questionnaires where each successive round summarizes the preceding round [39]. In each successive round participants are asked to re-evaluate their opinions based on the results from the previous round, thus moving towards group consensus [35, 40]. Accordingly, the Delphi technique is a useful method where judgmental information is necessary in order to solve complex problems [40-44]. The final round usually involves distribution of the results, providing an opportunity for the panel members to agree or disagree with the findings [45]. It has also been argued that Delphi provides forecasts that are more accurate than those from unstructured groups [46]. The main aspects of a Delphi study are anonymity, controlled feedback, statistical group response [46, 47], and expert panel selection and composition [43, 48, 49]. Hence, the selections of panelists cannot be random; they have to be selected based on their expert knowledge [50, 51]. Furthermore, panelists from various backgrounds should be selected, so that more holistic results can be obtained [35, 40, 52]. Thus, validity and reliability of results obtained through Delphi studies are attained by obtaining a consensus of expert judgments [53, 54]. Fowles [55] argued that panel sizes should be no less than seven participants, and others argued that panels should contain between 10 and 50 participants [43, 56-59]. Delbecq [35] on the other hand, suggested that there is no set number of panelists required, providing there are enough panelists to facilitate the pooling of judgments. Prendergast [45] argued that increasing the panel size beyond 12 provides little group error reduction.

The first round of the Delphi study was conducted at the 11th International Conference on Information Quality (ICIQ06), which was held at the Massachusetts Institute of Technology (MIT), Cambridge, USA. Study participants included a wide range of world's leading Information Quality (IQ) practitioners and academics. Subsequent rounds were conducted online and additionally included members of the International Association for Information and Data Quality (IAIDQ). The participants were first presented with a set of 45 potential Maturity Indicators, and asked to place each Maturity Indicator into the lowest Capability Maturity Level they thought it should belong to (see the appendix for the questionnaire). Thus, the resulting IQM-CMM should consist of evolutionary (staged) levels, where each subsequent level addresses more advanced IM & IQM practices. Second round was used to build consensus based on the results of the first round. Rounds three and four were used to assess the relative importance of each maturity indicator. Final stage of the research methodology ensured further external validation though the application of the model in a case study.

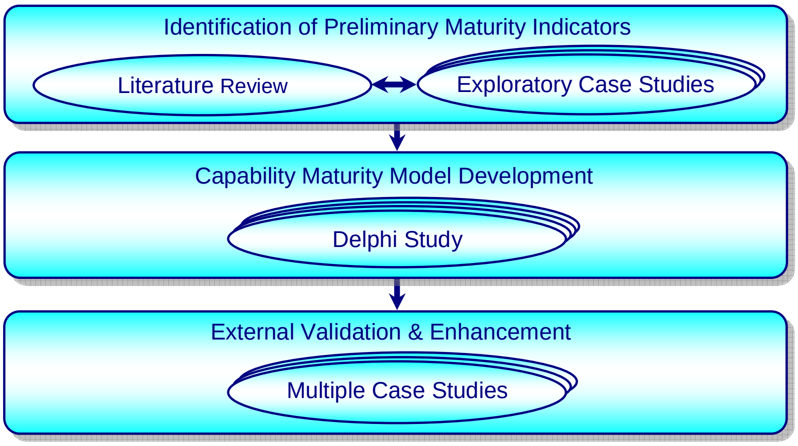

Figure 3 Research Methodology
(developed by the authors)

The Case Study

The resulting model was applied in a large Australian engineering asset management organization in order to assess information quality management practices employed by its Integrated Logistic Support (ILS) department. This paper also illustrates preliminary results of that case study. According to Yin [60] this case study can be classified as being explanatory in nature, since it is used to investigate casual relationships and to test prior theory. Explanatory case studies are characterized by "how and "why" research questions because they investigate the relationships that are proposed between different theory components [61]. Inconsistencies between a preliminary theory and the evidence are accommodated in an explanatory case study design by revising the preliminary theory [62]. Yin [61] defines the scope of a case study as "an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between the phenomenon and the context are not clearly evident" (p. 13). Thus, following recommendations from literature [61, 63], a range of documents were examined, which provided us with great insights into business processes employed by the organization as well as the overall design and use of the information system under investigation. Additionally, about a dozen in-depth interviews were conducted with relevant personnel, including the ILS manager, logistic information systems manager, ILS systems support manager, as well as a number of business analysts and database administrators. Furthermore, personnel were observed while using the information system and the associated databases. The assessment was carried out over a period of about six months.

CONSTRUCTING THE INFORMATION QUALITY MANAGEMENT CAPABILITY MATURITY MODEL

Delphi study results were analyzed using descriptive statistics, including the mean, the standard deviation, the median, and the interquartile range. The mean and median values indicate the preferred Capability Maturity Level for each Maturity Indicator, where 1 indicates the lowest and 5 the highest Information Quality Management Capability Maturity.

Table 1 Partial Summary of the Delphi Study Results, Rounds One and Two (developed by the authors)

	Round 1				Round 2			
Evidence of this "Maturity Indicator" Exists in the Organization	**Mean**	**SD**	**Median**	**IR**	**Mean**	**SD**	**Median**	**IR**
Security Requirements Management	2.58	1.17	3	1	2.95	0.21	3	0
IQM Team & Project Management	3.10	0.81	3	1	2.95	0.38	3	0
IQM Roles & Responsibilities	3.10	1.05	3	1.5	2.77	0.43	3	0
IQ Risk Management & Impact Assessment	3.68	0.94	4	1	3.64	0.73	4	0.75
IQ Metrics and IQ Assessment	3.26	0.93	3	1	2.73	0.63	3	0.75
Redundant Storage Management	2.63	1.06	3	1	2.68	0.48	3	1
Meta-Information Management	3.31	0.88	4	1.5	3.5	0.86	4	1
IQ Root-Cause-Analysis	3.47	0.96	4	1	3.64	0.85	4	1
IQM Cost-Benefit Analysis	3.47	0.90	4	1	3.64	0.73	4	0
Alignment of IQM with ICT and Organizational Strategies	4.05	1.02	4	1.5	3.68	0.72	4	0
IQ Accountability	3.78	0.78	4	1	3.68	0.89	4	0
Information Integration Management	3.10	0.80	3	1	2.77	0.43	3	0
Single Point of Truth (SPOT)	3.42	0.90	4	1	3.59	0.8	4	0.75
Information Quality Rules Management	3.5	0.70	3	0.5	2.73	0.46	3	0.75
Business process reengineering for IQ improvement	4.5	0.70	5	0.5	4.77	0.69	5	0
Dedicated IQ Function Exists	4	1.41	3	0.5	2.82	0.39	3	0
IQ in Corporate Balanced Scorecard	4.5	0.70	5	0.5	4.68	0.89	5	0

Interquartile ranges are commonly used in Delphi studies to indicate the degree of group consensus. When using a 5-point Likert scale, responses with a quartile deviation less than or equal to 0.6 can be deemed high consensus, those greater than 0.6 and less than or equal to 1.0 can be deemed moderate consensus, and those greater than 1.0 should be deemed low consensus [64, 65].

The Delphi study results (including qualitative comments provided by the participants) were then further analyzed to identify the most important aspects of each capability maturity level. Individual capability maturity indicators were grouped into categories which led to emerging themes of each level. The resulting Information Quality Management Capability Maturity Model is shown below.

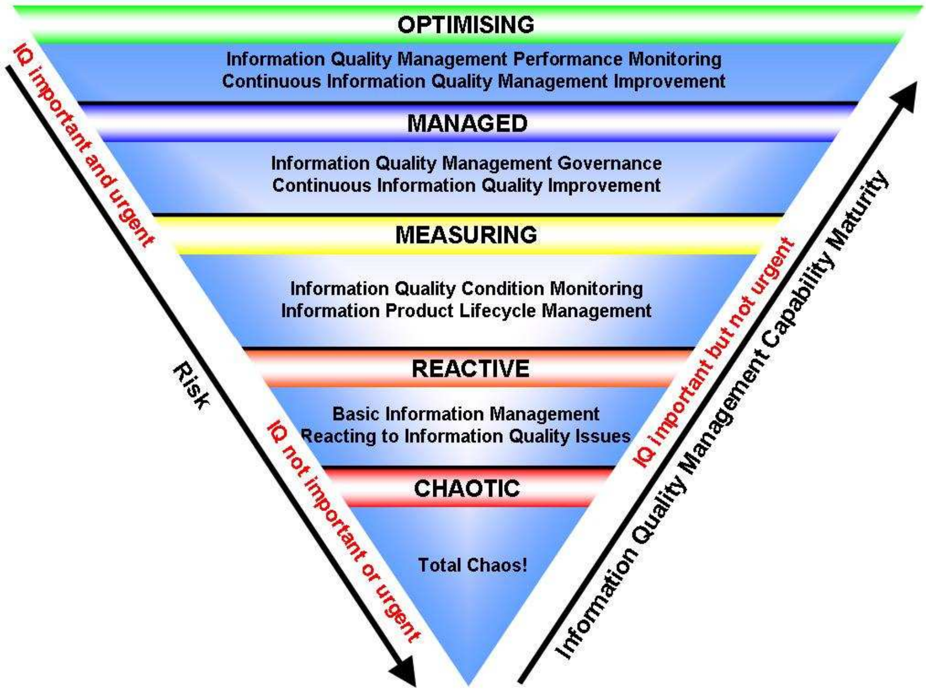

Figure 4 Information Quality Management Capability Maturity Model (developed by the authors)

Next, two more Delphi rounds, which investigated the relative significance of each maturity indicator were conducted. The participants were asked to rate the impact of each maturity indicator on the level that it was allocated to, where 1 indicates the lowest and 5 the highest impact. Partial summary of the results is shown in the table below. It indicates that the majority of maturity indicators identified have been deemed important to IQM efforts.

Table 2 Partial Summary of the Delphi Study Results, Rounds Three and Four (developed by the authors)

Evidence of this "Maturity Indicator" Exists in the Organization	Round 3				Round 4			
	Mean	SD	Median	IR	Mean	SD	Median	IR
Security Requirements Management	3.56	1.2	4	1	3.93	0.46	4	0
IQM Team & Project Management	3.78	1.11	4	2	4	0.53	4	0
IQM Roles & Responsibilities	2.44	1.42	2.5	2	3.33	0.62	3	0.5
IQ Risk Management & Impact Assessment	2.83	0.99	3	1.75	3.47	0.52	3	1
IQ Metrics and IQ Assessment	3.56	1.15	3.5	1.75	4	0.38	4	0
Redundant Storage Management	3.61	1.29	4	2.5	4	0.53	4	0
Meta-Information Management	3.83	0.62	4	0.75	4.13	0.35	4	0
IQ Root-Cause-Analysis	2.67	1.28	2	1.75	2.67	0.72	3	1
IQM Cost-Benefit Analysis	3.22	0.88	3	1	2.93	0.59	3	0
Alignment of IQM with ICT and Organizational Strategies	4.06	0.73	4	0	4	0.53	4	0
IQ Accountability	3.44	1.04	4	1	3.73	0.46	4	0.5
Information Integration Management	3.44	1.2	4	1	4.27	0.46	4	0.5

Single Point of Truth (SPOT)	3.72	1.13	4	2	4.47	0.52	4	1
Information Quality Rules Management	3.33	1.5	4	2.75	3.93	0.46	4	0
Business process reengineering for IQ improvement	3.72	0.75	4	1	4.2	0.41	4	0
Dedicated IQ Function Exists	3.5	1.15	3	1.75	3.47	0.74	3	1
IQ in Corporate Balanced Scorecard	4.28	1.02	5	1.75	4.73	0.46	5	0.5

INFORMATION (QUALITY) MANAGEMENT CAPABILITY MATURITY ASSESSMENT: A CASE STUDY

The Information Quality Management Capability Maturity Model (IQM-CMM) comprises of five staged levels, which represent an evolutionary path of increasingly structured and methodically more mature information quality management processes. Each level is dependent on a number of Maturity Indicators, which in turn depend on a number of criteria. The complete IQM-CMM includes 50+ criteria, and the assessment instrument employs approximately five appraisal measures per criteria, thus resulting in approximately 250 appraisal measures.

Contemporary engineering asset management organizations are managing vast quantities of exceedingly diverse data in their information systems. Asset design data, maintenance procedures and records, condition/performance data, and so on, all need to be efficiently managed in order to obtain the lowest possible asset lifecycle cost. Consequently, managing asset information efficiently, and utilizing information of high quality, is paramount to engineering asset management efforts. Nevertheless, many such organizations still struggle to assess their information quality management practices, and thus also find it difficult to develop potential improvement strategies. As a result, the IQM-CMM was applied in a large Australian engineering asset management organization for the purpose of evaluating their existing information quality management practices.

Organizational Background

XYZ was the principal contractor for the design, and construction of several large and complex engineering assets. XYZ has also been awarded a multi-billion dollar contract for the through-life support of those assets initially over 15 years, with the responsibility for the design, maintenance and enhancement until the end of their operational lives. XYZ’s Integrated Logistic Support (ILS) Department manages and controls the integrated logistic support activities for these assets. A simplified XYZ-ILS department structure is shown in the figure below.

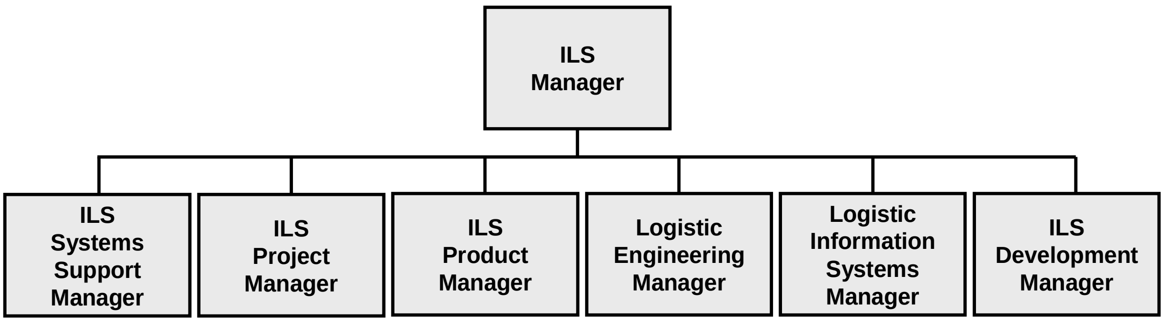

Figure 5 XYZ-ILS (simplified department structure), developed by the authors

XYZ-ILS mainly deals with two types of asset data: design data (e.g. design specifications and reports which represent various base lines), and logistic data (e.g. maintenance procedures, technical manuals and provisioning technical documentation). XYZ-ILS maintains three major computer systems. System A contains all the data and technical documentation required to support the operation and maintenance of the assets. It was developed by XYZ in the early 1990s and it provides a management capability for the logistic support, including configuration management, maintenance management, documentation management, safety management, and so on. System A was originally developed by XYZ for the purpose of supporting the build of the assets, and it then evolved into supporting through-life-support (i.e. ILS) activities. Thus, the system has been evolving over the years and now has a web-enabled user interface. It includes a very large database, which contains approximately 220 technical manuals, 25000 maintenance procedures, and 500000 hyperlinks. System A interfaces with System B to receive a range of ILS information products. The main functions of System B are management of the Logistic Configuration Baseline (LCB), maintenance analyses, supply support, and documentation and training requirements. Thus, System B is used to develop required ILS products, including creation of maintenance procedures from source data from various vendors and suppliers, or conversion of source data into a consistent format for use within System A. As a result, all ILS Information Products used in System A were originally developed in System B. Furthermore, System B ensures configuration management and validation against the LCB of all ILS information products. System C is used to store and process data relating to system and equipment failure analysis and system reliability and availability analysis.

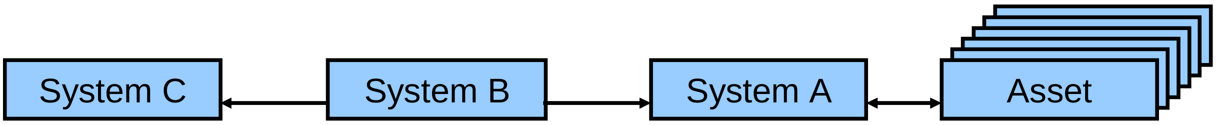

Figure 6 Simplified representation of XYZ-ILS information system (developed by the authors)

Assessment Method

Given the fact that the IQM-CMM comprises of more than 50 criteria, only a partial assessment summary is presented in this paper, illustrating partial evaluation of six Maturity Indicator Criteria: Information Profiling & Enrichment, IQ Metrics & IQ Assessment, Redundant Storage Management, Backup & Recovery, Authentication, and Audit Trail. Three quality ratings for each appraisal measure were used: not-satisfied, partially-satisfied, and fully-satisfied.

Table 3 Quality Ratings (developed by the authors)

Rating	Description
not-satisfied	There is no documentation and there is limited or no evidence to confirm the implementation.
partially-satisfied	Some documentation exists, however there is inconsistent implementation through ad-hoc processes.
fully-satisfied	Entirely documented, consistently implemented, effective and efficient, with above expectations results, utilizing industry best practices.

Table 4 Partial IQM-CMM Assessment Summary (developed by the authors)

Capability Maturity Level	Maturity Indicators	Criteria	Appraisal Measures	Rating not-satisfied, partially-satisfied, fully-satisfied
Level 3 MEASURING	IQM Roles & Responsibilities	Information Profiling & Enrichment	Evidence of the following exists in the Information Quality Management Policy (or equivalent):	
			Data cleansing tools are used for pattern verification.	fully-satisfied
			Incomplete information is identified and enriched from external sources.	fully-satisfied
		IQ Metrics & IQ Assessment	IQ metrics, for relevant IQ dimensions, have been developed and documented.	partially-satisfied
			Surveys are used to assess information consumers' subjective perceptions of IQ.	partially-satisfied
			Statistical valid samples of information are being assessed based on the IQ metrics.	partially-satisfied
			The quality of information products is assessed by aggregating individual IQ values.	partially-satisfied
			Assessments of IQ based on business rule violations.	fully-satisfied
Level 2 REACTIVE	Storage Management	Redundant Storage Management	Evidence of the following exists in the Information Storage Policy (or equivalent):	
			Requirements for replication of information have been identified and documented.	fully-satisfied
			The information that is replicated has been clearly identified and documented.	fully-satisfied
			Synchronisation frequency and schedule have been documented.	fully-satisfied
			Processes are in place to identify and resolve any update anomalies.	fully-satisfied
		Backup & Recovery	Critical information is being backed-up at regular intervals.	fully-satisfied
			Backups are stored off-site.	fully-satisfied
			Physical security of the backups is appropriately maintained.	fully-satisfied
			Backups are periodically restored to a test machine.	fully-satisfied
			Backups are appropriately labelled (e.g. date of backup, sensitivity level, etc.).	fully-satisfied
			Backups are encrypted whenever possible.	fully-satisfied
	Access Control Management	Authentication	Evidence of the following exists in the Access Control Policy (or equivalent):	
			User account management.	fully-satisfied
			Information System verifies the identity of every user.	fully-satisfied
			Session time out (users are logged off) after a certain period of inactivity.	fully-satisfied
			User accounts are being regularly reviewed.	fully-satisfied
		Audit Trail	Users' activities are being chronologically recorded/logged.	fully-satisfied
			Audit trail logs are being regularly analysed.	fully-satisfied

Preliminary Appraisal Results

The preliminary results indicate quite a high level of information quality management capability maturity, finding clear evidence of well documented and meticulously implemented information management processes, thus placing XYZ-ILS on IQM-CMM Level 4 (MANAGED).

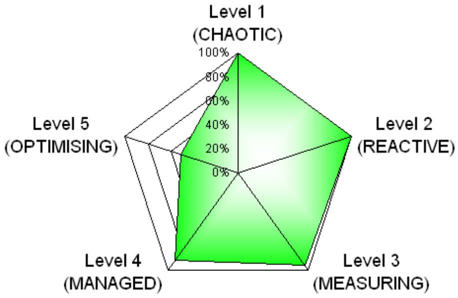

Figure 7: IQM-CMM Appraisal Results (developed by the authors)

Level 2 (REACTIVE), covering Information Needs Analysis, Storage Management, Access Control Management, and Security Management, was fully satisfied.

Level 3 (MEASURING), covering Information Product Management, Information Quality Needs Analysis, Information Quality Assessments, and Information Quality Management Roles and Responsibilities was largely satisfied. Processes for reviewing, analyzing and updating logistic, maintenance and product data, and for publishing of approved changes within the system, were found to be in place. The only area identified for potential improvement was Information Quality Metrics. Accordingly, it may be beneficial for XYZ to explicitly define qualitative and/or quantitative IQ-KPIs, along with explicit measurement procedures and target values. For instance, one simple metric could be the number of information quality related problem reports per month. Such metrics could then be tracked over time and used as a basis for quality improvements.

Level 4 (MANAGED), covering Information Quality Management Governance, Information Architecture Management, and Continuous Information Quality Improvement was largely satisfied as well. Identified areas for potential improvement were Information Quality Benchmarking and Information Quality Firewall. Accordingly, it may be beneficial for XYZ-ILS to benchmark its state of IQ against other departments. Furthermore, an opportunity may exist to implement advanced Information Quality Firewall functionality, which may be used to provide proactive and real-time IQ checking. Such functionality could be used to dynamically generate IQ rules by analyzing historical information in real-time.

Level 5 (OPTIMISING), covering Information Quality Management Performance Monitoring and Optimization was partially satisfied. Information Quality Management Performance Monitoring was identified as an area for potential improvement. Accordingly, it may be beneficial for XYZ to explicitly define qualitative and/or quantitative IQM-KPIs, along with explicit measurement procedures and target values. For instance, one simple metric could be the average time taken to resolve information quality related problem reports. Such metrics could then be tracked over time and used as a basis for IQM improvements. Furthermore, Statistical Process Control (SPC) may be employed to monitor IQM processes through the use of control charts. Consequently, any variations in IQM processes could be detected and corrected. Additionally, it may be beneficial to investigate how other XYZ departments perform IQM and benchmark against their practices.

CONCLUSION

This paper has identified a large number of success factors for Information Quality Management, and organized them into staged Capability Maturity Levels, thus constructing the Information Quality Management Capability Maturity Model (IQM-CMM). The research is moving towards developing a complete Capability Maturity framework for IQM, and associated assessment tools, to enable organizations to assess their own readiness and maturity in IQM. Thus, the resulting model may be of assistance to organizations who may wish to assess and/or enhance their existing IQM capability maturity. Given the fact that IQM-CMM aims to present “best practice” approaches as identified by subject matter experts, it may be used as a tool for gap-analysis and strategic planning. It should be noted, however, that not all organizations may wish to reach Level 5, since associated process costs may indeed exceed any benefits gained from improvements in IQ. Therefore, it is important to first identify IQ related business risks and benefits before proceeding with any IQM program.

Contemporary Engineering Asset Management Organisations (EAMOs) are dealing with more information than ever before. Consequently, assessing and ensuring information quality has become a major concern. This paper has also demonstrated preliminary results of a case study, where the IQM-CMM assessment instrument was applied to evaluate IM and IQM practices employed in a large Australian EAMO. The complete IQM-CMM assessment addresses more than 50 criteria with over 250 appraisal measures, covering a wide range of IM and IQM practices. The preliminary results of the case study indicate quite a high level of IQM Capability Maturity in the organization under investigation. There was clear evidence of very well documented and meticulously implemented IM processes; however, some IQM processes were implemented in an implicit manner.

FUTURE RESEARCH

IQM-CMM is currently being further modified/enhanced based on the case study results. Additional case studies are planned, which will contribute towards further external validation and enhancements.

ACKNOWLEDGEMENTS

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APPENDIX: INFORMATION QUALITY MANAGEMENT CAPABILITY MATURITY QUESTIONNAIRE (DELPHI - ROUND 1)

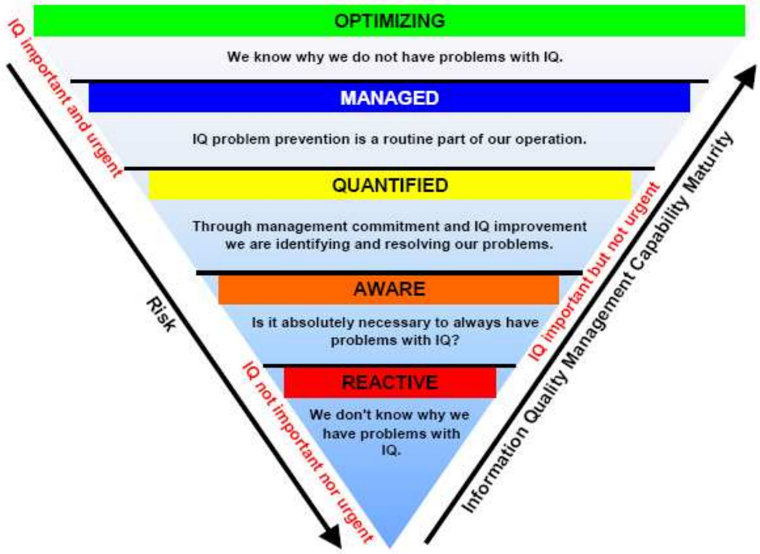
Information Quality Management Capability Maturity Questionnaire (Session 6B)

(Please direct any comments to: sasa.baskarada@unisa.edu.au)

Dear Colleague,

By completing this questionnaire, you are making a valuable contribution my PhD research. We sincerely appreciate your expert input and thank you for sharing your experiences and thoughts. This questionnaire should only take approximately 10 minutes to complete.

This doctoral research project aims to develop an Information Quality Management Capability Maturity Model. The model comprises five Maturity Levels that represent an evolutionary path of increasingly structured and methodically more mature IM & IQM processes. The Maturity Levels shown on the right have been adopted from Crosby's Quality Maturity Grid. Please provide any additional comments for each Level in the table below, and suggest any potentially more suitable names on the dotted lines. Furthermore, a list of "Maturity Indicators" is provided at the back of this page. For each "Maturity Indicator" please tick the "lowest" Maturity Level, in which you believe it should be present. For example, by ticking "QUANTIFIED", you are saying that the "Maturity Indicator" is only present in levels "QUANTIFIED" and above. Please also include any other "Maturity Indicators" you believe should be considered.



Maturity Level Please suggest any potentially more suitable names	Please provide any additional comments for each Capability Maturity Level
Level 5: OPTIMIZING (..............................)	
Level 4: MANAGED (..............................)	
Level 3: QUANTIFIED (..............................)	
Level 2: AWARE (..............................)	
Level 1: REACTIVE (..............................)	

We would be most grateful if you provided your name and email address so that you can help us further develop and validate this model through a Delphi study. **In return for your cooperation we will provide you with the final results of the study!**

Name: ______________________ **email:** ______________________

PLEASE TURN PAGE OVER

For each "Maturity Indicator", please tick the lowest Maturity Level in which you believe it should be present.

#	Evidence of this "Maturity Indicator" exists in the organization	REACTIVE	AWARE	QUANTIFIED	MANAGED	OPTIMIZING
1	Conceptual Data Modeling (concepts & relationships)					
2	Logical Data Modeling (attributes, primary/foreign keys, normalization)					
3	Physical Data Modeling (implementation in a DBMS, any physical considerations)					
4	Templates for presentation of Information Products					
5	Information Product Classification (e.g. public, restricted, confidential)					
6	Information System Stakeholder Identification					
7	IM Roles and Responsibilities					
8	Information Stewardship and Ownership					
9	DBMS Constraints (business rules, referential constraints, etc.)					
10	Information storage and archival procedures					
11	Specification of Derived Information Products					
12	Security Requirements (for receipt, processing, storage & output)					
13	IQM Team & Project Management					
14	IQ Requirements Specification					
15	IQM Policies					
16	IQM Education, Training & Mentoring					
17	IQ is Everyone's Responsibility!					
18	IQM Roles & Responsibilities					
19	(Offsite) Backup of any critical Information					
20	Secure transmission of any classified information					
21	Access Control for input/access/edits					
22	Procedures for correction and resubmission of erroneously entered information					
23	Scripted (SQL Based) Data Cleansing					
24	Information Product Configuration Management					
25	Disposal Management (of sensitive information)					
26	IQM Procedures based on industry best practices have been defined and are used					
27	IQ Risk Management & Impact Assessment					
28	IQ Metrics and IQ Assessment					
29	Redundant Storage Management (some information may need to be stored redundantly)					
30	Meta-Information Management					
31	Real-Time Information Capture (information is entered only once; no manual copying)					
32	Erroneous transactions are identified dynamically without being processed					
33	Information Profiling					
34	Information Enhancement (from external sources)					
35	Enterprise Architecture has been developed and documented					
36	Procedures for critical review, identification and handling of errors contained in the output					
37	An overall IQM plan, which promotes Continuous Improvement, is in place					
38	IQ Root-Cause-Analysis					
39	IQM Cost-Benefit Analysis					
40	IQM alignment with ICT and organizational strategies					
41	IQ Accountability					
42	Information Integration Management					
43	Single Point of Truth (Data Warehousing)					
44	Audit Trail (information creation/access/edits are logged)					
45	Extract Transform Load (ETL)					
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Please suggest any additional "Maturity Indicators" in the blank lines above.

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