

DEVELOPMENT OF A SYSTEMATIC MODEL FOR IMPROVING SOFTWARE QUALITY IN THE FINANCIAL SERVICE ORGANIZATION

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Abstract:

In the growth of global digital economy, the dynamic widespread of new business is emerging across a wide range of industries. A revolution of technological transformation is directly influencing the highly regulated financial services industry, financial leaders are under very high pressure for the complex technologies and aggressive time to market to meet their customer demands and regulatory changes during the regulatory modernisation of innovative financial technology which requires high quality of software delivery. This paper proposes a new quality management model to improve quality delivery of software through a set of practical assessment criteria from a conceptual quality management model to address quality performance problems which is derived by referencing software quality models and expertise from industry-academia professional through integrating knowledge management principles and software engineering disciplines, and then leveraging Total Quality Management philosophy from the latest European Foundation for Quality Management (EFQM) Excellence Model. The proposed model can be implemented structurally by using self-assessing evaluation criteria based on the fundamental concepts and derived assessment criteria. Hence, a holistic view for strengthening engineering management of software delivery can be established and used to prioritise and determine the right actions to drive sustainable continuous improvement of software quality in order to achieve excellence of software delivery in the regulated financial service organization.

Keywords: *software engineering, regulatory, quality management, knowledge management, finance*

1. INTRODUCTION

Global digital economy has been raised up from 15% in 2005 to 22% of the world's economy in 2015 and forecasted to be 25% in 2020 (Daugherty, Carrel-Billiard, & Biltz, 2016). Technological advancements foster the rapid growth of digital economy particularly emerging technologies in information and communication. Enhancing business processes using digital technology is capable of transforming the ways in which companies operate electronic-business, also known as, e-business, using digital technology to perform business processes (Vos, 2015). Software is the core element in digital world of technologies (Plummer, 2014) that animates business objectives through the structural quality of business applications for achieving important business outcome (Jones & Bonsignour, 2012). In fact, software engineering is used to design and develop high-quality software in a systematic, controlled and efficient manner by adopting engineering discipline for solving business problem (Marsic, 2012), which is heavily knowledge-intensive work thus knowledge management plays a comprehensive role in software engineering to improve software quality performance by integrating knowledge-based techniques with software quality management (Edbert, 1997; Baltus, 2001; Mehrez, 2005; Edwards, 2003). Technology, government regulation and customer expectations are forcing the change of financial services industry rapidly. Additionally, financial digital leaders are under very high pressure to deal with risks and challenges for the compliance of regulatory requirements during digital transformation, so it is very crucial to establish a systematic assurance framework in all projects covering new applications, application programming interface (API) and digital-enabled services to manage software quality holistically against industry-wise software engineering discipline as well as regulatory compliance as a whole in digital banking industry (Furlonger, D'Orazio, & Hunter, 2015). Software industry has not realised the importance of public confidence in our global financial ecosystem through assessing and achieving financial software quality to avoid numerous system failures and prevent service outages for millions of users and economic losses by making optimal business investment decisions. Therefore, this paper proposes a systematic approach by leveraging Total Quality Management (TQM) philosophy of excellence in business from the latest non-prescriptive European Foundation for Quality Management (EFQM) Excellence Model and integrating software engineering principles and knowledge management practices through Delphi-AHP technique with support from industrial professionals to formulate a set of practical assessment criteria for assessing its current level of excellence in software delivery internally based on the prescribed practical assessment criteria to improve software quality and drive sustainable continuous improvement of software delivery for regulated financial service organisations.

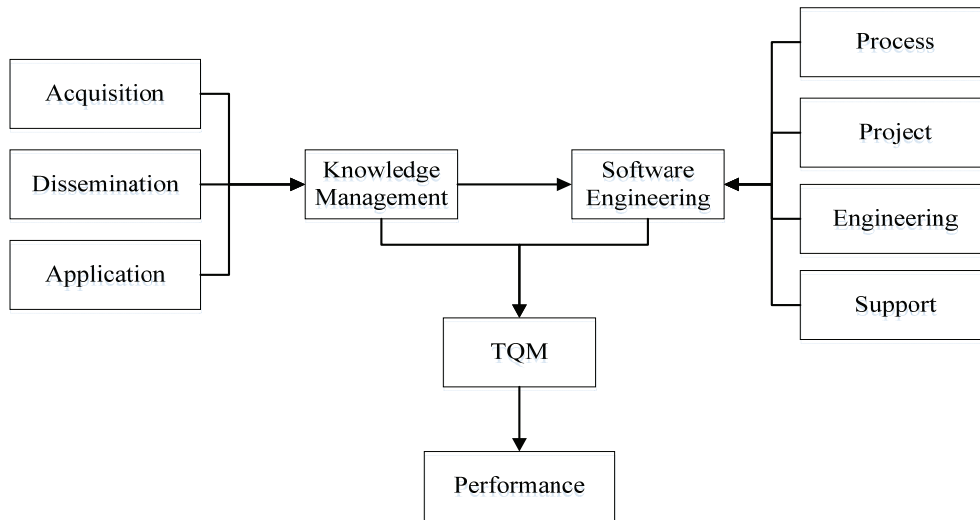
2. MODEL DEVELOPMENT

Throughout the literature review and interviews with industrial professionals, the core quality performance characteristics in software delivery for financial service are inherited from Al-Qutaish (2010) software product quality models of McCall, Boehm, FURPS, Dromey, ISO-9126 with the latest models of ISO-25010 and CISQ are analysed so that the key performance characteristics of software quality for financial service industry are identified including reliability, efficiency and regulatory compliance. Then, root causes analysis of those key software quality performance problem is conducted to track down the top issues and to identify relevant potential causes for ensuring mutual understanding within a financial service organisation. Firstly by referencing the three aspects of software quality according to the finding from Chappell (2012), the functional quality can be induced from process quality as the fundamental principle of quality performance in software quality engineering especially those knowledge assets are directly related process quality to support the repeatable development process as emphasised by Jones & Bonsignour (2012) and also mentioned by Chappell (2012). Secondly, in order to support standards and practices through the repeatable development process to ensure software performance, software organization should have better understanding of industrial software process quality models and then leverage their organizational software engineering knowledge, management of knowledge in particular of knowledge asset has become considerable interest as important drivers for business and management for ensuring organisational survival and competitive strength due to shorter time-to-market, better productivity and even better quality. Thus, a Knowledge-Based Software Quality Engineering strategy can help to address software quality issues (Virvou & Matsuura, 2012). Besides, Total Quality Management (TQM) can integrate many approaches to address software quality problems (Carroll, 1995); TQM and KM also contribute significantly for organizational performance (Ooi, 2009)

resulting for internal benchmarking and external performance comparison for continuous performance improvements (Yiu & Sankat, 2008).

Figure 1 illustrates the integrating multiple models approach of integrating software engineering and knowledge engineering.

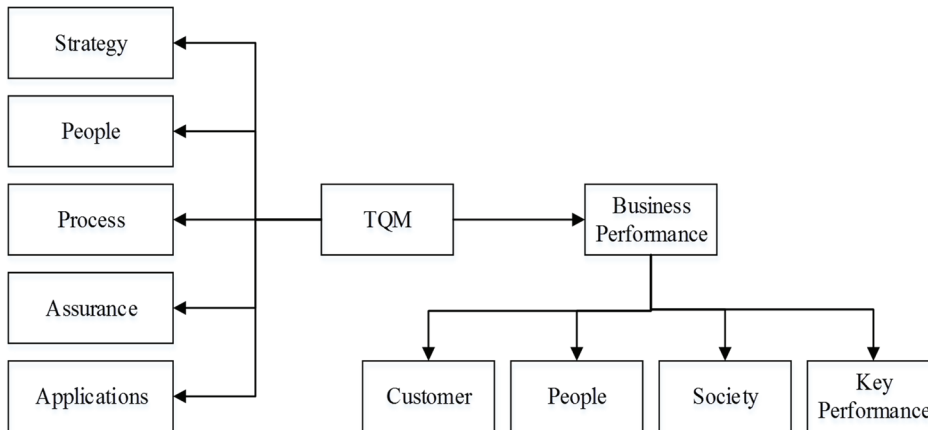
Figure 1: Integrating multiple models



Consequently, the uniqueness of conceptual model is established to tackle the challenges by leveraging Total Quality Management (TQM) philosophy of excellence in business from the latest non-prescriptive European Foundation for Quality Management (EFQM) Excellence Model as the proxy of TQM and then integrating software engineering principles and knowledge management practices through Delphi-AHP technique with support from industrial professionals to formulate a set of practical assessment criteria. The conceptual model comprises nine criteria and is divided into two parts including “Enablers” and “Results”. Enablers focus on how the organisation is executed and operated, and Results focus on what the expected outcome to be measured and achieved against the targeted organisational objectives. So that customer results, people results and society results are achieved through five “Enablers” criteria covering strategy, people, processes, assurance and application that lead to excellence in key results in total of four “Results” criteria as illustrated in

Figure 2.

Figure 2: Conceptual integrated software excellence model



2.1 Fundamental Principle of Model

EFQM has been recognized as a generic non-prescriptive model in promoting sustainable quality improvement for any kind of organization regardless of size, industry sector or maturity; it does not specifically cover the software delivery aspects. Those essential defined concept for each elements are constituted to the fundamental concepts of excellence for EFQM that could be leveraged by adding to those aggregated elements into this proposed model.

The eight derived fundamental concepts of excellence are:

- (1) **Adding Value for Customers**
Excellence organisations have substantiated behavioural competency in customer service orientation to view situations from customer's perspective and explore the opportunities of managing delivery of service offering along with regulatory changes to fulfil business needs and customer expectations.
- (2) **Creating a Sustainable Future**
Excellence organisations have achieved sustainability by enhancing performance capability and embedding ethical culture through guiding principle to deliver economic business value service with social responsibilities in meeting regulations.
- (3) **Developing Organisational Capability**
Excellence organisations have effective engineering management processes and knowledge engineering practices as the critical driver to enhance innovative capacity of organisations constantly in order to ensure sustainable strategic competitive advantage and business conduct in the marketplace.
- (4) **Harnessing Creativity & Innovation**
Excellence organisations encourage nurturing of creativity and innovation culture through a systematic engineering management processes and knowledge engineering approach within the organisation constructively.
- (5) **Leading with Vision, Inspiration & Integrity**
Excellence organizations have strong leadership as role model to create vision and reinforce the commitment to inspire real trust, performance value and ethics to shape the organization's future direction.
- (6) **Managing with Agility**
Excellence organizations have established structural governance, effective risk management processes and proactive compliance assurance focus promoting sustained wellbeing and agility for the organisation.
- (7) **Succeeding through the Talent of People**

Excellence organizations build an employee appreciation culture to encourage collaboration mutual respectfully and empowerment for achieving professional success by sharing experience and expertise with employees to build confidence, domain knowledge and skills.

(8) Sustaining Outstanding Results

Excellence organisations achieve sustain performance by planning and achieving a balanced set of results to satisfy regulations and create outstanding value to all stakeholders.

2.2 Assessment Criteria of Financial Software Excellence Enablers

Strategy

a. Strategy to drive software excellence with supporting polices are developed, reviewed and maintained against organizational guiding principle, business and stakeholders needs and comply with regulatory objectives

- Formalizing and maintaining strategy for software delivery to align organization's policies, business strategy, regulations and meet stakeholder's needs and expectations
- Establishing and implementing communication strategy for driving software excellence
- Identifying and analysing the policies, quality strategies, engineering management processes and knowledge engineering discipline to establish and maintain traceable good practices to provide assistance and guideline for the implementation and refinement of software excellence

b. Management commitment and governance to support the development, implementation and continuous improvement of software excellence

- Demonstrating management commitment in supporting and promoting the culture of excellence and continuous improvement thereby encouraging feedback from all stakeholders
- Defining governance structures (levels, functions, responsibilities and competencies) and ensuring a system for managing processes in accordance with strategy, planning and needs and expectations of stakeholders.
- Identifying and ensuring clear roles and responsibilities to drive and support the culture of software excellence
- Developing a management information system with measurable targets for balancing the stakeholders' needs and input from the risk management and internal control function to track and monitor the organisation's achievement of strategic and operational goals (e.g. Balanced Scorecard)

People

a. People resources for establishing and supporting software excellence

- Identifying and continuously maintaining roles and responsibilities required for drive and support the culture of software excellence
- Managing recruitment; career development and succession plan for people working in management of software delivery
- Using people surveys and other channels of staff feedback to improve people strategies, polices and plans

b. People awareness for supporting and improving software excellence

- Eliciting the communication needs, establishing appropriate strategies and communicating to the stakeholders
- Enabling the knowledge sharing, skills and competencies and people performance levels required to establish, operate and monitor software excellence

c. People involvement and empowerment

- Encouraging and supporting individual and team participation to manage and control quality to reach excellence continuously in software delivery
- Conducting training and workshops to develop and strengthen people's knowledge and competencies for managing software delivery
- Identifying and creating a culture to report current issues and problems, and leverage experiences and innovation of best practices for software delivery

Process

a. Software delivery processes are systematically designed and developed

- Designing, analysing, mapping and documenting processes on a regular basis to induce engineering management practices according to the changes in business needs and regulatory requirements
- Defining and conducting training to strengthen engineering management processes and knowledge engineering practices in managing software delivery and conducting the processes according the standards and guidelines
- Ensuring the development, alignment and measurement of processes and knowledge management practices for driving software excellence

b. Software delivery processes are refined, implemented, assured and improved

- Identifying and engaging stakeholders to refine and implement processes and knowledge management practices to drive and improve quality of software delivery and comply with regulations
- Monitoring and reviewing the experiences and perceptions of stakeholders and ensure processes are aligned to respond appropriately to any feedback

Assurance

a. Performance impact of software delivery is identified and related measurement are defined

- Identifying quality dimensions for software delivery according to business needs and priorities and regulatory expectations
- Specifying performance metrics of engineering processes and knowledge engineering maturity for the quality of software delivery
- Defining performance indicators including thresholds and targets for the quality of software delivery
- Defining maintenance of good practices and processes and responsibilities for the measurement of software delivery

b. Quality of software delivery is monitored, controlled and improved

- Developing, implementing and improving methods and measurement for the transformation of software delivery
- Monitoring and analysing the threshold values and trends of performance indicators and initiating transformation programmes to drive continuous improvement of software delivery

Application

a. Institutionalizing software excellence is established, assessed and continuously improved

- Monitoring and evaluating processes and practices risks and critical success factors to support and achieve the strategic goals and objectives of the organisation
- Defining and updating priorities for transformation or activities that are aligned with the business strategy and cost-benefit analyses
- Identifying critical path of key activities to drive the success of transformation

b. Roadmap to implement software excellence model is managed and improved to support continuous improvement

- Developing a stakeholders' analysis, defining their major actual and future needs, and sharing these findings with the organisation
- Implementing transformation according to the assessment process and guidelines

c. Action plan for closing the gap between as-is and to-be is planned, managed and continuously improved

- Developing and implementing improvement actions
- Monitoring and controlling the actions for improvement
- Conducting assessment to re-assess the results upon completion of improvement actions

2.3 Assessment Criteria of Financial Software Excellence Results

Customer Results

a. Perceptions – measures of customers' perceptions of software excellence model regarding software delivery quality

Measures could include:

- International customer satisfaction regarding the software excellence model
- Products and Services (ie. Reliability, compliance with quality standards)

b. Performance Indicators – internal measures for the organization to monitor, understand, predict customer's perceptions and to improve performance of software delivery to internal customers against baselined performance and recalibrate any services accordingly

Measures could include:

- Number of reported incidents related to software delivery
- Number of projects adopted software excellence model
- Number of change requests to the systems adopted software excellence model
- Number of internal customer dissatisfaction or complaints caused by software delivery

People Results

a. Perceptions – measures of staff's perceptions of software excellence model regarding software delivery quality

Measures could include:

- Staff satisfaction
- Commitment to knowledge sharing (ie. Involvement in development of best practices and community of practices)

b. Performance Indicators – internal measures for the organization to monitor, understand, predict staff's perceptions, improve performance of software delivery against baselined performance and recalibrate any services accordingly

Measures could include:

- Number of staff involved in software excellence model
- Number of training and workshops hosted
- Number of improvement ideas captured

Society Results

a. Perceptions – measures of community's perceptions of software excellence model regarding software delivery quality

Measures could include:

- Fulfilment of regulatory compliance
- Reduction of compliance risk
- Relationships with relevant authorities, group and networks
- Involvement in the industry advisory board with others

b. Performance Indicators - internal measures for the organization to monitor, understand, predict community perceptions, improve performance of software delivery against baselined performance and recalibrate any services accordingly

Measures could include:

- Number of non-complaints during software assurance audits

Key Results

a. Perceptions – these key results demonstrate the success of the deployment of software excellence model regarding software delivery quality

Measures could include:

- Time-to-Market for profitable growth
- Compliance to regulatory requirements

b. Performance Indicators – operational performance measures used to monitor, understand, predict and improve likely key performance outcomes

Measures could include:

- Improve service reliability
- Improve process efficiency and maturity
- Reduced compliance risk to regulation
- Reduced costs caused by software quality
- Reduced time and costs for activities during software development lifecycle

2.4 Scoring mechanism

Regulated financial service organizations are moving toward integrated quality management systems into one single framework with respect to five criteria for enablement and four criteria for results achievement to encourage TQM philosophy of continuous improvement for IT to develop new pragmatic quality management model to drive quality delivery in software excellence for facing the dynamic changes and challenges in financial service industry. There is a configurable weighting for each of criterion of the model that can be used for scoring and assessing performance and even benchmarking within an organisation in order to be progressively towards achieving excellence. The scoring mechanism for assessing the results is basically referring to EFQM Excellence Model RADAR logic without any changes to ensure the consistency with generic model of tools and methodologies are still applicable to the framework by selecting the appropriate rating of five results characteristics.

Assessing the Enablers

- 0% Examples available but not structured (ad-hoc)
 - No clear approach or process defined, but some examples
- 20% Approach defined and initial deployment complete
 - Evidence to show the planned approach established and just start implemented
- 40% Evidence of approach and / or deployment being measured and reviewed
 - Evidence to show the approach implemented and controlled by measuring and reviewing the performance

- 60% Evidence of approach being embedded and / or deployment being improved over time
 - Evidence to show the approach reviewed and refined with quantifiable benefits
- 80% Clear evidence of external benchmarking being used to further refine the approach
 - Evidence to show the approach baselined for benchmarking to drive continuous improvements
- 100% Clear evidence that approach is "best in class"
 - Evidence to show the approach benchmarked the industry best-in-class

Assessing the Results

The scoring for the "Results" should be assessed by selecting the appropriate rating from the drop-down list of the "Results RADAR" sheet against RADAR logic regarding the scope, integrity, segmentation, trends, targets, comparisons, causes

- No results / anecdotal (0%)
- About 1/4 of result areas (25%)
- About 1/2 of result areas (50%)
- About 3/4 of result areas (75%)
- All result areas (100%)

Furthermore, it is strongly recommended to assess the rating based on the factual evidence related to all areas, otherwise the assessor should go for the rating one level below and then capture the improvement required in order for achieving the next level for continuous learning and improvement. Therefore, using the assessment instrument that can provide a systematic way to support software engineers with a better guidance in a structural way to identify the gaps and then manage their process and govern their delivery through assurance to drive improvement activities in related to quality aspects for software in financial service industry organizations.

3. CONCLUSIONS

This paper tries to show how the proposed model as the proxy of TQM with its derived assessment criteria from the synergy of integrating software engineering disciplines and knowledge management practices is developed with configurable scoring mechanism for self-assessing performance and even benchmarking for improving quality performance of software delivery in particular for the regulated financial service organization so that time-to-market, production incident and compliance risk are reduced. More important, the developed model in this work represents a significant advance over the generic excellence model by providing a systematic of compliance-oriented approach to support the prioritisation of improvement opportunities, determine right decision and take prompt action progressively towards achieving excellence of software delivery for the regulated financial service organisation.

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