Table D-1: Model's modification for file format standardization

Level	Factor Description in the Initial Model	Evidence	Modifications	Factor Description in Final Model
Level 5	An integrated system used to standardise file formats in all IT systems within an organisation.	In the highest maturity level, all systems integrate the system with other authorized systems only. The authorization is given by top management.	Add, "…*between the system and other authorized internal/external systems*" into description.	An integrated system is used to standardize file formats between the system and other authorized internal/external systems.
Level 4	A centralised system is used to standardize file formats for a particular IT system.	An automated tool was established in the level, and it was designed to be used by the dedicated system. The tool was centralized to connect all the modules involved in the system.	▪ Change the word 'centralized system' to '*a centralized tool*'. ▪ Change the word 'for a particular system' to '*used within the system*'. ▪ Add, "*A centralized and automated tool*", into description.	A centralised and automated tool is used within the system to standardize file format.
Level 3	Standardized file formats are used for each type of IT system.	Standard file formats for all modules in system R and system Q had been determined at this stage. The file format was manually standardized, using existing applications such as PDF Professional and Converter.	Change the whole description as follows: ▪ 'Standardized file formats are used' to "*Standardized file formats are determined*". ▪ 'For each type of IT system' to "*for the whole modules within the system*". ▪ Add, "…*with file conversion exists in standard procedure*" into description.	Standardized file formats are determined for the all modules within the system; manual file conversion in standard procedure.
Level 2	Limited standardized file formats for some parts of IT system exist.	File format standardization only covers few modules at this stage, as experienced in all systems. The files were manually converted using existing applications in the market with unstructured procedure involves. Here, data was gathered and sorted in order to determine the best format should be established in entire system.	Description changed to reflect a more accurate meaning.	Standardized file format in some modules of the system; manual file conversions.
Level 1	Each IT system has its own file formats.	In all systems, each module had its own file format but they did not communicate to each other.	Description changed to reflect a more accurate meaning.	The system does not support different file formats.

Table D-2: Model's modification for integration interval

Level	Factor Description in the Initial Model	Evidence	Modifications	Factor Description in Final Model
Level 5	Able to integrate in minutes to seconds	System R aims to make the integration success in few days (stated in Organization Eko Research Proposal 2010). In the latest Work Policy introduced in 2012, System Q expects to allow integrations in 2 to 3 days.	The keyword is "*in few days*". The description is changed accordingly.	Able to integrate in few days.
Level 4	Able to integrate in days to minutes	According to the Annual Report 2011, System P was expected to be able to integrate in less than a week. The integration for System R took a week, in average, since the development has taken over by the vendor. System Q was targeting to allow integration within a week in order to achieve the highest maturity level.	The keyword is "*in a week*". The description is changed accordingly.	Able to integrate within a week.
Level 3	Able to integrate in weeks to days	System Q is currently at this stage; they were able to get integrated in less than a month.	The keyword is "*less than a month*". The description is changed accordingly.	Able to integrate in less than a month.
Level 2	Able to integrate in weeks	System P was able to complete integration in more than one month. System R took between 2 to 3 months. System Q managed to improve to less than 3 months. The improvement occurred because of growing experience and understanding about the system.	The keyword is "*less than 3 months*". The description is changed accordingly.	Able to integrate in less than 3 months.
Level 1	Able to integrate in months to weeks	Due to bureaucracy and lack of expertise, System P took up to 6 months to complete integration. For the same reason, System R took between 3 to 4 months, and System Q was normally taken more than 3 months.	The keyword is "*more than 3 months*". The description is changed accordingly.	Able to integrate in more than 3 months.

Table D-3: Model's modification for system design

Level	Factor Description in the Initial Model	Evidence	Modifications	Factor Description in Final Model
Level 5	Computerized system is used to test the design usability and design analysis.	The functions of using an automated tool at this stage is for design assimilation, hence providing usability test for its improvement. This finding was consistently found in all case studies.	▪ Change the word 'computerized system' to "*automated tool*". ▪ Rephrased for a more accurate meaning.	The automated tool is used to assimilate the design for usability improvement.
Level 4	The documentation is updated on a regular cycle to reflect the updated IT designs.	For all systems, documentation was updated upon new requirements and necessities to reflect the updated IT designs.	Change the word 'on a regular cycle' to "*upon new requirements and necessities*".	The documentation is updated when new requirements are added and when necessities arise.
Level 3	Design standards exist. Technical reference mode and standards profile framework established.	System Q and System R have established design standards, but it was not refined.	Description changed to reflect a more accurate meaning.	Formal design standards and procedures exist.
Level 2	IT documentation and standards are established by a variety of ad hoc means, and are localized or informal.	At early stage, almost every IT project was designed on ad hoc basis without any continuality between the documentations made.	No adjustment.	IT documentation and standards are established by a variety of ad hoc manner, and are localized or informal.
Level 1	IT documentation and standards are not established.	In less complicated modules, the team was normally ignore the importance of system designs documentation, as experienced by System P and System Q.	No adjustment.	No IT documentation and standards are established.

Table D-4: Model's modification for teamwork

Level	Factor Description in the Initial Model	Evidence	Modifications	Factor Description in Final Model
Level 5	Fully support the individual's effort towards continuous development of team competencies.	Team-building activities were carried out to support continuous development, showing that the organizations understand the importance of nurturing teamwork. This was experienced by project team for System Q and System R.	Add, "*team building*" into description.	Perform team-building activities to support continuous development of team competencies.
Level 4	Establish a project management team. Team building activities are performed.	In all cases, team-building activities did not concurrently performed with the establishment of an IT Project Management team.	Simplified the description.	Establish a permanent IT Project Management team.
Level 3	Identify roles based on the core competencies required to perform the specific nature of IT project.	Staffing management plan was established to identify the core competencies required to perform the specific nature of IT project.	No adjustment.	Identify roles based on the core competencies of individuals required to perform specific IT projects.
Level 2	A formal organisational chart and staffing management plan are defined.	A formal organizational chart was established by defining each role and responsibility, but in all cases, the job roles were always beyond the job's description.	Description changed to reflect a more accurate meaning.	Establish dedicated job descriptions, but roles and responsibility are beyond the job's scope.
Level 1	Form an ad hoc team with minimal understanding of each responsibility.	In early exposure of System P, System Q, and System R's development, IT team was formed on project basis, without proper clarification of roles required to perform the tasks.	No adjustment.	Form an ad hoc team with minimal understanding of each other's responsibility.

Table D-5: Model's modification for independence and pro-activeness

Level	Factor Description in the Initial Model	Evidence	Modifications	Factor Description in Final Model
Level 5	Trust gained from the top management.	System Q's development team was autonomous, where suggestions of new solutions are fully trusted by the top management.	Description changed to reflect a more accurate meaning.	Autonomous and trust gained from top management and actions are taken with freedom and not influenced by other factors.
Level 4	Reliable and can work under own initiative	System R's development team has developed an ability to propose new technical solutions and ideas with little influence from top management.	Add, "*...need little assistance from the top management*" into description.	Reliable but require some assistance from top management.
Level 3	Proactive but needs the manager to determine the goal.	In case of System P, the IT managers set the goals. With that, the sub-ordinates performed the tasks with minimal guidance.	Description changed to reflect a more accurate meaning.	Responsibilities are completed proactively using individual expertise with goals set by top management.
Level 2	Committed and understand the function of the team, and perform the common and repeatable methods for the specific tasks.	In all cases, the IT managers need to set up standard methods to help sub-ordinates to perform when requested. The managerial level revised the standards periodically.	No adjustment.	Committed and understand the function of the team, and perform the common and repeatable methods for the specific tasks.
Level 1	Aware about the tasks' objectives, but actions taken only under manager's instructions.	Actions were taken only when instructed by the managers.	No adjustment.	Aware about the tasks' objectives, but actions taken only under manager's instructions.

Table D-6: Model's modification for IT awareness

Level	Factor Description in the Initial Model	Evidence	Modifications	Factor Description in Final Model
Level 5	Establish a data management system and trend analysis.	System P and System Q have established a data management system to centralize the latest information and help them in preparing trend analysis.	No adjustment.	Establish a data management system and trend analysis.
Level 4	Awareness shared through knowledge sharing activities within organization.	In all cases, knowledge-sharing activities were conducted periodically to create IT awareness among staff.	No adjustment.	Perform knowledge sharing activities within the organization.
Level 3	Latest IT awareness grows among top management level.	In all cases, management has allocated funding and aligned activities to encourage IT awareness among the staff.	Description changed to reflect a more accurate meaning.	Aware of new IT, when encouraged by top management.
Level 2	Latest IT awareness varies among individuals.	In all cases, staff took own initiatives to keep abreast with latest IT news without encouragement from management.	Description changed to reflect a more accurate meaning.	Aware of new IT on individual/personal efforts basis.
Level 1	Unaware/not interested in latest IT tools.	Before IT was introduced in the industry, IT awareness was considered not important in improving business prospective, as experienced by System R's development team.	No adjustment.	Unaware/not interested in latest IT.

Table D-7: Model's modification for IT learning commitment

Level	Factor Description in the Initial Model	Evidence	Modifications	Factor Description in Final Model
Level 5	Integrated and standardized data management used within organization.	System Q has established an integrated data management system, which is aligned with their business objectives and committed to encourage IT learning among their staff.	Description changed to reflect a more accurate meaning.	Establish a standardized and integrated knowledge management system.
Level 4	Document relevant latest IT processes and share within organization.	System P and System R's development team has established an isolated data documentation system to keep the step-by-step process of the technology. They have performed knowledge-sharing activities.	No adjustment.	Document relevant to the latest IT processes are shared within organization.
Level 3	Some of IT processes are documented but in isolation. Learn by demonstration, through conferences, and readings.	In all case studies, top management encouraged staff by funding for trainings, conferences, and demonstrations. Manuals and guidelines obtained; filed and kept to be shared by all in the organizations.	Description changed to reflect a more accurate meaning.	Encouragement from the top management (training, conference, or demonstration attendance). Informal documentation exists.
Level 2	Learning technology processes in individual effort basis, without an existence of any documentation.	In all case studies, the organizations went through a phase without encouragement from top management. It was based on individual's initiative.	No adjustment.	Learning technology processes is practiced in an individual effort, without an existence of any documentation.
Level 1	Not interested to learn related IT process.	In all case studies, the organizations were not interested about IT before it was introduced in the construction industry.	No adjustment.	Not interested to learn related IT process.

Table D-8: Model's modification for willingness on change

Level	Factor Description in the Initial Model	Evidence	Modifications	Factor Description in Final Model
Level 5	Flexible in adapting to changing realities through reviewing best practices.	System Q's development team received continuous encouragement from top management to have a high degree of change willingness. At this stage, majority of the staff were flexible and being adaptable to changes has become a culture in the organization.	▪ Description changed to reflect a more accurate meaning. ▪ Add, "*continuous encouragement*" into description.	Continuous encouragement with change willingness is embedded into the culture of the organization.
Level 4	Enforcement by the top management to adapt new approaches.	In case of System P and System R, top management made enforcement for the staff to adapt changes without option to deny the new approaches. Before the enforcement took place, sufficient training and information were provided. The staff were assessed through Annual Appraisal Report.	Add, "…*by providing information and training*" into description. Add, "…*with performance assessment*" into description.	Enforcement from the top management, by providing information and trainings, with a performance assessment.
Level 3	The top management encourages new approach adaptation, with the change willingness is vary.	As experienced by System P and System R's development team, in early years, top management enforced staff to adapt new approaches but no training was provided and there was no obligatory to accept. As a result, change willingness among staff was varied.	▪ Description changed to reflect a more accurate meaning. ▪ Add, "…*without sufficient training to educate*" into description.	Enforcement from the top management without sufficient training to educate.
Level 2	No encouragement from the top management, with change willingness is on individual efforts.	In all cases, the change willingness ability was started with the individual's initiative.	No adjustment.	No encouragement from the top management, with change willingness is on individual efforts.
Level 1	Unwilling to change, and prefer to work within a comfort zone.	Before IT was booming in the construction industry, IT awareness among the staff was very low.	No adjustment.	Unwilling to change, and prefer to work within a comfort zone.

Table D-9: Model's modification for hybrid skills

Level	Factor Description in the Initial Model	Evidence	Modifications	Factor Description in Final Model
Level 5	Harmony understanding between IT and the other departments within a whole organization.	System Q's development team has established a mutual understanding between them and the management side.	No adjustment.	Harmony understanding between IT and the other departments within a whole organization.
Level 4	All IT individuals commonly understand business objectives, but without mutual understanding between technical and management team.	System P has developed hybrid skills among IT staff, but the management team's poor understanding on technical matters resulted to misunderstandings.	Change "All IT individuals" to "*IT team*".	The IT team understood common business objectives but there were no mutual understanding between technical and management team.
Level 3	A manager capable to understand business objectives, but the understanding among individuals varies.	System R's development team has had a knowledgeable IT leader, but the sub-ordinates need to be guided towards achieving the goals set by the management.	No adjustment.	An IT manager is capable to understand business objectives, but the understanding among individuals varies.
Level 2	Limited understanding of business objectives with minimal guidance.	In all case studies, the IT team had limited understanding about the management needs and vice versa; resulting to repeated episodes of misunderstandings throughout the development process	Add, "*…from the management*" into description.	Limited understanding of business objectives, with minimal guidance from management.
Level 1	Unguided understanding about business objectives.	In case of System Q and System R, the development team was unguided about the management needs and goals in early stage of its development.	No adjustment.	Poor or no understanding about business objectives.

Table D-10: Model's modification for awareness of project Critical Success Factors (CSF)

Level	Factor Description in the Initial Model	Evidence	Modifications	Factor Description in Final Model
Level 5	Able to perform IT project CSF analysis and react to its changing.	System R has enabled CSF analysis for continuous improvement to manage CSF in changing surroundings.	No adjustment.	Able to perform IT project CSF analysis and react to its changing.
Level 4	Able to provide solutions in correspond to IT project CSF.	CSF for System R and System Q were established through a development of strategic planning and task workforce.	No adjustment.	Able to provide solutions in correspond to IT project CSF.
Level 3	Aware about IT project CSF with active involvement in identifying CSF.	In case of System R and System Q, workshops and a series of road shows were conducted to identify CSF from industry or/and experts' perspective.	No adjustment.	Aware about IT project CSF with active involvement in identifying CSF.
Level 2	Aware about IT project CSF, with identification made by the top management.	In case of System R, CSF was identified in a ad hoc manner by an in-house committee.	No adjustment.	Aware about IT project CSF, with identification made by the top management.
Level 1	Little awareness of IT project CSF based on individual efforts.	System P has had no effort to measure CSF; IT project is developed based on 'trial and error'.	No adjustment.	Little awareness of IT project CSF based on individual efforts.

Table D-11: Model's modification for connectivity

Level	Factor Description in the Initial Model	Evidence	Modifications	Factor Description in Final Model
Level 5	Utilize open system framework in promoting full stack interoperability and portability.	System Q has utilized cloud networking that offers on-demand network access to a shared pool of configurable computing resources.	No adjustment.	Utilize open system framework in promoting a complete suite of interoperability and portability.
Level 4	Provide network that connects to one another wirelessly and automatically.	System Q has implemented an automatic wireless network to allow the users get connected from any location.	No adjustment.	Provide internal and external network that connects to one another wired/wirelessly and automatically.
Level 3	Combine more than one network interface into one physical logical interface.	In all case studies, a physical interface was established to secure the network if one of the devices collapses.	No adjustment.	Combine more than one network interface into one physical logical interface.
Level 2	Provide internal wireless and cabled network.	In all case studies, both wireless and cabled networks play a very important role for system's security in connectivity.	No adjustment.	Provide internal wireless and cabled network.
Level 1	Provide internal cabled network.	System R and System Q was provided with internal wireless network with low speed connection.	▪ Description changed to reflect a more accurate meaning. ▪ Change 'cabled network' to "*wireless network*".	Provide wireless network.

Table D-12: Model's modification for IT security management

Level	Factor Description in the Initial Model	Evidence	Modifications	Factor Description in Final Model
Level 5	Utilize artificial intelligence into the development of IT system security tools.	System Q has implemented an auto-recovery tool in entire modules of the system.	No adjustment.	Utilize artificial intelligence into the development of IT system security tools.
Level 4	Carry out data encryption and establish IT risk and security analysis.	In all case studies, selected data modules were encrypted as a preventive measure to safe data at the event of the computer gets malicious malware or are hacked	No adjustment.	Implement data encryption and establish IT risk and security analysis.
Level 3	Execute the statistical data security system to control the access to systems.	System Q has deployed a statistical data security audit and testing to continuously check number of incident, audits, and testing.	No adjustment.	Execute the statistical data security system to control the access to systems.
Level 2	Provide networked IT security to protect and secure the entire platform, including access controls.	In all case studies, the entire system's platforms secured with access controls.	No adjustment.	Provide networked IT security to protect and secure the entire platform, including access controls.
Level 1	Basic IT security; the use of identifications (username) and authentications (passwords) in stand-alone PCs.	In all case studies, the organizations provided basic IT security – identifications and authentications, and protected of the entire platforms with anti-virus, anti-malware, and firewalls, and provide networked security through access controls.	Add, *"…with complete computer security (anti-malware, antivirus, and firewalls)"* into description.	Provide identifications and authentications in stand-alone PCs, with complete computer security (anti-malware, antivirus, and firewalls).

Table D-13: Model's modification for data management

Level	Factor Description in the Initial Model	Evidence	Modifications	Factor Description in Final Model
Level 5	Integrate the in-house data management tool that has search ability across multiple systems, and include auto-reporting and analyzing.	System Q has the ability to cross-reference, and search capabilities across multiple data types and platforms, allowing easy reporting and analyzing.	No adjustment.	Integrate the in-house data management tool that has search ability across multiple systems, and include auto-reporting and analyzing.
Level 4	Develop a stand-alone in-house data management tool.	System Q and System R has established an in-house data management tool. The tool suits the organization well in comparison with tools that are available in the market.	No adjustment.	Develop a stand-alone in-house data management tool.
Level 3	Utilize a third-party data management tool, in isolation.	A third-party data management tool was utilized in System Q to manage the increasingly complex data and their inter-relationships.	No adjustment.	Utilize a third-party data management tool, but in isolation.
Level 2	Define stand-alone data administration on project basis.	In all case studies, a job scope was defined to manage data using basic applications and in isolation.	No adjustment.	Define stand-alone data administration on project-by-project basis.
Level 1	Manage data manually using local disk storage.	Data was kept in paper-heavy form, and it was managed using the on-the-shelf filing system.	No adjustment.	Manage data manually by hardcopy.

Table D-14: Model's modification for IT project management

Level	Factor Description in the Initial Model	Evidence	Modifications	Factor Description in Final Model
Level 5	Establish an ability to anticipate future capacity demands and capability requirements, with IT change management plan is recognized..	Continuous improvement and refinement are needed to track progress and changes throughout the development period. IT change management plan is required to smoothen the change process.	No adjustment.	Establish an ability to anticipate future capacity demands and capability requirements, with IT change management plan is recognized.
Level 4	Institutionalize the project management with service centric and integrated processes.	Process efficiency is monitored for improvement by taking into account changing business needs and external factors.	No adjustment.	Process efficiency is monitored for improvement by taking into account changing business needs and external factors.
Level 3	Consistent standards are used by all IT projects.	Standard approaches are needed to develop each of the modules involved in the system.	Change the word "all" to "*the whole system*".	Consistent standards are used throughout the whole IT system.
Level 2	Inconsistency or defined standards approaches between IT systems.	In all case studies, the standard approaches were inconsistent from one task to another with many ad hoc plans involved.	No adjustment.	Inconsistent or undefined standards approach between IT systems.
Level 1	Unstructured approach to dealing with IT system.	In early state of development, System R and System Q were developed without any standard approach – at an ad hoc manner.	No adjustment.	Unstructured approach in dealing with IT system.