QUALITY MANAGEMENT SYSTEMS FOR DESIGN CONSULTANTS - A CASE STUDY IN COMMERCIAL PROJECT CONSULTANTS IN THE GREATER JAKARTA AREA

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Abstract

Standardization of Quality Management System (QMS) for design consultants has not been established as a regulation by Indonesian local government. As a result, quality of design consultants varies. The research combined literature review and interviews with experts in design consultants, addressing 12 elements of quality management system based on ISO 9001 AND 9004. The quality data gathered from consultants were then verified with major users to find gaps and point of improvements. There were four finding of mismatch, namely: documentation and follow up by consultant to feed-back and complaints of service user, product verification before it reaches the service user, innovation to process, and design result. These four findings of mismatch were then looked into further with the corresponding consultant and service user. As the end of the study, a model completed with activities briefs and checklists were proposed to address mismatch and as improvement.

Keywords: *design consultants, ISO, quality management system*

INTRODUCTION

A successful construction project is the one that are finished on time, within budget and with quality as per clients' requirement. These three requirements are somehow linked together making it necessary to balance between quality, time and cost management. (González, González, Molenaar & Orozco, 2013; Kog & Loh, 2012) Design is an integrated and crucial element in construction. To be successful, construction projects must conduct a good planning and controlling task at every aspect of project from start to finish. To do this, a quality management system must be in place to help reducing non-value-added activities and avoid defective design (Han, Lee & Peña-Mora, 2012). However, success of QMS adoption in construction projects depend on other organizational variables (Olafsdottir, Sverdrup, Stefansson & Ingason, 2019).

Quality, in American Heritage Dictionary is defined as "an inherent or distinguishing characteristic". As a distinguishing attribute quality refers to measurable characteristics and can be compared to certain established standards. Quality design is fitness for use, which mean must be in accordance to user expectation. This is the key element that determine the success of a project in general and its construction phases (Ezeldin & Abu-Ghazala, 2007).

Quality management system (QMS) is a series of measurement, assessment and testing process used in the overall design cycle to ensure product is according to specification. Combination of measurement and its respond allows consultant to improve the process whenever the result is out of specification and user expectation. This approach view quality management system as part of consultant work process.

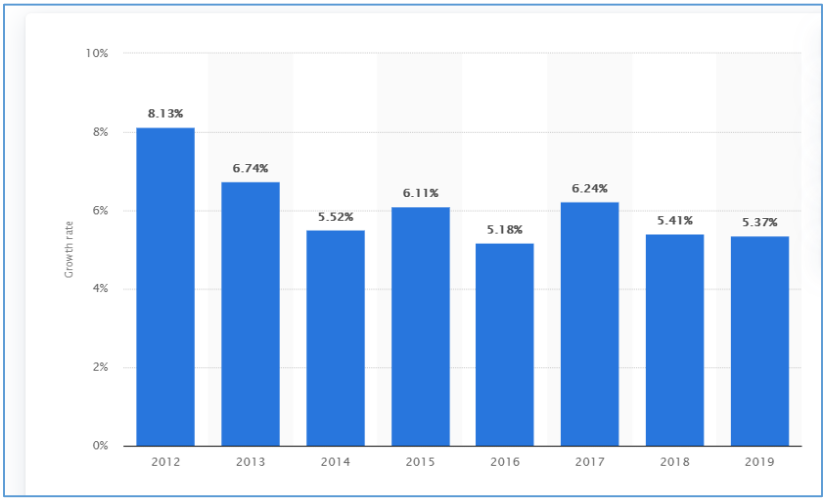

Figure 1. Gross Domestic Product (GDP) Growth rate of Construction Sector in Indonesia
Source: R. Hirschmann, (2020)

QMS is an enabler to manage consultants work effectively. The effectiveness of QMS depends on effectiveness of engineers in creating ideas, skills and enthusiasm in producing design drawings, specification and other information for the project in accordance to quality and safety standard, agreed project time and budget. Despite recent decline since 2012, Indonesia construction sectors still enjoy a healthy growth on yearly basis, as indicated by Figure 1. The growth is concentrated in Greater Jakarta area, which is replica of Indonesia, with development occurs in other big cities across the country. Construction industry is still one of the major growth contributors for Indonesia and Greater Jakarta area.

Nevertheless, standardization of quality management system has not been obligated by local government of Jakarta, resulting variation amongst consultants. This also reflected when registering the consultancy firms to LPJK "Lembaga Pengembangan Jasa Konstruksi Nasional" under the ministry of public work, where ISO 9001 and 9004 as international quality standard is not compulsory and only adopted by few consultants.

Non-conforming quality bring disadvantages to stakeholders in a project. Misconstruction due to lack of integration in design process, non-documented design flow, and non-validated drawings by responsible person are examples of and quality management system in design consultancy firms. These drawbacks can deteriorate accountability, branding and later profitability of consultants themselves. Users also must bear additional and unexpected cost due to design flaw.

The objective of the research is to study QMS applied in design consultancy firms in Greater Jakarta area; to verify to service users QMS that has been applied by respected consultants; to propose improvements to consultants to increase their user's satisfaction; and lastly propose a QMS model applicable for design consultant in Jakarta. The novelty and contribution of the study lies in providing situational analysis faced by major design consultants in the greater Jakarta area when adopting quality management system. Analysis from both major design consultant's collective assessment as well as from users' perspective give insights on where is the mismatch and common mistakes that should be avoided. Based on that, a model of QMS was proposed to help design consultant address users' requirement better.

LITERATURE REVIEW

Peculiarity of Construction Projects

Construction management is defined as construction planning which consists of a series of planning activities and/or execution as well as monitoring of architectural, civil, mechanical, electrical and environmental planning in order to construct a building or other structure. Construction management is a temporary effort within a project with a unique output. Unique traits of a construction project are (Heizer, Render & Munson, 2020): (1) The work contains complex interrelated tasks requiring specialized skills; (2) Time is limited which reflected into a project deadline; (3) The chain of activities is not repetitive, resulting a unique output; (4) Has specific objective, end products or deliverables. Can be in form of drawings, technical specifications, or design reports; (5) The project is temporary but cut across multi discipline area.

Construction industry has embraced continuous improvement initiatives for example with the adoption of six sigma methodology in quality management tool. Nevertheless, the implementation is different with other sector, because the above mentioned nature of construction projects (Bharath & Shankar, 2020). Challenges, defects and environments varied in every construction projects as every product are not repetitive (Negi, Mandaliya, Mahida, Patel, & Patyal, 2017).

Construction projects are also characterized by having a finite-time spans, which may influence the working relationship amongst stakeholders since it is under temporary system (Buvik & Rolfsen, 2015). Because of that, project participants are selected based on collaboration, communication and performance-based traits (Jelodar, Yiu, & Wilkinson, 2016). An effective relationship management is required in project environment which stress more on collaborative ways of working instead of traditional working environment (Atuahene, Agyekum & Baiden, 2018). With multiple stakeholders in construction projects, collaboration even needs more than just technical expertise and must take into account organization cultural aspect (Barrett & Khalfan, 2018). Early collaboration along the project phase, e.g. early contractor involvement, is suggested to create more benefits, such as better design quality, a more reliable project schedule and cost estimates, better risk assessment and possibility for innovation through value engineering (Rahmani, Khalfan & Maqsood, 2016).

Construction can be considered as conservative industry with its reluctance to change and embrace innovation (Cheung & Qi, 2017). Because of its nature, construction industry most of the time generate more ad-hoc innovations to solve day-to-day problems instead of scientific and engineering breakthrough (Loosemore, 2015). In order to create competitive advantage, innovation is important to all industry sectors. Because of its nature, creating and addressing innovation is another challenge faced by construction sector. To address this design consultant can play an important tole, since innovation can start and derived from design.

With its unique traits of its deliverables, managing personnel in construction project is another challenge. Most of personnel in construction is highlight specialized person. Some of the knowledge is tacit in form and not explicitly stated or documented. As a result, human resource management is an important roles in knowledge management to support employee replacement process so that not to disturb overall project and company achievement (Khalfan, Alshanbri & Maqsood, 2016).

The Role of Design Consultant

Design consultants are firms or individuals giving professional service of construction design with design documents as their deliverables. Typically design consultants are specialized into specific areas such as architecture, civil works, mechanical, electrical, environmental planning. Design consultancies require skills to effectively interpret data provided by clients/users. However it is not always easy, since consumers most often look backward when they try to explain their expectation for the future (Page, 2016).

End product of consultants is arranged based on the agreed service with its users. Typically there are 6 stages of design consultant work, namely concept design, schematic design, development design, final design, tender design and monitoring design, each of which produces different interim outputs and deliverables for the next stages (Burney, Papageorge, Rueda, Cellura, & Woolley, 2003). It is important to have an early phase design iteration within the consultancy environment, as they are the influential concept providers (Abrahamson, 1996; Suddaby & Greenwood, 2001). With early phase design iteration, introduction of innovative concept can be made possible and hence help in stimulating the service demand (Benders & Verlaar, 2003).Design consultants have a major role in construction projects. Poor quality of design documents can cause construction inefficiency causing delays, reworks, variations and modifications, disputes, claims and possible litigations amongst project stakeholders (Jarkas, 2014).

Quality Management System

The purpose of quality management is to ensure consistent quality of organization, product or service. Four main components of QMS are quality planning, quality control, quality assurance and quality development, with focus on process and organization. QMS is a formal statement of organization policy, responsibilities, processes and controls which reflects on how they meet customer expectations while attaining its own business objectives (Thorpe & Sumner, 2004).

International Organization for Standardization (ISO) created QMS in 1987 which consists of ISO 9000:1987; ISO 9001-1987; ISO 9002-1987 and ISO 9003-1987 series which valid to various industry (Cianfrani, Tsiakals, West, & West, 2001). Because of its complexity, it was revised and published in the year of 2000 as ISO 9001:2000 (Cachadinha, 2009), stressing into eight core QMS principles. ISO released a minor revision, ISO 9001-2008, but this revised standard does not contain new requirement. The most current version of ISO standard is ISO 90001:2015 which accommodate risk management (CABEM Technologies, 2017). Figure 2 shows hierarchy of ISO 9000. Since then, it has been widely used in construction industry as guideline to improve organization and project performance, despite some challenges and difficulties in adopting it (Leong, Zakuan & Saman, 2014; Senaratne & Jayarathna, 2012). To be effective QMS typically need to be integrated with other quality tools and techniques (Negi et al., 2017). QMS based on ISO 9001 and 9004 can be applied within an organization with 12 interconnected elements (International Organization for Standardization, 2009), i.e: (1) Quality management; (2) Quality objectives; (3) Quality manual; (4) Organization structure: roles and responsibilities; (5) Data management; (6) Process; (7) Resources; (8) Product quality to customer satisfaction; (9) Continuous improvement; (10) Maintenance; (11) Sustainability; (12) Transparent and independent audit.

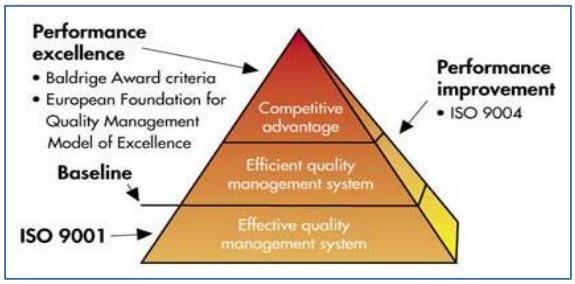

Figure 2. Hierarchy of ISO 9000
Source: (Cianfrani et al., 2001)

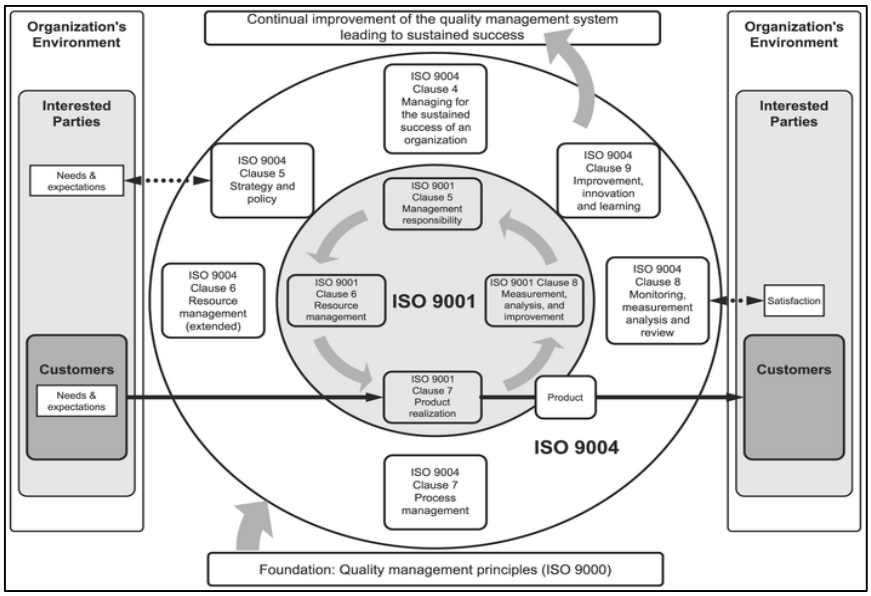

Figure 3. QMS Model based on ISO 9001 & ISO 9004
Source: (International Organization for Standardization, 2009)

Figure 3 describe how elements of QMS in ISO 9001 and 9004 can create work cycle within organization to deliver needs and expectation of users, stake holders, and society in term of quality. To some extent, it is hard to evaluate the benefit of QMS in construction industry (Olafsdottir, Ingason, Stefansson, 2016). Previous research in construction industry also lack discussion on non-technical approaches and human behavioral issues (Leong et al., 2014). Nevertheless, QMS is enabler to avoid four types of Cost of Quality (COQ), namely (Heizer et al., 2020): (a) Prevention costs: costs associated with reducing potential for defective products or services. Example of prevention costs are training, quality improvement programs; (b) Appraisal costs: costs related to evaluating products, processes, parts and service. Examples are testing, labs, inspections; (c) Internal Failure costs: costs that results from production of defective parts or services before delivery to customers, such as rework, scrap or downtime; (d) External Failure costs: costs that occur after delivery of defective parts or services such as rework, returned goods, liabilities, loss of goodwill or costs to society.

RESEARCH METHOD

This study is a qualitative descriptive research. It systematically assessed and evaluate data about design consultants in Jakarta. Data was taken from in-depth interviews from several design consultancy firms and verified by users of those consultants. The

respondents were senior engineers with minimum 5 years' experience in design consultants and holds managerial role for the service users. The respondents were also prioritized to those involved with major property developers in greater Jakarta area. The research framework in Figure 4 describe the overall steps conducted during the research.

The main focus of the study lies in the process and content from questionnaire and interview, while literature study served as general guidance. Literature study was done by studying scope, responsibility and product of design consultant based in ISO 9001 and 9004. It covers the job of design consultant starting from concept design stage, schematic design stage, development design stage, final design stage, up to onsite monitoring stage. ISO 9001 was used as baseline for international standard for QMS. Together they are combined to serve as initial model of QMS for design consultant. The next step of the research was to design questions for the interviews, based on result from previous literature study. The interviews were done to several design consultants and their users. Interviews to users serves as verification step. The questions in the interview to the design consultants were set based on 12 QMS elements of ISO 9001, namely: Quality Management; Quality objective; Quality manual; Organization Structure; data management; process; resources; product quality in relation to user satisfaction; continuous improvement; monitoring and maintenance; sustainability; independent and transparent audit. The questions for verification process cover only three elements of QMS that are relevant to the users, namely process: product quality in relation to user satisfaction, and continuous improvement. The last step of the study was to perform data analysis from the interview. The initial model from literature study was then adjusted to the interview results before suggesting the proposed QMS for design consultant. Suggestion and recommendation were also added.

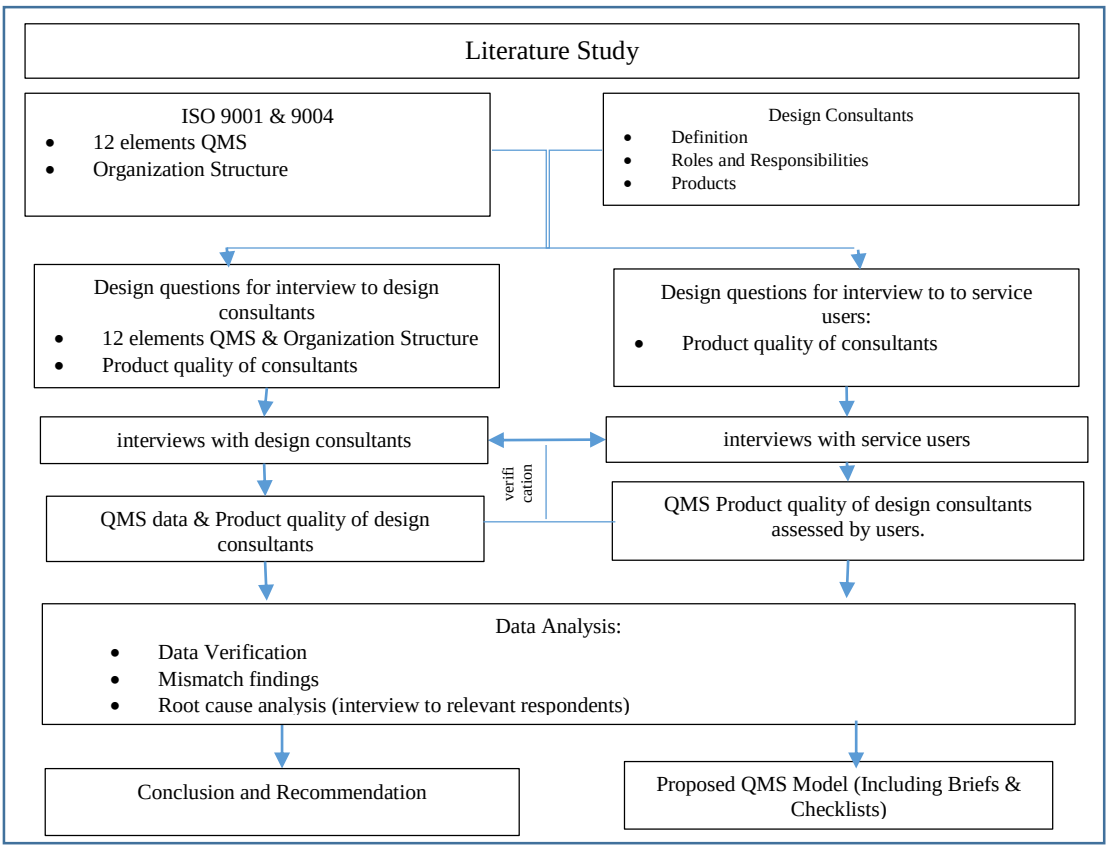

Figure 4. Research Framework

RESULT AND DISCUSSION

The distributed questionnaires consisted of 20 questions, with 15 respondents from different consultancy firms, as indicated by Table 1 below.

Table 1. List of Respondents from Design Consultants

Consultant Names	Area	# of employee	Respondents	Length of Service (year)
1. Airmas Asri, PT	Architecture	150	Design Manager	7
2. Adhicipta Prajawidya, PT	MEP	22	Project Coord	20+
3. BDW	Structure	20	Director	20+
4. Davy Sukamta & Partners, PT	Structure	51	MR ISO	17
5. Duta Cermat Mandari, PT	Architecture	40	Arch Associate	8
6. Fernandus Budi & Associates	Structure	6	Director	20+
7. Indomegah CBC, PT	Architecture	51	Head of projects	19
8. Ketira Engineering Consultants, PT	Structure	150	Technical Manager	6
9. Meco Systech Internusa, PT	MEP	30	Project Coordinator	12
10. Megatika International, PT	Architecture	100	Architect	10+
11. Poly Cipta Abadi, PT	MEP	40	Director	20+
12. Sonny Sutanto Architects	Architecture	15	Director	20+
13. Sygmatech Tatakarsa, PT	MEP	48	MR ISO	8
14. Tetra Desain Indonesia, PT	Architecture	33	Architect	6
15. Tws & Partners	Architecture	16	Chief of Studio	14

Table 2. Results from Consultants

No	Questions based on 12 ISO Elements	Results
1	Use of departmental (administrative) organization structure instead of using studio (functional) organization structure	40%
2	QMS exists in the firm	100%
3	QMS is not as per international standard	80%
4	No written procedures for quality	53%
5	Assign dedicated person to ensure QMS in the organization	93%
6	Top management involvement	100%
7	Nonsystematic individual assessment (only based on superior assessment)	66%
8	Nonsystematic training and competency development (has no curriculum)	60%
9	No planning and monitoring of working time	92%
10	Feedback from users' complaints is recorded	80%
11	Feedback from users' complaints are actioned	100%
12	Product is controlled as per standard and regulation	93%
13	Has responsible person for design deliverables	86%
14	Drawings and calculation are verified prior to use	93%
15	Has responsible person for design verification	93%
16	Controlling products as per users' term of reference (TOR)	100%
17	Historical design changes are documented	86%
18	Has not measured customer/service user's satisfaction	73%
19	Innovate in processes and products	60%
20	Learning and sharing of information within the organization	80%

Table 2 describes assessment of the respondents from consultants towards their overall users. During the interviews it was highlighted the following challenges in adopting QMS for the design consultants: (a) Insufficient of human resources, due to high turnover and/or imbalance with the number of project (26%); (b) Difficulty in validating design (13%); (c) Assessment and competency improvement of the human resource (13%); (d) Innovation (6%); (e) Data and process documentation (6%).

The relevant questions in the questionnaires were also asked to 6 users, as indicated by Table 3. The users are senior staff from big developers in greater Jakarta area. Only eight questions were relevant asked to users. Result of the users' perspective towards their consultants' performance is displayed Table 4.

Table 3: List of users (developers)

Developer (user)	Respondent
Agung Podomoro Land Tbk, PT	Project Manager
AKR Land Development, PT	Ass Manager Design & Business Development
Ciputra Development Tbk, PT	Architect – Technical Depart
Fairpoint Reality Indonesia, PT	Project Manager
Summarecon Agung Tbk, PT	Assistant Director
Synthesis Karya Pratama, PT	Project Director

Table 4: Results from Users (developers)

	Questions based on relevant 12 ISO elements	Users Results
10	Feedback from user complaints is recorded	71%
11	Feedback from user complaints is actioned	90%
12	product is controlled as per standard and regulation	74%
15	Has responsible person for design verification	71%
16	Controlling product as per user's term of reference (TOR)	87%
17	Historical of design changes are documented	58%
18	Has not measured customer/service user satisfaction	80%
19	Innovate in processes and products	45%

From the interview with users, the following feedback were identified for design consultants: (a) Product is not as per standard, especially on detail drawings (19%); (b) Lack of innovation in design (9%); (c) Need to increase communication system, especially with foreign design consultant (9%); (d) Need to increase design validation to match with users need and wish (9%); (e) Need control on quality and quantity of human resource (6%); (f) Need verification and completeness of drawings (3%). Data from 11 design consultants used by their respected users were then compared. Result is as per Table 5.

Note: one user (developer) can engaged with more than one design consultant | Grey cells indicates four major mismatch

Based on the verification in Table 5, four major mismatch findings were found (highlighted in grey). The lower score on question 18 and 19 should also rise alert as they are directly related to users satisfaction and hence retention. Based on these findings, further in-depth interviewed were performed to the respected consultants and users, and the following root causes were identified as summarized in Table 6.

Table 5: Comparison results between consultant's vs users

Questions based on relevant 12 ISO elements		Consultants Results			Users Verification		
		yes	sample	%	yes	sample	%
10	Feedback from user complaints is recorded	10	11	91%	7	9	78%
11	Feedback from user complaints is actioned	11	11	100%	10	11	91%
12	product is controlled as per standard and regulation	10	11	91%	10	11	91%
15	Has responsible person for design verification	11	11	100%	10	11	91%
16	Controlling product as per user's term of reference (TOR)	10	11	91%	10	11	91%
17	Historical of design changes are documented	9	11	82%	7	8	88%
18	Has not measured customer/service user satisfaction	3	11	27%	2	11	18%
19	Innovate in processes and products	7	11	64%	4	10	40%

Table 6: Root Cause of Mismatch

Mismatch areas	Root causes
1. Feedback from user complaints is recorded	• No awareness on function of recording user feedback • Recording is done only from the consultant side without formal reporting to users, resulting no clear accountability and responsibility. • No formal QMS in place. QMS is done individually as firms are simple in structure
2. Feedback from user complaints is actioned.	• Result from feedback not yet standardized and coordination amongst relevant area not yet smooth. • Top management were aware of the status and action of the feedback but result still not satisfy users. • No formal and clear QMS and its application, resulting individual interpretation dominant the workflow
3. Product verification before reaching users were not done.	• No standard on quality and completeness on design drawings. Still depends on individual project managers on site. • No designated PIC to ensure issued drawings as per standards. • No clear and formal rules in QMS application
4. Firm has not performing innovation.	• improvement program by consultants were not implemented yet, or still perceived inadequate by users. • innovation still considered unimportant by 50% of users, as long as consultants fulfill its expected role.

The above result conformed with study by Olafsdottir et.al (2016), who highlighted documented procedures, documented client expectations, documented additional works and communication as important factors in evaluating the activeness of a QMS.

To address the benefit and importance of QMS as well as the identified mismatch and its root case, we proposed QMS model for design consultant as summarized in Figure 5. The left part of the model displays the higher-level components of the QMS, starting

from quality policy cascaded down to process requirement. The right part of the model displays the services and deliverables to be performed by design consultants in each of the design stages. The model was equipped with details of activities' briefs and checklists required for each of them.

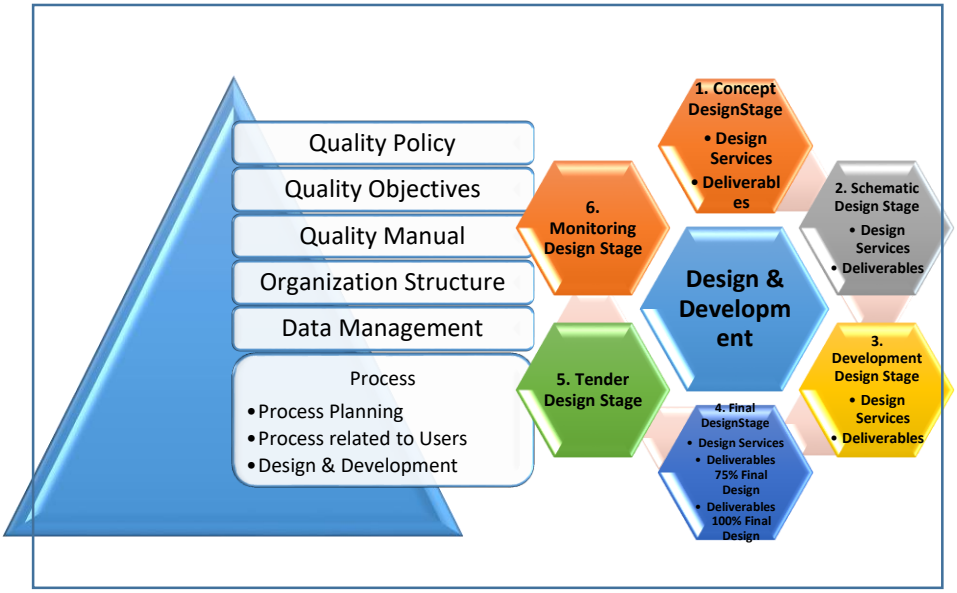

Figure 5. Proposed QMS Model for Design Consultants

CONCLUSIONS AND SUGGESTIONS

The study gave overview of application of QMS in design consultants in Greater Jakarta area: Their own assessment compared with users' perceptions. The study involved 15 design consultancy firms in Jakarta covering different design areas and 6 medium and big developer. Four mismatch areas were found in the study. Difficulties experienced by designed consultants were also found, i.e: limited human resource with high turnover in design area; Design validity; Assessment and Competency development; Innovation and Data and process documentation in the design process.

Common mistakes and ignorance experienced by consultants were also highlighted, i.e.: Mistakes and/or ignorance in design validation triggered by idealism and ego from the designers as compare to users' need; Products are not as per standard, especially in detail drawings; Communication with foreign consultants; Coordination amongst consultants (architect vs structure vs MEP); Historical design changes are not properly documented; Verification and completeness of drawings.

Implementation of QMS in project environment poses more challenge than in production environment. Being unique and less repetitive, projects typically more constrained to deadline and less to cost as long as budget still met. On the other hand, QMS implementation is long term investment, where immediate benefits may not directly visible. Nevertheless, QMS implementation in projects will benefit organization in the long run, as it helps reducing non quality cost, speed up projects, reduce cost and strengthen company's brand and reputation.

The study recommends the following steps for design consultants: (a) It is important to have a clear QMS for design process in order to satisfy users need. Clear QMS adopted throughout the project organization will give better coordination. ISO 9001 and 9004 can

be a standardize guideline. Top management commitment is a must in implementing QMS; (b) Training and application of QMS is important in order to develop teams' competency and better coordination amongst team members; (c) It is important to assign responsible person/position to verify product prior to be released to users; (d) Complete QMS system consist of integrated checklists and procedures should be established to enhance implementation.

To provide a thorough guideline for design consultant, a proposed model of QMS was summarized to address service and deliverables requirement in each of design stages. The model was equipped with complete checklist and work activities' briefs.

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