

Research Article

Mapping of Various Quality Management System Model to ISO 9001:2015

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Measurement of Quality Management Systems (QMS) in construction projects is very important to assess the fulfillment of quality standards. A comprehensive and up-to-date standard setting is paramount. Much research has been done to develop a Quality Management System (QMS), but only focused on the quality management system in general by means of interviews and statistics. There are still only a few studies that focus on determining quality variables based on ISO 9001:2015, but they do not consider other Quality Management Systems (QMS) to obtain variables that are not in ISO 9001:2015. This research aimed to map out ISO 9001:2015 to find additional variables that are not present inside it. Six Sigma, Deming, Total Quality Management (TQM), Quality Management System (QMS), Baldrige Performance Excellence Framework, and LEAN Manufacturing are models for developing Quality Management Systems (QMS) that are widely applied in the construction industry today. This research produced eight additional variables as audit materials, which were expected to make ISO 9001:2015 better in its application and development in construction services. The eight variables were breaking down barriers between departments, eliminating pressure, eliminating arbitrary numerical targets, respecting people, contributing to society, reducing cycle time, increasing process transparency, and focusing on global process control. This research provides factors from a more varied and up-to-date quality management system that complements ISO 9001:2015

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1. Introduction

Many studies have been conducted to find important variables in the Quality Management System (QMS) in construction projects. Several previous studies that have been carried out include Mohd Asmoni et al., which conducted a literature review by analyzing the critical factors of the Quality Management System (QMS), Firas conducted research by surveying respondents on construction projects and also determine the critical factors of the Quality Management System (QMS) [1, 2], Neystani conducted research by combining literature reviews and surveys to obtain critical factors from the Quality Management System (QMS) [3]. These studies are studies of determining the

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important variables of Quality Management System (QMS), but they still do not represent or are based on the latest standards where ISO 9001 was last published in 2015.

Thus, ISO 9001 is a Quality Management System (QMS) standard that is very useful in global competition, including as a standard used in Indonesia. Based on the Decree of the Director General of Construction Development Number 89/KPTS/DK/2021, ISO 9001:2015 is one of the requirements for obtaining a Business Entity Certificate (SBU). In other words, ISO 9001 2015 is also a tender requirement for government projects.

Many studies to determine important factors based on Quality Management System (QMS) standards based on ISO 9001:2015 have also been carried out, one of which is Aburas and Lee using a literature review [4]. Aburas also conducted a literature review and then processed statistically and interviews to be an important factor in implementing a Quality Management System (QMS) based on ISO 9001:2015 [5]. These studies are also considered insufficient because they do not consider other Quality Management Systems (QMS) to obtain variables that do not exist in ISO 9001 2015.

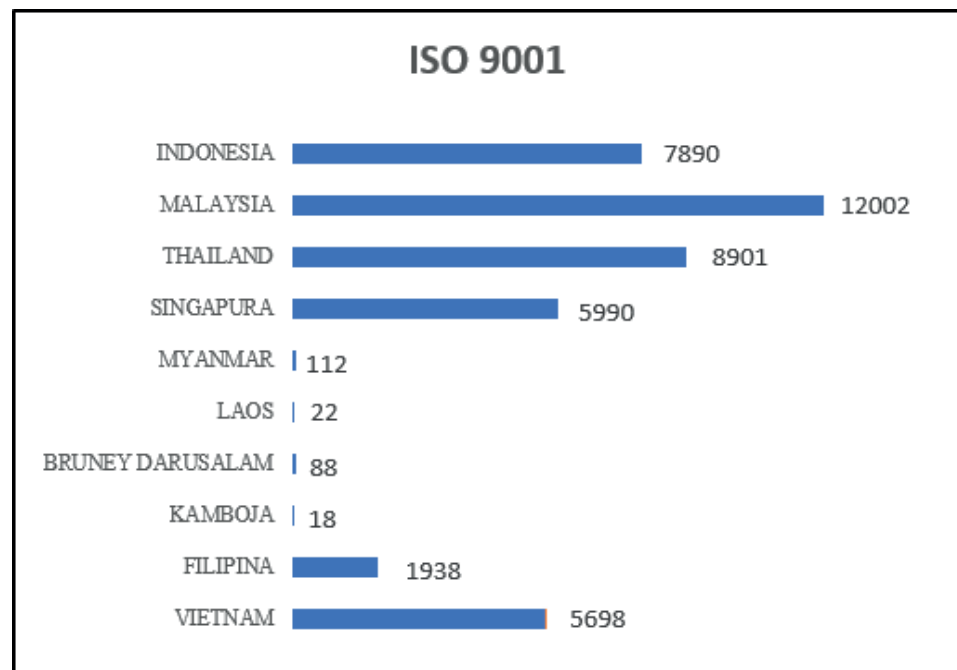


Figure 1: Use of ISO 900:2015 certification in ASEAN Source: [6].

The search for important Quality Management System (QMS) variables based on ISO 9001:2015 should be done by using comparisons to other management system models to determine the important variables. Six Sigma, Deming, Total Quality Management (TQM), Quality Management System (QMS), Baldrige Performance Excellence Framework, and LEAN Manufacturing are models for developing Quality Management Systems (QMS) that are widely applied today. Mapping variables with a clear picture

also needs to be done to know for sure the relationship between the variables being mapped.

One of the studies that can be obtained is Asa et al., which uses the old version of ISO 9001 in 2000 with mapping carried out with the Quality Management System (QMS) model [7]. The research results are internal audits that do not exist in other Quality Management System (QMS) models. Another result is the public responsibility clause in the NBNQA as well as quality objectives (quality objectives) that measure the improvement costs of Six Sigma which do not exist in ISO 9001:2000 need to be added. If we look at the latest clause in ISO 9001:2015, the quality target variable has been added because it is important for a Quality Management System (QMS) to determine the quality targets to be achieved.

This research by Asa et al. still does not clearly describe the differences between each model against ISO 9001, so this study aims to conduct research on Quality Management System (QMS) variables that are not yet included in the latest ISO 2015 by mapping out the latest models and research [7]. This study aims to obtain results that are more in line with current conditions and also aims to map using a table that compares the ISO 9001:2015 clause with each model specifically.

2. Quality Management System Model Determination

This research was conducted empirically by looking for quality management system models that are widely used in the construction world and then filtering research related to quality management system models in construction services, including:

2.1. Six sigma

Hammer and Goding define Six Sigma as a structured and disciplined set of methodologies and techniques for reducing costs and improving quality [8]. Reducing variation has been the focus of Six Sigma [9], as it strives to have no more than the number of defects per million opportunities (DPMO) matched, or the percentage of defects [10].

2.2. Deming's management principles

Successfully led a revolution in quality management systems in Japan, by introducing the use of problem-solving techniques and statistical process control. The Deming cycle is what he made famous. The Deming cycle was developed to link products to customer

needs and to focus the resources of departments (research, design, production, marketing) to be collaborative and meet those needs.

2.3. Total Quality Management (TQM)

Total Quality Management is a management philosophy that emphasizes continuous improvement in all aspects of an organization. The main goal is to meet customer needs and survive in the market. Thus, it is important to define the variables that lead to a successful implementation. In particular, the identification of critical success factors (CSF) of TQM is more important in construction companies than in other industries, because most organizations are confused about TQM CSF, and often they do not implement a suitable framework with the right variables. important for the implementation of TQM.

2.4. Quality Management System (QMS)

Quality management system is all activities of the management as a whole which aims to determine the quality policy, objectives and responsibilities in ways such as quality planning, quality control, quality assurance and quality improvement in the quality system. QMS includes a systematic approach, documentation, guidance and auditing that can be part of the project management process from the moment the project starts to the last step in the project closing phase as well.

2.5. Baldrige performance excellence framework

For more than 30 years, Baldrige has been recognized globally as the spearhead of validated performance and leadership practices. Thus, Balbridge is a very popular quality management system model. Baldrige is a non-prescriptive framework that empowers organizations to achieve their goals, improve results, and become more competitive. Core Values and Concepts by BPEF is a set of beliefs and behaviors found in high performing organizations. it is the foundation of this framework.

2.6. LEAN manufacturing

Lean is a production management model in the construction industry, Lean Manufacturing aims to increase the level of efficiency in production. Project management in the construction industry using lean systems differs from conventional practices in that the

result is a clear set of objectives, improved performance, simultaneous conception of products and procedures, and control of production over the life of the project.

3. Clause ISO 9001:2015

Clause ISO 9001:2015 which can be seen in table 1.

4. Comparing Quality Management System (QMS) Models To ISO 9001:2015

The models selected for mapping are obtained from recent studies that use or develop these models. Recent research shows the applied model's existence and the development of the changing times. The Comparing of various models of quality management systems against ISO 9001:2015 is as follows:

4.1. Six Sigma Relationship (THAMRIN) with ISO 9001:2015

4.1.1. Define

1. Management team (4.4, 7.1.1)
2. Recruitment (7.1.2)
3. Define specifications (0.3.2, 4.4, 4.4.1, 5.2.1, 6.2, 6.2.1, 6.2.2, 7.1, 7.1.1, 9.1, 9.1.1, 9.2, 9.2.2)
4. Set project plan (6, 6.1.1, 6.1.2, 6.2, 6.2.1, 6.2.1, 6.3)

4.1.2. Measurement

1. Define units, metrics and results (7.1.5, 7.1.5.1, 7.1.5.2, 8.3.5, 8.5.1, 9.3.2, 0.3.2, 4.4.1, 8.3.5, 8.5.1, 9.3.2)
2. Generate and validate designs and measurement systems (8.3.2, 8.3.4, 8.5, 8.5.1)
3. Managing project documents (4.2, 7.5)
4. Collecting data (0.3.1, 7.1.6)

TABLE 1: Clause of ISO 9001:2015.

ISO 9001 2015 CLAUSE			
0	Introduction	0.4	relationship with other management system standards
0.1	General	1	Scope
0.2	Quality management principles	2	normative reference
0.3	process approach	3	terms and definitions
0.3.1	General	4	organizational context
0.3.2	Plan-Do-Check-Act Cycle	4.1	Understanding Organization and Context
4.2	Where necessary, the organization should	7.5.3	Documented information control
5	Leadership	3.5.3.1	Documented information is required by the quality management system and this International Standard must be controlled
5.1	Leadership and commitment	3.5.3.2	To control documented information, organizations must follow applicable standards
5.1.1	General	8	Operational
5.1.2	Customer focus	8.1	Operational planning and control
5.2	Policy	8.2	Requirements for products and services
5.2.1	set quality policy	8.2.1	Customer communication
5.2.2	Quality Policy Communication	8.2.2	Determination of requirements for products and services
5.3	Organizational roles, responsibilities, and authorities	8.2.3	Overview of requirements relating to products and services
6	Planning	8.2.3.1	Organizations must conduct a review before committing to supplying products and services to customers
6.1	Actions to address risks and opportunities	8.2.3.2	The organization shall retain documented information, as applicable
6.1.1	determine the risks and opportunities that need to be demonstrated	8.2.4	Changes to requirements for products and services
6.1.2	Organizations must plan	8.3	Product and service design and development
6.2	Quality objectives and planning to achieve them	8.3.1	General
6.2.1	The organization shall establish quality objectives at the functions, levels, and processes required for the quality management system	8.3.2	Design and development planning
6.2.2	Plan and determine how to achieve quality objectives	8.3.3	Input design and development
6.3	Change planning	8.3.4	Design and development control
7	Support	8.3.5	Design and development output
7.1	Resource	8.3.6	Design and development changes

TABLE 1: Continued.

ISO 9001 2015 CLAUSE			
7.1.1	General	8.4	Control of external products and services provided
7.1.2	People	8.4.1	General
7.1.3	Infrastructure	8.4.2	Type and level of control
7.1.4	environment for process operation	8.4.3	Information for external providers
7.1.5	Resource monitoring and measurement	8.5	Production and service provision
7.1.5.1	General	8.5.1	Production control and service provision
7.1.5.2	measurement traceability	8.5.2	Identification and Search
7.1.6	Organizational Knowledge	8.5.3	goods belonging to customers or external providers
7.2	Competence	8.5.4	Protection
7.3	Awareness	8.5.5	Post-delivery activities
7.4	Communication	8.5.6	Control over change
7.5	documented information	8.6	Release of products and services
7.5.1	General	8.7	Control over non-conforming output
7.5.2	Create and update	8.7.1	The organization shall ensure that outputs that do not conform to requirements are identified and controlled.
7.5.3	Documented information control	8.7.2	Organizations must retain documented information
3.5.3.1	Documented information is required by the quality management system and this International Standard must be controlled	8.5.3	goods belonging to customers or external providers
3.5.3.2	To control documented information, organizations must follow applicable standards	8.5.4	Protection
8	Operational	8.5.5	Post-delivery activities
8.1	Operational planning and control	8.5.6	Control over change
8.2	Requirements for products and services	8.6	Release of products and services
8.2.1	Customer communication	8.7	Control over non-conforming output
8.2.2	Determination of requirements for products and services	8.7.1	The organization shall ensure that outputs that do not conform to requirements are identified and controlled.
8.2.3	Overview of requirements relating to products and services	9	Performance Evaluation
8.2.3.1	Organizations must conduct a review before committing to supplying products and services to customers	9.1	Monitoring, measurement, analysis, and evaluation
8.2.3.2	The organization shall retain documented information, as applicable	9.1.1	General
8.2.4	Changes to requirements for products and services	9.1.2	Customer satisfaction
8.3	Product and service design and development	9.1.3	Analysis and evaluation

TABLE 1: Continued.

ISO 9001 2015 CLAUSE			
8.3.1	General	9.2	Internal audit
8.3.2	Design and development planning	9.2.1	The organization shall conduct internal audits at planned intervals to provide information on whether the quality management system
8.3.3	Input design and development	9.2.2	Organizations must:
8.3.4	Design and development control	9.3	Management Review
8.3.5	Design and development output	9.3.1	General
8.3.6	Design and development changes	9.3.2	Management review input
8.4	Control of external products and services provided	9.3.3	Management review output
8.4.1	General	10	Improvement
8.4.2	Type and level of control	10.1	General
8.4.3	Information for external providers	10.2	nonconformities and corrective action
8.5	Production and service provision	10.2.1	take action When a non-conformity occurs, including any complaints that arise
8.5.1	Production control and service provision	10.2.2	The organization shall retain documented information as evidence
8.5.2	Identification and Search	10.3	continuous improvement

4.1.3. Analysis

1. Identify the stages of the project process (8.3.2,)
2. Design verification (8.3.2, 8.3.4, 8.4.2)
3. Evaluating procurement activities (4.1, 6.1.2, 7.2, 8.3.4, 9, 9.1, 9.1.1, 9.1.3, 10, 10.2.1)

4.1.4. Repair

1. Project execution: start construction (0.1, 0.3.2, 9.2.2, 10.3)
2. Recording construction data (9.2.2)
3. Risk analysis (0.3.3, 5.1.2, 10.2.1)
4. Developing solutions to risks (0.1, 4.1, 5.1.1, 5.1.2, 6.1, 6.1.1, 6.1.2, 9.1.3, 9.3.2)

4.1.5. Control

1. Record, register, and report results (0.3.2, 5.3, 8.2.3.2,)
2. Result evaluation (6.2.2, 9, 10)

3. Project completion and closure (9. 9.1, 9.1.1, 9.1.2, 9.1.3, 9.2, 9.2.1, 9.2.2, 9.9, 9.3.1, 9.2.2, 9.3.1)
4. Record every lesson (7.1.6) [11].

4.2. Relationship of Deming's Management Principles (Dr. W. Edwards Deming) with the Clauses of ISO 9001:2015

1. create strong goals (6.3, 7.1.5.1)
2. New Philosophy (7.5.2)
3. Stop relying on mass inspection (0.1, 0.2, 0.3.1)
4. End the lowest tender contract (8.6, 8.7, 8.7.1)
5. Improve every process (0.2, 0.3, 0.3.1, 0.3.2, 4.1)
6. Organizing on-the-job training (7.1.5.2, 7.5.2)
7. Institutional Leadership (0.2, 5, 5.1, 5.1.1)
8. Dispel fear (7.1.4)
9. Break the barrier -
10. Remove the warning -
11. Eliminate numerical targets –
12. Allow the pride of workmanship (8.3.2)
13. Encouraging Education (7.1.5.2)
14. Top management commitments and actions (5.1, 5.1.1, 5.1.2, 8.2.3.1, 8.3.3) [12].

4.3. Relationship of Total Quality Management (TQM) (P & Juanzon) with Clause ISO 9001:2015

1. Customer focus (0.1, 0.2, 0.3.2, 0.4, 5.1.2, 5.3, 6.2.1, 7.1.6, 8.2.1, 8.2.3.1, 8.3.2, 8.4.1, 8.4.2, 8.7.1, 9.1.2, 9.3.2)
2. Leadership (0.2, 5, 5.1, 5.1.1)
3. Process management (0.2, 0.3, 0.3.1, 0.3.2, 4.4, 4.4.1, 4.4.2, 5.3, 6.2.1, 8.1, 8.3.1, 8.3.2, 8.4.1, 8.4.2, 8.4.3, 8.5.1, 9.2.2)

4. Supplier management (8.4, 8.4.1, 8.4.2, 8.4.3)
5. Employee engagement (0.2, 4.4.1)
6. Information and analysis (0.3.1, 4.1, 4.4.2, 5.2.2, 7.1.3, 7.1.5.1, 7.5, 7.5.1, 7.5.3, 7.5.3.1, 7.5.3.2, 8.1, 8.2.1, 8.2.3.2, 8.3.2, 8.3.3, 8.4.3, 8.5.1, 8.6, 8.7.1, 8.7.2, 9.1, 9.1.1, 9.1.3, 9.2.2, 10.2.1, 10.2.2)
7. Education and training (7.1.5.2, 7.2)
8. Continuous quality improvement (0.1)
9. Strategic quality management (0.1, 5.1.1, 5.2.1, 9.3.1)
10. Human Resource Management (0.3.2, 4.4.1, 5.1.1, 6.2.2, 6.3, 7.1, 7.1.1, 7.1.2, 8.1)
11. Product and service design (4.3, 5.1.2, 6.2.1, 7.1.6, 8.1, 8.2, 8.2.1, 8.2.2, 8.2.3, 8.2.3.1, 8.2.3.2, 8.2.4, 8.3, 8.3.1, 8.3.2, 8.3.3, 8.3.5, 8.4, 8.4.1, 8.4.2, 8.4.3, 8.5, 8.5.1, 8.5.5, 8.6, 8.7.1, 9.1.3, 9.3.2, 10.1)
12. Teamwork (0.2, 5.2.2)
13. Communication (5.1.1, 5.2.2, 6.2.1, 7.1.3, 7.4, 8.2.1)
14. Quality culture (0.1)
15. Quality system (0.1, 0.3.1, 0.3.2, 0.4, 1, 4.2, 4.3, 4.4, 4.4.1, 5.1.1, 5.2.1, 5.3, 6.1.1, 6.1.2, 6.2.1, 6.3, 7.1.1, 7.1.2, 7.2, 7.3, 7.5.1, 7.5.3.1, 8.4.2, 9.3.1, 9.3.3, 10.1, 10.2.1, 10.3)
16. Recognition and awards (5.1.1)
17. Comparison (5.1.1, 6.1.2)
18. The role of the quality department (5.3)
19. Fact-based management (0.3.1)
20. Quality assurance (1, 6.1.1)
21. Commitment to quality (5.1, 5.2.1, 8.3.3)
22. Resources (0.3.2, 4.4.1, 5.1.1, 6.2.2, 6.3, 7.1, 7.1.1, 7.1.5.1, 8.1, 8.3.2, 8.5.1, 9.3.2, 9.3.3)
[13].

4.4. Relationship of Quality Management System (QMS) (Mohd Asmoni et al.) with ISO Clause 9001:2015

1. Communication with customers (8.2.1)
2. Integration of the quality plan (5.1.1, 6.1.2)
3. Measurement and improvement (4.4.1, 7.1.5.1, 7.1.5.2, 8.3.5, 8.5.1, 9.1.1, 9.3.2)
4. Learning and Practice (7.1.6)
5. Teamwork and communication (5.1.1, 5.2.2, 6.2.1, 7.4)
6. Use of information and communication technologies (7.1.3)

4.5. Relationship of Baldrige Performance Excellence Framework (2021) to ISO Clause 9001:2015

1. System perspective (0.2, 5, 5.1, 5.1.1)
2. Visionary leadership (0.2, 0.3, 5, 5.1, 5.1.1)
3. Customer-focused excellence (0.1, 0.2, 0.3.2, 1, 5.1.2, 5.3, 6.2.1, 7.1.6, 8.2.1, 8.2.3.1, 8.3.2, 8.4.1, 8.4.2, 8.4.3, 8.5.3, 8.5.5, 8.7.1, 9.1.2, 9.1.3, 9.3.2)
4. Mutual respect -
5. Agility and resilience (6.1, 6.1.1, 6.1.2, 8.5.6, 8.7, 8.7.1)
6. Organizational learning (9. 9.1, 9.1.1, 9.1.2, 9.1.3, 9.2, 9.2.1, 9.2.2, 9.3, 9.3.1, 9.2.2, 9.3.1, 10, 10.1, 10.2, 10.2.1, 10.2.2, 10.3)
7. Focus on success and innovation (7.2, 8.3, 8.3.1, 8.3.2, 8.3.6)
8. Management by facts (0.3, 0.3.1, 9.2, 9.2.1)
9. Social contribution -
10. Ethics and transparency -
11. Delivering value and results (9. 9.1, 9.1.1, 9.1.2, 9.1.3, 9.2, 9.2.1, 9.2.2, 9.9, 9.3.1, 9.2.2, 9.3.1)

4.6. Lean Manufacturing's Relationship (D'Aureliano et al.) with ISO Clause 9001:2015

1. Reduce activity without affecting results (0.3.1, 4.4.1, 5.1.1, 7.1.2, 9.1.3, 9.2.1, 10.2.1)
2. Considering the needs of customers to increase the value of products (0.2, 5.1.2, 5.3)
3. Reduced variability (0.3.1, 1, 4.4.1, 5.1.1, 7.1.2, 9.1.3, 9.2.1, 10.2.1)
4. Reduced cycle time -
5. Simplify through stage reduction (0.3.1, 1, 4.4.1, 5.1.1, 7.1.2, 9.1.3, 9.2.1, 10.2.1)
6. Flexible improvement in results (8.5.1)
7. Improve process transparency-
8. Focus on global process control-
9. Introduce continuous process improvement (10.2, 10.2.1, 10.2.2)
10. Workflow balance through increased conversions (0.3.1, 10.2.1)
11. Benchmarking (0.3.2, 4.4.1, 8.5.1, 9.3.2) [14].

5. Quality Management System (QMS) Mapping

Mapping is carried out by coloring each quality management system model to find out if it already exists and is not yet in ISO 9001 2015 (Fig. 2).

6. Result and Discussion

From this study there are eight points that should be of concern to them. Breaking down barriers between departments Breaking down barriers means breaking down the boundaries between departments and employees. People in different areas, such as the leasing, maintenance, and administration departments, must work in teams to deal with every problem. Eliminate the exhortation, Eliminate slogans, posters and calls to the workforce, demanding zero defects and new levels of productivity, giving no method. Such advice only creates a hub of hostility, most of the low quality and low productivity belong to the system and are thus beyond the power of the workforce. Eliminate numerical targets, Eliminate labor standards that set rigid targets for labor and people

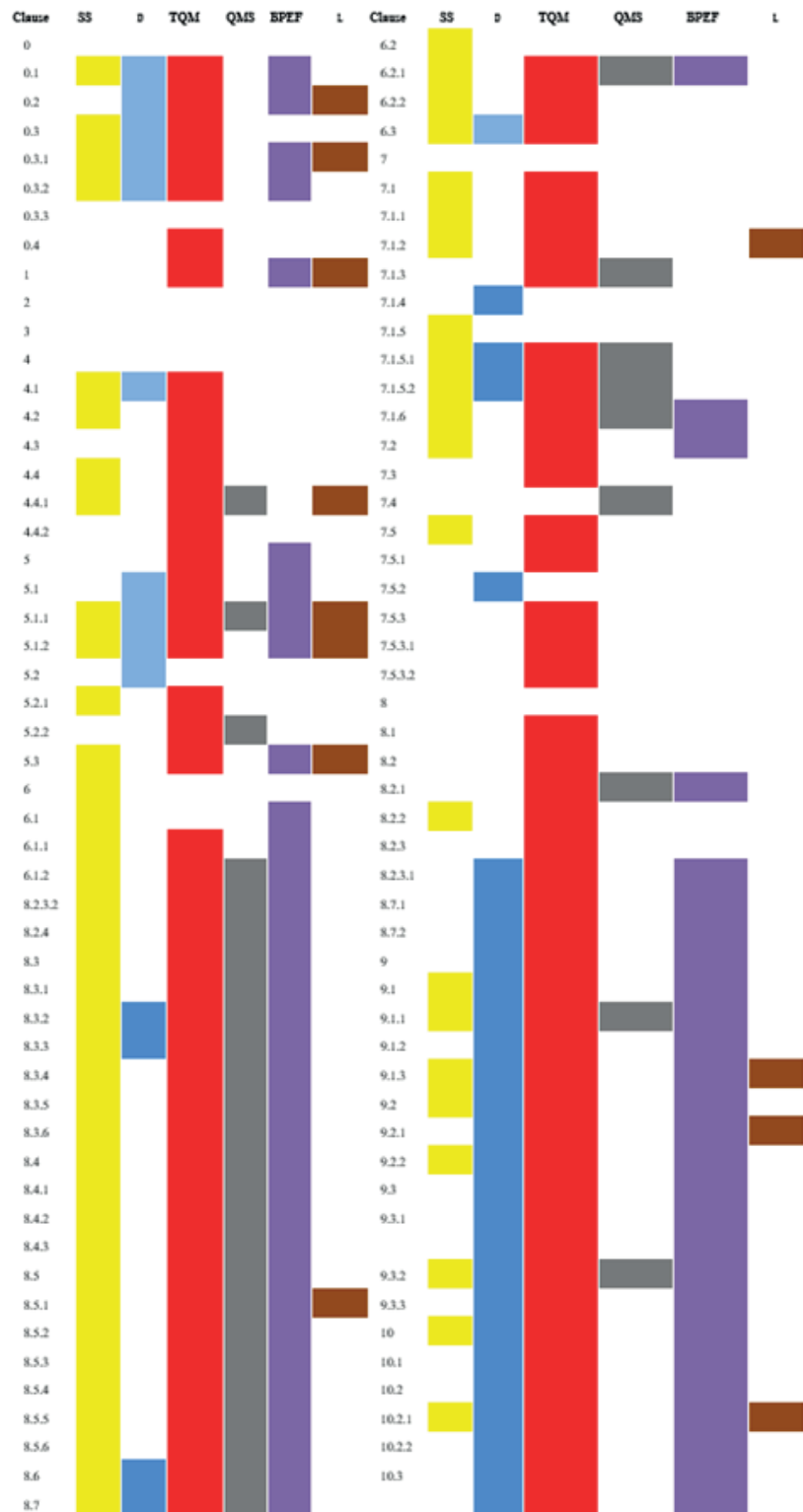


Figure 2: Mapping models quality management system to ISO 9001:2015.

in management. Substitute assistance and leadership that helps to achieve continuous improvement in quality and productivity. Value people Successful organizations value members of their workforce and others who have an interest in the organization,

including customers, members of the public, suppliers and partners, and any other party affected by its actions. Community contribution Leaders of organizations must emphasize contribution to the public and consideration of the welfare and benefit of society. Leaders must be role models for the welfare of society. Cycle time reduction, Connect all important periods and materials in construction. Cycle time reduction shows that each process runs at the right time because it avoids increasingly severe delays. Increase process transparency, the more transparent a process is, the easier it is to have better control and improvement. Transparency, increase production visibility, and drive improvement. Focus on global process control, it has different units to control each segment but thoroughly.

7. Conclusion

From the research that has been done, there are eight additional variables that complement ISO 9001:2015 these additional variables are Break down barriers between departments, Eliminate exhortations, Eliminate arbitrary numerical targets, Valuing people, Societal contributions, Cycle time reduction, Increase process transparency, Focus on global process control.

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