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Improve customer satisfaction by quality functions deployment: Case in Indonesian SMEs

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Abstract

This paper explores how the quality function deployment (QFD) is used to translate customer needs into technical parameters that will be controlled in the process and ultimately can produce products as customers expect. This research through field observations and brainstorming with representative employees to create house of quality and set recommendation actions. With strong support and commitment to complete actions, resulting in better product quality that shows a gradual shift in product quality from grade B to grade A means that operations are more reliable. Through QFD, it will be known what customers really want, which is the most important customer needs, what can be controlled in meeting customer needs so that customer needs can be met. This paper suggests several approaches and actions that can be of high value especially in the woodworking industries.

Keywords: Customer Need; House of Quality; QFD; Quality; Woodworking

1. Introduction

Understanding customer needs is a must for companies that want their business to survive and grow in the future. Understanding customer needs will be able to avoid problems that arise both regarding the quality of services and products that can interfere with long-term cooperation.

Many organizations/companies that develop products, services, processes or strategies, must be able to answer some very basic questions. These questions include; who are our customers? What do they really want? Which are their most important needs? Where should we focus? What can we control in meeting customer needs?

As well as in the woodworking industry. Albasia Bare-core is a sheet of wooden board with dimensions of thickness x width x length = 13.0 x 1,220 x 2,440 mm which is arranged from pieces of Albasia wood/Sengon wood which are glued together using glue adhesive. This product is still a semi-finished material which will be processed further. Companies that produce bare-core boards outside Indonesia are timber companies in the Philippines and Vietnam, where production in Indonesia is still higher. If production in Indonesia is too many and uncontrolled, it is certain that bare-core world board prices will also decline, given that Indonesia is the key to the dominance of world bare-core board production.

The countries with the highest demand for bare-core board products now are China and Taiwan. Due to the demand from China in 2013 increased, resulting in the emergence of many factories in Indonesia producing bare-core boards. Start in 2014 the export quota of the bare-core board was limited, resulting in thousands of workers being laid off. By companies in China, bare-core boards are further processed with coatings on the surface side to be used as block boards. Exports from Indonesia's bare-core board industry are now difficult for growing up because they are so heavily dependent on China. The trend from year to year purchasing bare-core boards by timber companies in China and

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Taiwan declined. This worsened with falling prices as a result of competition from the bare-core board companies in Indonesia to enter these countries. Bare-core board prices fell as a result of the company's lack of interest in buying bare-core boards from Indonesia, while production continued to take place resulting in a build-up of bare-core board production which prompted companies to compete to enter goods at lower prices. Many bare-core board industries are closed due to collapse.

The decline in the price of the bare-core board has caused a decline in the price of Albasia wood, which is feared to make farmers and factory continue to be depressed. The long-term impact, farmers may be reluctant to plant and factory out of business, because it is difficult to sell goods. The cause of the decline in timber prices is because the price of timber produced by Indonesia is more expensive than wood from Vietnam. Which makes foreign buyers prefer Vietnam's wood. Vietnam is more economical because of its closer to buyers from China.

In addition to the declining selling price, the quality of wood demanded by large buyers or factories also increased. Here the buyer has the freedom to choose products from producers that are in line with his expectations, namely cheaper prices with better product quality among existing producers. By understanding customer needs, especially product quality and translating them into technical parameters through a process of analysing quality function deployment that needs to be corrected and controlled, it can avoid customer complaints and will provide a great opportunity to win the tight bare-core board business competition.

2. Problem Statement

The object of the study was the product of Albasia Barecore board which produced by SMEs Company K which located in Central Java Indonesia, where most of the products are exported to various companies in China.

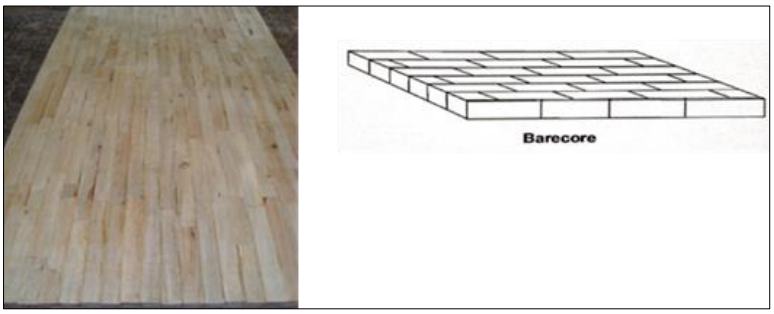


Figure 1 Barecore board

Based on the background of the problem above, in this study the researchers formulated the problem of improving product quality using QFD and the main focus of research as follows:

- How do consumers respond to the attributes that are considered important?
- How is the process of improving product quality in this company so that it can compete with other companies?

3. Literature

QFD is used to capture the voices and desires of customers, then convert them into the right strategies for products and processes needed. QFD is the product development process to maximize customer satisfaction [1]. QFD is widely used to capture customer requirements which are real by focusing on customers' needs [2]. Customer expectations are translated into specific needs in the direction of strategic planning and technical action. To accomplish that goal, it is important to know the customer's needs or requirements (Customer Voice) so that they can be involved from the early phases of the planning process [3]. The primary concept at the back of this technique is to take into critical attention the "Wants" of the customers, in order that they may be translated to engineering traits of the product/service [4].

QFD began to develop a systematic approach to the 'control plan' from which processes, equipment, and measuring instruments, material control can be emphasized through the identification of significant process characteristics. Cross-departmental teams implement QFD by creating a series of one or more matrices. The first matrix is called the House of Quality (HOQ). These matrices relate customer wants and needs to an extensive set of product features [5].

The following can be concluded that QFD in a broad sense, is a team approach to explore the "voices of consumers" related to the quality of services or products and translate them into technical parameters that are easily understood in the process of service and production activities so that the results can meet the expectations of consumers, which in turn may fulfil overall customer satisfaction for a product or service [6]. QFD is a structured multi-purpose framework, which can be used to translate improvement needs of various systems into prioritized improvement activities [7], exercise provides the prioritized technical requirements [8].

The benefits of this QFD implementation for companies include: (a) speed up development time, that is the time caused by initial identification and resolve design problems. This will reduce development costs and bring a faster market response time. (b) Improve customer satisfaction, to focus more on issues/problems that are very important for customers. (c) Improve the direction of the Organization, because all products, services or business directions have been approved by the team.

[9] Defines Quality Function Deployment (QFD) as a method for generating policies based on consumer evaluations to achieve customer satisfaction. QFD is a method that can bring a product according to consumer needs [10]. [11] States that QFD is a structured method of product planning and development by following the desires and needs of consumers, and conducting a systematic evaluation of its ability to produce products to satisfy consumers. This method is used to determine the performance of the production support department on service satisfaction in the production department which is carried out by making a house of quality.

Making House of Quality (HOQ) consists of several processes. Processing of the results of observations that will be described in the discussion, interviews with several consumers and employees, and distributing questionnaires is the data needed to build the HOQ matrix. Observations were made by observing behaviour and interviewing stakeholders as a framework for building HOQ attributes. The process for building the HOQ can help design as needed. The results of the processing are the target specifications that will be the basis for improving product quality.

According to [11], QFD is a structured method used in the product planning and development process to determine the specifications for the needs of a product or service in meeting the needs and desires of consumers. QFD implementation has several phases, where all activities carried out in each phase can be applied like a project, namely:

- Voice of Customer Gathering Phase
- Phase of making Quality Houses,
- Design phase and product quality development/improvement.
- The third phase is the phase that is considered to have a very large influence on the object to be studied.

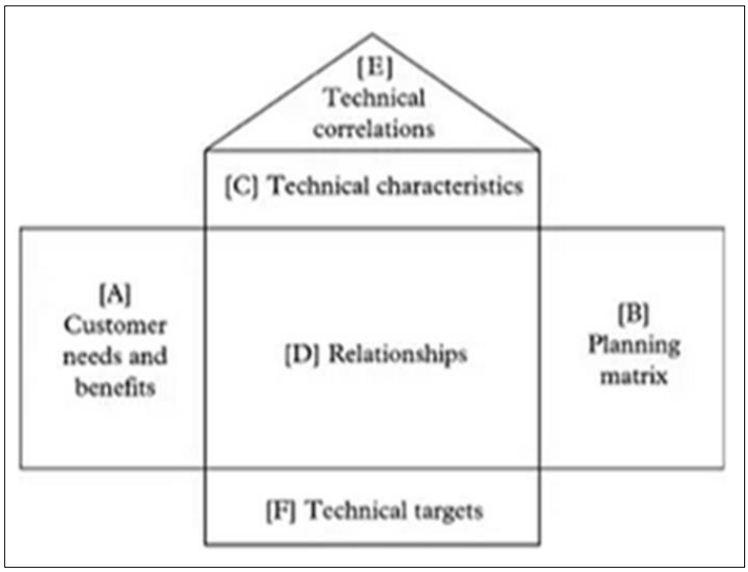


Figure 2 House of Quality. Source: [11]

The QFD section is the House of Quality (HOQ). This matrix describes the basic process in QFD, namely meeting customer needs (what's) with consideration of technical requirements (how's) [12]. [13] States that the structure of the

QFD chart is similar to the frame of the house. The HOQ has several sub-matrixes that are connected in several ways, each with related information. These matrices are tools for QFD practitioners to re-prioritize consumer attributes [14]. After determining the data about the attributes of the problem, a planning matrix is prepared which contains important information.

Part A (customers need and benefit), lists all customer needs and expectations for customers usually determined by qualitative market research. The way to find out customer needs and expectations is as follows:

- Conduct online or face-to-face interviews with customers to find out their wants and needs.
- Distribute questionnaires or questionnaires to customers regarding the needs and expectations of customers for the products or services provided by the organization or company to customers.
- Receive customer complaints and suggestions.
- Conduct testing on potential customers, namely by giving them a new product, then asking for their response to the product.

Part B (planning matrix), contains the following three types of information.

Market data quantitatively shows the relationship and expectations with customers as well as the level of customer satisfaction with the organization or company and the competitors of the company.

- Use of strategic plans for new products or services.
- Calculate the level of customer needs and expectations.

Section C (technical characteristics), contains the technical language of the organization as well as a high-level description of the product or service. Normally, a technical description is composed of the customer's needs and expectations in section A.

Section D (relationship), contains the team's consideration of customer relationships and expectations with technical feedback.

Section E (technical correlation), on technical relationships contains assessments on the applicability of the interrelationships of elements in the technical response of the development team.

Section F (technical targets), contains the following three types of information:

- Priority technical response based on customer needs and stages
- Company technical target
- Determine company benchmarking

4. Methodology

4.1. Research Design

This study uses a qualitative research approach. Research design is a research framework and structure designed to provide answers to research questions. This study used a descriptive and descriptive study design. The scope of this study is focused on improving the production process in the internal of the factory. Whereas the aim to be achieved from this research is to get process improvement especially to the technical parameters that play a role in the emergence of complaints about a product quality by customers.

4.2. Data collection and processing

The QFD Rules

In the implementation of QFD in the manufacturing industry, the following are examples of QFD rules applied

- QFD is a living document (must be reviewed regularly at least once / year) and must be maintained as an attachment in the 'control plan'.
- QFD is required for all analyses and studies to determine significant characteristics in the production process where the technical characteristics are measured.

- QFD must begin at the Development stage of new product development. The output of QFD is a requirement for a 'control plan' at the factory.
- QFD must be updated when significant characteristics are not in accordance with product/process requirements and will require corrective action.
- All generated QFDs (new or revised) must be signed by a quality manager for each department section.
- Changes made or improvements to the situation achieved during QFD must be reflected in the preparation of the 'control plan'.
- QFD must be updated when significant changes are needed due to customer complaints or changes in expectations.
- To reflect customer expectations, QFD can be developed taking into account external customer surveys and customer complaints or with direct customer involvement.

4.3. Stages of QFD

- Prepare 'house of quality'
- Fill in the customer attributes in the field of customer/customer contributions.
- The customer contribution area is the horizontal part of the matrix that contains information on customer needs. Customers who use products are asked about their expectations for the product. Their opinions about product parameters are recorded in the "customer needs" column. Customer product parameters are then translated into technical attributes/characteristics. These "customer needs" will be ranked based on the importance of the column that refers to the customer's voice. (e.g. customer complaints and/or field returns, customer satisfaction surveys (CSS), customer surveys, etc.). The importance rating level will be assessed by the QFD team. To determine the level of importance, categorize each customer's voice items (e.g. customer complaints and/or field returns, customer satisfaction surveys, customer surveys, etc.) into grades 1 to 5 (for example 1 = very weak, 2 = weak, 3 = medium, 4 = strong, 5 = very strong).
- Fill in the characteristics of the technique.
- The product is studied and broken down into all steps of the manufacturing process. Each step will have characteristics called technical characteristics or technical parameters. Each technical characteristic is equipped with unit measurements
- Find the correlation between customers and techniques.
- Location is prepared between the customer column and the engineering row (matrix area). Scores between 1 - 9 indicate the level of relationship, 1 = weak, 3 = moderate and 9 = strong. If there is no correlation it must be filled with 0 (zero). Study and test customer views and techniques through the matrix method.
- Fill in the correlation characteristics of the technique.
- Correlation of technical characteristics is a score calculated from the correlation between technical characteristics. Location score is on the roof of the house. The score is 1-9, where 1= weak, 3= medium and 9= strong. If there is no correlation it must be filled with 0 (zero). Study and check and fill scores.
- Ranking (raw score) Calculation.
- Calculate the importance rank (raw score). Multiply the customer priority ranking (level of importance) with the correlation between the customer and the technique in each matrix box and add the product produced in each column. This rating can help determine the priority of technical characteristics
- Study and Analysis.

The QFD team changes customer needs into technical attributes. The team also set priorities for determining significant technical characteristics by using important ranks (raw scores) and correlation values by combining organizational priorities (engineering attributes) with customer priorities (customer needs). However, it is always possible that certain characteristics have very low values and consequently can be ignored. In that case, the QFD roof provides additional data where the correlation between characteristics is a determining factor whether to check the process or not.

5. Results and discussion

This section discusses the data collected from interviews provided to various stakeholders. The analysis was carried out from the collected interviews and then the discussion was carried out according to the supporting literature.

5.1. House of Quality Analysis

Table 1 House of quality weighting

	Customer needs	Customer Value	Enginering Att	Degree of importance	Process parameters	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16		
					Unit	Grade	°C / # day	siku	Max 2mm	45 °	mm	mm	mm	Grade	Grade	Grade	siku	Rata	°C / pc/mnt	Grade	Bundle		
						Material sawntimber quality	Kiln Dry setting	Straight knife jumping saw	The difference between the edges of the knife edge DP	Degree of inclination of blade DP	Distance between Multi rip saws	Multi rip saw blade flatness	Multi rip saw wobble	Cross cut	Sorting out cross cut	Arrangement on the baking sheet	Straightness of the saw cut on the baking sheet	Glue coating on composer table	Composser setting	Sort out composer	Packing		
1	No outspec of product dimension	3	Cutting Size + tolerance	5		3	1	9	9	9	9	9	9	9	3	3	9	3	9	9	1		
2	Knots as per each grading rule (A & B)	3	Knots	5		9	1	1	1	1	1	1	1	9	9	9	1	1	1	9	1		
3	Center Pith as per each grading rule (A & B)	3	Center Pith	5		9	1	1	1	1	1	1	1	9	9	9	1	1	1	9	1		
4	Gap as per each grading rule (A & B)	3	Gap	4		3	3	9	9	9	3	3	3	9	9	9	1	1	9	9	1		
5	No defect within 10 cm from end	3	Defect within 10 cm from end	5		9	1	3	1	1	1	1	1	3	9	9	1	1	1	9	1		
6	Split as per each grading rule (A & B)	3	Split	4		3	3	3	3	3	1	1	1	3	9	9	1	1	1	9	1		
7	Water stain as per each grading rule (A & B)	3	Water stain	5		9	1	1	1	1	1	1	1	1	9	9	1	1	1	9	1		
8	Pinhole as per each grading rule (A & B)	2	Pinhole	3		9	1	1	1	1	1	1	1	1	9	9	1	1	1	9	1		
9	Unflat as per each grading rule (A & B)	3	Unflat	4		3	1	3	3	3	9	9	9	1	9	3	1	1	1	9	1		
10	No Decay	3	Decay	5		9	3	1	1	1	1	1	1	1	9	9	1	1	1	9	1		
11	Lamina pitch as per each grading rule (A & B)	3	Lamina Pitch	4		1	1	1	1	1	1	1	1	1	9	9	1	1	1	9	9		
12	Frame as per each grading rule (A & B)	2	Frame	4		1	1	1	1	1	1	1	1	1	9	9	1	1	1	9	1		
	Raw Score					227	59	131	121	121	121	121	121	203	339	315	81	51	113	369	73	0	2566
	Relative Weight					0,088	0,023	0,051	0,047	0,047	0,047	0,047	0,047	0,079	0,132	0,123	0,032	0,020	0,044	0,144	0,028	0,000	1,000

From the house of quality above whereby giving weighting;

- Against 'customer value', where score 1=weak, 2=moderate, 3=strong
- Against "degree of important", where score 1=very weak, 2=weak, 3=moderate, 4=strong, 5=very strong
- Customer correlation and process parameters, where 0=no relationship, 1=weak, 3=moderate, 9=strong

The weighting above gives the results of relative weight numbers which can then be used to determine the priority scale for follow-up improvements.

Table 2 Prioritization of process parameters

No	Process Parameters	Relative Weight	Cum
1	Sort out composer	0.14	0.14
2	Sorting out cross cut	0.13	0.28
3	Arrangement on the baking sheet	0.12	0.40
4	Material sawn timber quality	0.09	0.49
5	Cross cut	0.08	0.57
6	Straight knife jumping saw	0.05	0.62
7	The difference between the edges of the knife edge DP	0.05	0.66
8	Degree of inclination of blade DP	0.05	0.71
9	Distance between Multi rip saws	0.05	0.76
10	Multi rip saw blade flatness	0.05	0.81
11	Multi rip saw wobble	0.05	0.85
12	Composer setting	0.04	0.90
13	Straightness of the saw cut on the baking sheet	0.03	0.93
14	Packing	0.03	0.96
15	Kiln Dry setting	0.02	0.96
16	Glue coating on composer table	0.02	1.00

Source: processed field data

From the table above, we can see the relative weight numbers that have been sorted to make it easier in determining the priority parameters that will be followed up with corrective steps.

5.2. Prioritization of Recommended Actions

Table 3 Prioritization of recommended actions

No	Process Parameters	Recommended Action	Resp
1	Sort out composer	Redefine quality standard and agreement with customers	Q. Mgr
		Train the operators about new quality standard	Q. Mgr
		Implement weekly regular audit and review	Q. Spv
2	Sorting out cross cut	Train operators about grading rules of core pieces	P. Mgr
		Implement weekly regular audit and review	Q. Spv
3	Arrangement on the baking sheet	Re layout operators position for arrangement core pieces	P. Mgr
		Train operators about new rules of arrangement core pieces	P. Mgr
		Implement weekly regular audit and review	Q. Spv
4	Material sawn timber quality	Adapt ratio percentage of sawn timber grade	P. Mgr
5	Cross cut	Train operators about new rules of cutting core pieces	P. Mgr

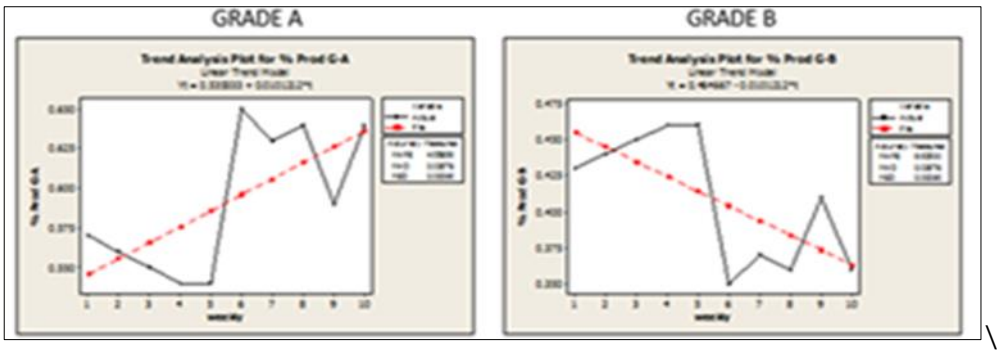
		Implement weekly regular audit and review	Q. Spv
6	Straight knife jumping saw	Train operators about new rules of cutting sawn timber	P. Mgr
		Implement weekly regular audit and review	Q. Spv
7	The difference between the edges of the knife edge DP	Create procedure of knife saw blade preparation & train operators	M. Spv
8	Degree of inclination of blade DP	Create procedure of knife saw blade preparation & train operators	M. Spv
9	Distance between Multi rip saws	Create procedure of knife saw blade preparation & train operators	M. Spv
10	Multi rip saw blade flatness	Create procedure of knife saw blade preparation & train operators	M. Spv

Source: processed field data

To get optimal results, the corrective steps are focused on 10 parameter processes that cover 80% of the trigger problems at the customer.

5.3. Finish Product Grading Performance

From Figure 3. it can be seen that the trend of % A grade products have increased and vice versa with% B grade seen decreasing, this indicates the process is getting better.



Source: processed field data

Figure 3 Quality Grade of Finish Product

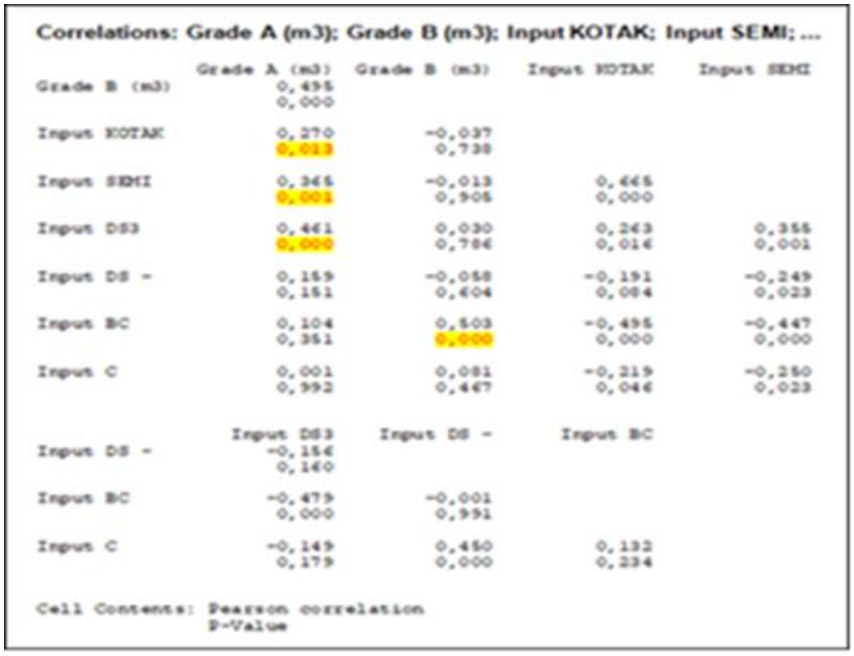
5.4. The key factors of successful QFD implementation

5.4.1. QFD process

Team objectives and membership roles have been clarified where the team needs to function effectively. In terms of the complexity of the problem which has an impact on customer interest, the selection of the right team member is key to effective problem solving. The role of team members who are experts in their fields will help in the preparation of the house of quality well to get prioritization of problems and actions. Including the commitment in completing action recommendations have to be stated. In the implementation all of this information must be correct in communicating on the floors and training for those who do not understand. An audit is needed to ensure that what has been agreed has been carried out correctly and the regular review process of the achievements can encourage the fulfilment and achievement of objectives.

5.4.2. Adapt % of sawn timber grade

By implementing the recommended action plan, specifically, the shift % in sawn timber material grade obtained from correlation analysis can provide a shift in the grade performance of the finished product as large as the needs of the customer.



Correlations: Grade A (m3); Grade B (m3); Input KOTAK; Input SEMI; ...

	Grade A (m3)	Grade B (m3)	Input KOTAK	Input SEMI
Grade B (m3)	0,495 0,000			
Input KOTAK	0,270 0,013	-0,037 0,730		
Input SEMI	0,365 0,001	-0,013 0,905	0,665 0,000	
Input DS3	0,461 0,000	0,030 0,786	0,263 0,016	0,355 0,001
Input DS -	0,159 0,161	-0,058 0,604	-0,191 0,084	-0,249 0,023
Input BC	0,104 0,361	0,503 0,000	-0,495 0,000	-0,447 0,000
Input C	0,001 0,992	0,081 0,467	-0,219 0,046	-0,250 0,023

	Input DS3	Input DS -	Input BC
Input DS -	-0,156 0,160		
Input BC	-0,479 0,000	-0,001 0,991	
Input C	-0,149 0,179	0,450 0,000	0,132 0,234

Cell Contents: Pearson correlation
P-Value

Source: processed field data

Figure 4 Correlation analysis % sawn timber and Finish product grade

5.4.3. Finish Product Grade A

- Box shape of sawn timber material has a significant effect on the positive direction.
- Semi-Box shape of sawn timber material has a significant effect on the positive direction.
- DS3 shape of sawn timber material has a significant effect on the positive direction.

This means that the more % of the three above sawn timber materials used will give addition of grade A of finish product.

5.4.4. Finish Product Grade B

- BC shape of sawn timber material has a significant effect on the positive direction. This means that the more % of the BC shape sawn timber material used will give addition of grade B of finish product.
- In connection with the correlation results above, it is recommended in the purchase of sawn timber material to purchase sawn timber material as% of the composition required for production and this means having to communicate again to the supplier to work together to follow the pattern of the composition. This correlation analysis result can also apply to similar industries.

5.5. Managerial Implication

This research provides empirical evidence that customer satisfaction can be improved through a structured approach in translating customer desires. By translating customer desires into technical parameters, it is easy to determine the things that need to be improved and controlled so that the production process is more reliable. Commitment in completing action recommendations have to be stated. Communicating on the floors and training for those who do not understand. An audit is needed to ensure that what has been agreed has been carried out correctly and the regular review process of the achievements can encourage the fulfilment and achievement of objectives. With a structured approach through QFD, it is easy for managers to focus more on things that give benefit the customer.

6. Conclusion

QFD is used to capture the voices and desires of customers, then convert them into the right strategies for products and processes needed. Through house of quality was obtained 10 parameter processes that cover 80% of the trigger problems at the customer. To improve finish product, grade A which requested by customer mainly can be achieved by arrangement % composition of sawn timber material that mostly influent by box shape, semi-box shape and DS3 shape of sawn timber material which also can apply to similar industries.

Compliance with ethical standards

Acknowledgments

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Disclosure of conflict of interest

The Author wish to declare that none has any interest to disclose.

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