Quality Management Strategy for Indonesian Aircraft MRO Companies Based on Kano Model, QFD Matrix, and AHP

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Abstract

The growth of commercial aviation in Indonesia is increasing and making the potential growth of MRO (maintenance, repair, overhaul) company. Tight competition among MRO companies in Indonesia demands the right quality management strategy in order to compete globally. This reseach objective is to find a implementation of quality management strategy for Indonesian aircraft MRO companies. This research methodology based on Kano Model, Quality Function Deployment (QFD) matrix, and Analytic Hierarchy Process (AHP) to understand and analyze customer's need. The results of this study are strategies that can be applied by Indonesian aircraft MRO companies to improve product quality and maintain company's competitive advantage.

Keywords
MRO, Quality Management, Kano, QFD, AHP

1. Introduction

The aviation world today has a huge social and commercial role for society, so as global economic growth continues to grow, demand for air transportation is expected to grow rapidly (Poll, 2017). Although demand for air transport needs is often considered close to GDP, the International Air Transport Association (IATA, 2016) reports that passenger traffic growth has exceeded global GDP over the past nine years (Wyman, 2017). In Indonesia alone, throughout 2014, national route services increased by 18% compared to 2013, then on international lines increased by 32% (Ministry of Industry, 2016).

The rapid growth of the aviation world will undoubtedly have an impact on the growth of the aircraft maintenance industry which is an important factor in the success of airlines generating revenue with high-flying aircraft utilities, where data indicate that aircraft maintenance costs can generate businesses by two-thirds the price of the aircraft itself, and play 10-20% of shares in airline international costs (Jingmin, 2006). The growth rate of the global aircraft maintenance industry is expected to increase at an average rate of 5.2% to 2022 and 3.8% on average per year until 2027 (Wyman, 2017).

Currently airlines tend to use outsource strategies for areas that are not their core business, one of which is in the field of aircraft maintenance as it is considered capable of transferring risks associated with regulation and at a reasonable cost (Rieple, Outsourcing for competitive advantage: an examination, 2008) and (McFadden & Worrells, 2012). Overall, airlines allocated an average of 64% of their maintenance costs in 2007, compared to 37% in 1996, for outsourcing aircraft maintenance activities, covering everything from repairing critical components, such as landing gear and engine repairs, to check the weight plane (FAA, 2008). Outsourcing MRO allows airlines to avoid significant capital investment in the facilities, equipment and supply of parts and components (Tang & Elias, 2012), therefore

airlines with large fleets tend to have their own aircraft maintenance centers rather than airlines with small fleets or low-cost carrier (Phillips, 2008).

While current airline trends are increasing the portion of their outsourcing activities in the field of aircraft maintenance, the MRO's main role is to provide aircraft with high servicability levels with minimum cost and optimal quality (Al-kaabi, Potter, & Naim, 2007) received much criticism from consumers (Machado, Araújo, Urbina, & Macau, 2016). This is a very open opportunity for MRO companies to compete in offering maintenance services to airlines since most airlines still outsource their aircraft maintenance work without long-term contracts (Al-kaabi, Potter, & Naim, 2007) and (Wibowo, Tjahjono, & Tomiyama, 2016), so MRO companies should be able to implement the right strategy to maintain or gain new markets and customers globally (Flottau, 2014). Thus, the discussion of airline consideration of their aircraft maintenance service providers remains a topic of complex discussion (Rieple & Helm, Outsourcing for competitive advantage: An examination of seven legacy airlines, 2008).

2. Research Gap

(Al-kaabi, Potter, & Naim, 2007) examines the characteristics of the airline's outsourcing pattern for aircraft maintenance, and the results show that the business model of aircraft maintenance becomes very dynamic, as shown in Figure 2, where none of the airlines have an outsourced pattern the same in each aircraft maintenance activity due to differences in the characteristics of each type of maintenance activities. Machine maintenance and component maintenance are the first and the second most outsourced activities by airlines, and line maintenance is the least outsourced activity (Al-kaabi, Potter, & Naim, 2007)

MRO activity	In-sourced	Some outsourcing	Fully outsourced
Line maintenance	A,C,D,E,F,G,H	B	
Base maintenance	A,C,D	B	E,F,G,H
Engine maintenance		D	A,B,C,E,F,G,H
Spares and routables		A,B,E	C,D,F,G,H
Aircraft modifications	B,C	A,D,E,F	G

Figure 1. Matrix types of outsourcing of airline MRO (Al-kaabi, Potter, & Naim, 2007)

(Momme & Hvolby, 2002) examines the outsourcing decision steps, which begin by analyzing core competencies, cost efficiency and effectiveness and the financial situation of outsourcing firms. Subsequent activities involve selecting the most qualified providers carefully. The results of this phase include the right strategic reasons for outsourcing, the right function or activity to be left out and the provider of the right to outsource to the service provider company.

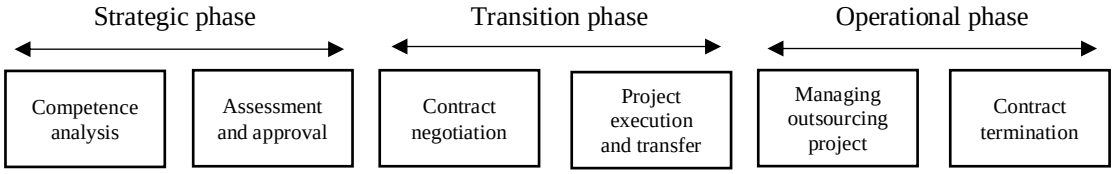

Figure 2. Steps of outsourcing decisions (Momme & Hvolby, 2002)

Airlines also tend to provide aircraft maintenance work to MRO companies in countries with low hourly labor costs (Phillips, 2008). This makes MRO companies in developing countries have great potential to compete in the global aircraft maintenance market considering the competitive advantage of developing countries in general one of them is the low cost labor (Allen, 2017).

But, the actual selection process varies according to the airline and is based on the needs and priorities set by management. Becher, a spokesman for Northwest Airlines stated in 2005: "Rather than cost factors, Northwest focuses more on the form of management, control systems and technical capabilities. Therefore outside vendors undergo a rigorous review before being offered a maintenance contract by Northwest. (cited in " Maintenance Outsourcing ", 2009). Jet Blue's technical service deputy director, Ramage, said that the timing of completion and quality of service is a key factor in the selection process. He said " The first thing we see is corporate culture. And obviously when I talk about quality, this is a safety culture and whether they can do a good job. Quality, safety and experience are very important " (quoted by Arnoult, 2010). (Sakburanapech, 2008) then determines customer requirements of aircraft MRO outsourcing management: (1)Mutual understanding, (2)Clearly defined contract/agreement, (3)Mutual benefit, (4)Frequent and open communication, (5)Commitmen, (6)Clearly defined performance measurement, (7)Trust, (8)Clear delivery process, (9)Clearly defined product/services, (10)Joint resolution, (11)Shared information, (12)Shared knowledge, and (13)Flexibility. (Sakburanapech, 2008) also already determine technical requirements of aircraft MRO outsourcing management: (1)Productivity, (2)Availability of Resources, (3)Quality, (4)Responsiveness, and (5)Costs. From the research mentioned, it can be seen that there is no research that analyzed in depth and integrate customer requirements and technical requirements into a strategy to improve quality of products/service.

3. Literature Review

There are four areas that get the most attention from recent researchers about MRO, namely (1) planning and scheduling, eg. The et al. (2003) and Alfares (1999) examining the model of aircraft maintenance personnel; (2) supply chain and inventory management, eg. Adams (2004) and Ghobbar and Friend (2003) investigating inventory forecasting techniques, then (3) safety and reliability risks, eg. Leung et al. (2007) and Sachon and Pate-Cornell (2000) investigating risk analysis methods to improve the reliability of aircraft maintenance, and (4) outsourcing model of aircraft maintenance. Research on outsourcing aircraft maintenance itself has also not been widely discussed, only in aspects (1) characteristics of global MRO outsourcing; such as (Al-kaabi, Potter, & Naim, 2007) and (Rieple & Helm, Outsourcing for competitive advantage: An examination of seven legacy airlines, 2008) discussing the types of outsourcing of MRO aircraft as well (Wibowo, Tjahjono & Tomiyama, 2016) discussing the productivity of MRO aircraft companies, and (2) safety (Machado, Araújo, Urbina, & Macau, 2016). No research has focused on analyzing the customer needs of aircraft MRO companies-in this case airline-in depth as the basis for developing a company's quality management strategy.

The role of customers in the aviation industry is increasingly being highlighted because the delivery of high quality services is critical to the viability of airlines and is critical to the competitiveness of the aviation industry itself (Park et al., 2005). Currently, MRO's corporate treatment in Indonesia towards airlines as its main customers is still traditionally, where customers are regarded as kings and in this way, MRO Indonesia's company only focuses on satisfying customers with reactive systems, focusing on customer specific demand, one -at-a-time. Of course this results in a lack of customer satisfaction, as indicated by the still untapped target of Customer Satisfaction Index (CSI) of the largest MRO aircraft company in Indonesia by 2016. In a competitive industry such as the aviation industry (Phillips, 2008), it is important for companies not to just do what the customer wants or hopes for, but also to do corporate strategy planning and sound resource-based management of the customer (Chow, 2015). Therefore, one question arises that the main problem in this research is how to develop quality management strategy based on aspects affecting the airline in determining its aircraft maintenance service provider company?

Quality Function Deployment (QFD) is known as a method to ensure that the quality of products and services is developed according to customer expectations (Babayi, 2008). Quality Function Deployment (QFD) is used to understand customer needs for the product and relate it to the design specifications through quality home (HoQ), a systematic method based on the idea of adaptation techniques in people (Andersson 1995). QFD can be used to help organizations understand the needs of their clients and meet those needs with their own capabilities and resources (Liang, Croitoru, & Tao, 2005). Given the characteristics of the world of aircraft maintenance that prioritizes safety and the regulation of the aviation authority (Machado, Araújo, Urbina, & Macau, 2016), the systematic approach of QFD in capturing technical / engineering requirements is appropriate for this research.

However the QFD method mentioned has a deficiency in analyzing customer satisfaction (Sireli, Kauffmann, & Ozan, 2007). The Kano model is a method that can identify customer needs in greater detail by classifying and prioritizing

customer needs based on how it affects customer satisfaction (Pakizehkara, Sadrabadi, Mehrjardi, & Eshaghieh, 2016). The combination of QFD and Kano models is an appropriate methodology for better listening and understanding customer requirements to improve customer satisfaction (Garibay, Gutiérrez, & Fig, 2010).

The result of QFD and Kano integration was not yet able to show the priority of any customer needs that have the most significant impact on customer satisfaction (Zong, Yu, & Li, 2013). Analytic Hierarchy Process is a method in which complex disintegration is transformed into smaller parts and then fed into the hierarchical structure (Pakizehkara, Sadrabadi, Mehrjardi, & Eshaghieh, 2016). The hierarchy becomes important because it can represent reality in a simple way to present the most important elements and relationships (Saaty, Decision making for leaders - the Analytic Hierarchy Process for decisions in a complex world, 2000). The benefit of this method is that the value of the assessment of the same comparison is based on experience, intuition, as well as physical data, AHP can deal with the qualitative and quantitative aspects of decision making issues (Salgado, Salomon, & Mello, 2012). Therefore, the Analytic Hierarchy Process (AHP) method will be used as the third method along with Kano and QFD to show the priority aspects of customer needs that MRO companies must be aware of in quality development.

4. Theoritical Background

4.1 Quality Management

Quality management is the process of identifying and administering the activities necessary to achieve the organization's quality objectives (Pyzdek & Keller, 2013). The seven quality management principles are (ISO, 2015):
QMP 1 – Customer focus
QMP 2 – Leadership
QMP 3 – Engagement of people
QMP 4 – Process approach
QMP 5 – Improvement
QMP 6 – Evidence-based decision making
QMP 7 – Relationship management

4.2 Customer Satisfaction

One thing affected by quality management is customer satisfaction. Customer "satisfaction" does not simply happen; it is an effect. Quality is one important cause of the customer satisfaction effect, along with price, convenience, service, and a host of other variables. Quality and customer satisfaction are not synonyms; the former causes the latter. Generally businesses do not seek customer satisfaction as an end in itself. The presumption is that increased customer satisfaction will lead to higher revenues and higher profits, at least in the long term. (Pyzdek & Keller, 2013). PIMS authors also concluded: "The Customer is KING!" To best serve customers, the successful quality program will apply specific principles, techniques, and tools to better understand and serve their firm's royalty—the customer (Buzzell & Gale, 1987).

4.3 Kano Model

The Kano Model of Customer (Consumer) Satisfaction classifies product attributes based on how they are perceived by customers and their effect on customer satisfaction (Verduyn, 2013). In his model, professor N. Kano (Sauerwein et al., 1996) distinguishes three product requirements (features) used to determine customer satisfaction:
1. Must-be requirements (features); The must-be requirements are the main criteria of the product/service. In most cases, this is a crucial competitive and if they do not provide much satisfaction, the customer will not be interested in product at all.

2) One-dimensional requirements (features); according to these requirements, customer satisfaction is proportional to the needs of the level – the higher the satisfaction level is, the higher the customer's satisfaction is and vice versa. One-dimensional requirements – a clear customer's requirements.

3) Attractive requirements (features); these requirements are based on the evaluation of the product, which is mainly determined by what level the customer will be satisfied with a product. Attractive requirements are neither urgent nor expected by the customer.

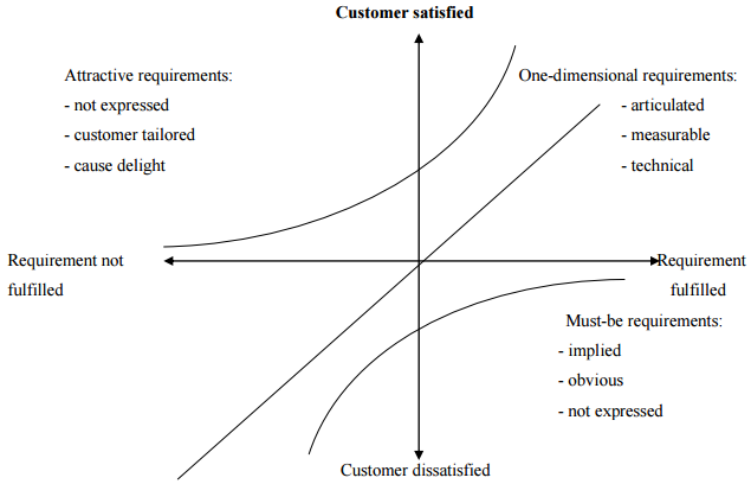

Figure 3. Kano's model customer satisfaction chart

Berger et al. (1993), presenting a chart, explain that the horizontal axis provides how well and fully product/service requirements are met, and the vertical axis shows the level of customer satisfaction (satisfied or dissatisfied customer). ReVelle et al. (1998) presented all three customer requirements types of profiles and in what ways or research the company can get the best information about customer needs. Attractive requirements often becomes innovations, completely unprecedented novelties, and also the authors describe in keywords such as customer delight, surprise, performance improvements etc. One-dimensional (performance) requirements are easily described as known needs and features which customer expects before buying products or services. Finally, must-be requirements are described as buyers expectations. These requirements can be obtained by monitoring competitors or customer complaints.

4.4 Analytic Hierarchy Process (AHP)

The Analytic Hierarchy Process (AHP), introduced by (Saaty, The Analytic Hierarchy Process, 1980) , is an effective tool for dealing with complex decision making, and may aid the decision maker to set priorities and make the best decision. By reducing complex decisions to a series of pairwise comparisons, and then synthesizing the results, the AHP helps to capture both subjective and objective aspects of a decision. In addition, the AHP incorporates a useful technique for checking the consistency of the decision maker's evaluations, thus reducing the bias in the decision making process.

The AHP considers a set of evaluation criteria, and a set of alternative options among which the best decision is to be made. It is important to note that, since some of the criteria could be contrasting, it is not true in general that the best option is the one which optimizes each single criterion, rather the one which achieves the most suitable trade-off among the different criteria.

The AHP generates a weight for each evaluation criterion according to the decision maker's pairwise comparisons of the criteria. The higher the weight, the more important the corresponding criterion. Next, for a fixed criterion, the AHP assigns a score to each option according to the decision maker's pairwise comparisons of the options based on that criterion. The higher the score, the better the performance of the option with respect to the considered criterion. Finally, the AHP combines the criteria weights and the options scores, thus determining a global score for each option, and a consequent ranking. The global score for a given option is a weighted sum of the scores it obtained with respect to all the criteria. The AHP can be implemented in three simple consecutive steps:
1) Computing the vector of criteria weights.
2) Computing the matrix of option scores.
3) Ranking the options.

4.5 Quality Function Deployment (QFD)

QFD is a system for designing a product or service based on customer demands that involves all members of the producer or supplier organisation. In Japanese, 'deployment' refers to an extension or broadening of activities and hence 'Quality Function Deployment' means the responsibilities for producing a quality item must be assigned to all parts of a corporation. It is sometimes referred to as the most advanced form of Total Quality Control, Japanese style (Roberts, 2007). QFD is a method for developing a design quality aimed at satisfying the consumer and then translating the consumer's demand into design targets and major quality assurance points to be used throughout the production phase, QFD is also a way to assure the design quality while the product is still in the design stage (Mizuno & Akao, 1994).

QFD presents its structure in the form of House of Quality (HOQ). HOQ is the most commonly used matrix in QFD methodology. The basis of HOQ is the belief that the product should be designed to reflect the demands of the customer. The focus on HOQ is the correlation between identified customer needs, called WHATs, and technical characteristics, called HOW (Hauser and Clausing 1998). The steps for building a room in HOQ based on Figure 3 are described below (Low and Yeap 2001; Xie et al., 2003):

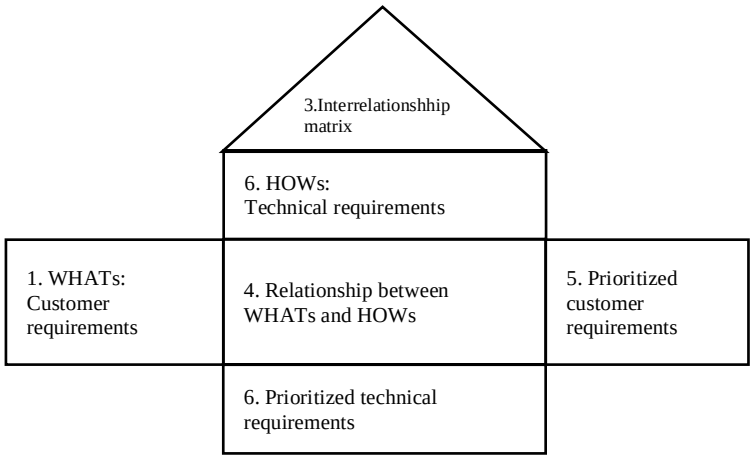

Figure 4. House of Quality (HOQ) of QFD method

Room 1: List of customer requirements (WHATs)

QFD starts with a list of goals / goals. This room is often referred to as what required or expected customers from a particular task. This list of key customer needs is usually vague and very common. Further definitions are made by defining a new secondary requirements list of new subscribers to support key customer needs. In other words, major customer requirements may include many secondary customer requirements.

Room 2: List of technical characteristics (HOWs)

To fulfill the HOQ objectives, once customer needs and expectations are identified, QFD teams must develop technical characteristics that refer to HOW that can affect one or more of the customer's needs. The characteristics of this technique are part of the ceiling and second floor of HOQ. This characteristic is an expression of Voice of Customer (VOC) in technical language. The development process should continue until every item on the list can be acted upon. In addition, the list of technical characteristics can be divided into hierarchies of several levels of engineering/technical characteristics.

Room 3: Matrix of interconnection between pairs HOW

HOQ roof, called correlation matrix, is used to identify the linkage between the pair of technical characteristics. This is a triangular table attached to the technical characteristics. This matrix allows the QFD team to uncover which technical characteristics are most important as this is not only often the result of conflicting customer requirements, but also points to the point where trade-offs should be made. Some of these trade-offs may require high-level managerial decisions, and some are cross-functional area boundaries.

Room 4: Matrix of relationship between WHAT and HOW
This room, called the relationship matrix, provides a comparison between customer requirements and engineering characteristics. The number of comparisons depends on the number of customer needs and the number of technical characteristics. Doing this early in the development process will shorten the development cycle and reduce the need for future changes.

Room 5: Priority customer requirements
This room deals with the development of priority customer requirements by creating a single column block corresponding to each customer's needs in the HOQ on the right-hand side of the relationship matrix. It should contain a calculation algorithm to prioritize customer requirements. Examples of these algorithms include the assessment of linear importance, AHP, and fuzzy rating methods.

Room 6: Prioritized engineering characteristics
The space of priority engineering characteristics lies under the relationship between WHATs and HOW room. In this room, the QFD team prioritizes technical characteristics based on the relationship matrix and priority customer requirements using both the calculation algorithm and the linkage matrix.

5. Research Methodology

The first step of this research is a review of the literature to establish a theoretical framework for research / subject topics, 13 customer requirements by (Sakburanapech, 2008) will be used as main customer requirements in this research. After that, customer requirements will be calssified by using Kano Model. Airline and MRO executives opinions and interviews with aviation expert will be used as the primary tool for Kano Model. After all customer requirements are identified and classified by Kano Model, AHP analysis will be used to determine priority of customer requirements. To obtain data for AHP, 100 questionnaire are distributed to airline and MRO companies in Indonesia, with a focus on employees and executives involved in aircraft maintenance. After that, technical requirements must be determined and analyzed before using QFD. Technical requirements data are gathered by using questionnaire, too by using 5 technical requirements by (Sakburanapech, 2008) as main focus. QFD are then used to integrate customer requirements and technical requirements into quality management strategy. The development of this QFD matrix will also use data from discussions with experts. The main framework of the research are described on figure 5:

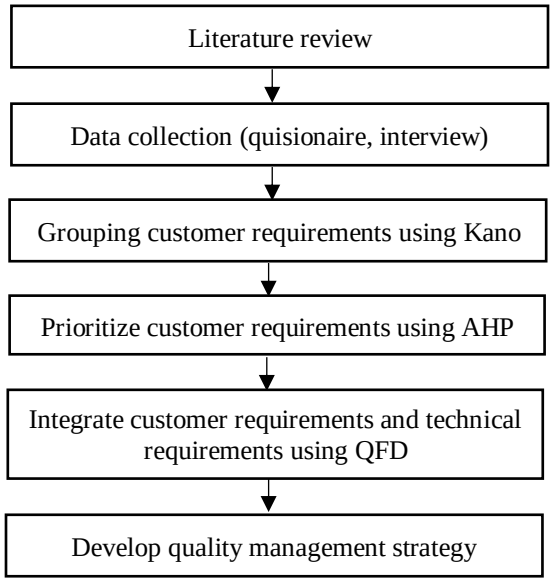

Figure 5. Research methodology

6. Results and Discussion

Kano Model

After interviews are done with three Indonesian MRO Companies' General Managers in field related to airlines relationship management, result are shown in figure 6.

Must-be Attribute	One Dimensional Attribute	Attractive Attribute
Clearly defined contract/agreement	Mutual understanding	Mutual benefit
Clearly defined product/services	Clear delivery process	Trust
Clearly defined performance measurement	Shared information	Shared knowledge
	Frequent and open communication	Flexibility
	Joint resolution	
	Commitment	

Figure 6. Kano model result

AHP

After Kano Model of customer requirements are done, all customer requirements then prioritized by AHP. Questionnaire are spread to employee of six major Indonesian airlines in field related to aircraft maintenance and it's outsourcing. The result of AHP are shown in figure 7.

Customer Requirements	AHP
Clearly defined contract/agreement	0.1555
Clearly defined performance measurement	0.1247
Clearly defined product/services	0.0978
Clear delivery process	0.0940
Commitment	0.0861
Joint resolution	0.0841
Frequent and open communication	0.0775
Trust	0.0558
Shared information	0.0517
Mutual benefit	0.0502
Flexibility	0.0466
Mutual understanding	0.0415
Shared knowledge	0.0346

Figure 7. Customer requirements priority based on AHP

QFD

After quantitative and qualitative method of analyzing customer requirements has been done by using Kano and AHP, customer requirements will be used in house of quality of QFD. Technical requirements also needed to develop house of quality of QFD, so five factors of technical requirements also has been analyzed by using descriptive survey. Results are shown in figure 7-figure 11.

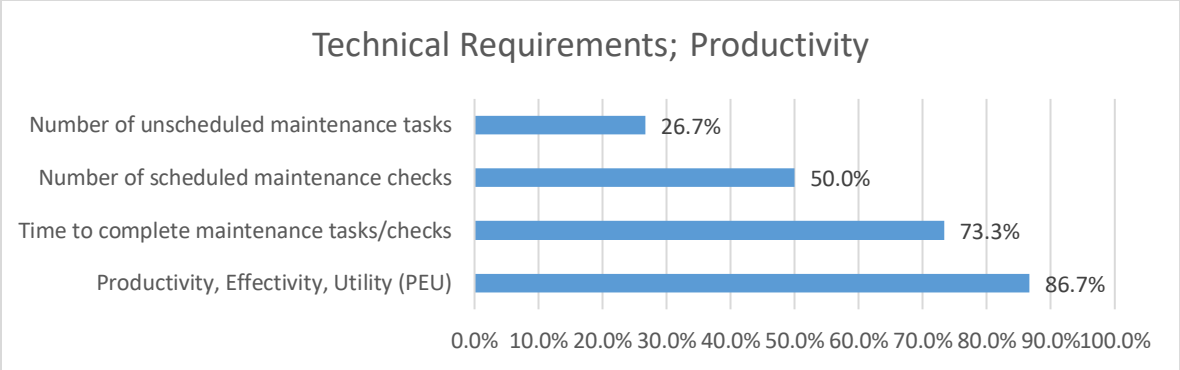

Figure 8. Technical requirements related to productivity

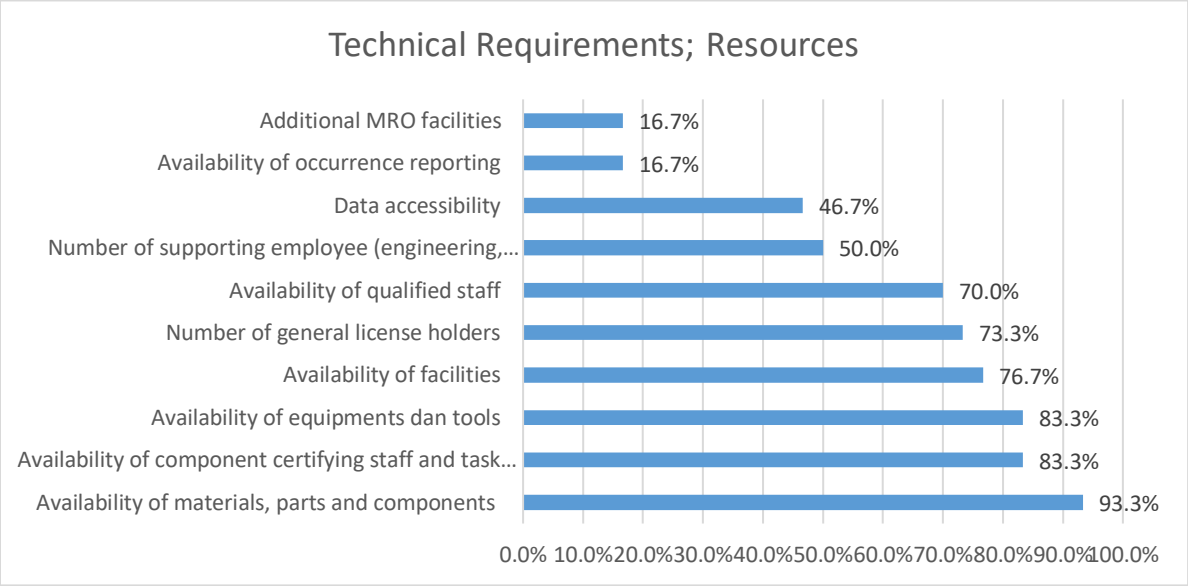

Figure 9. Technical requirements related to resources

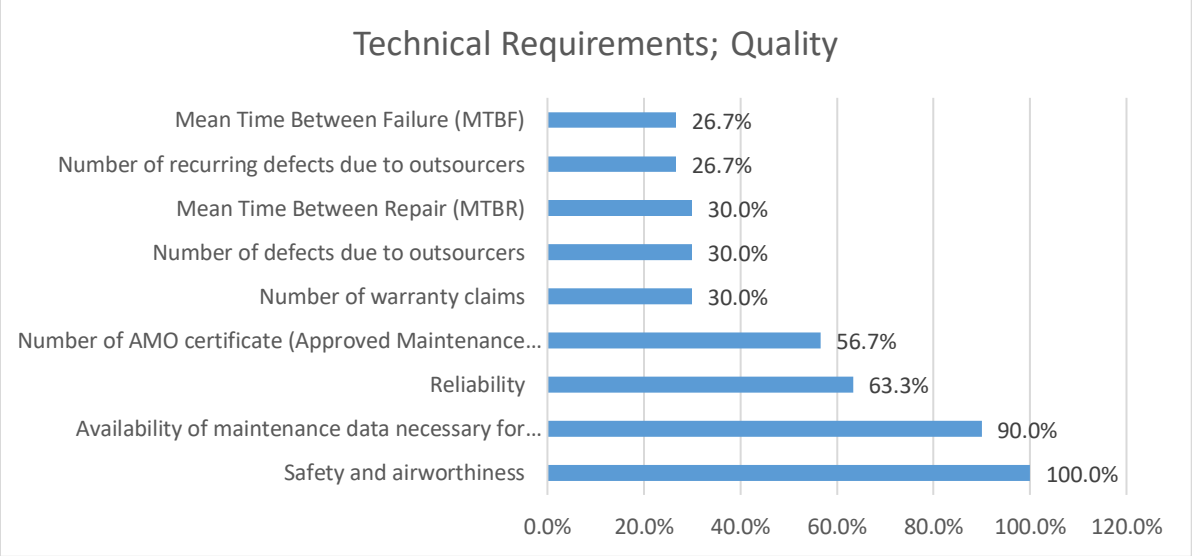

Figure 10. Technical requirements related to quality

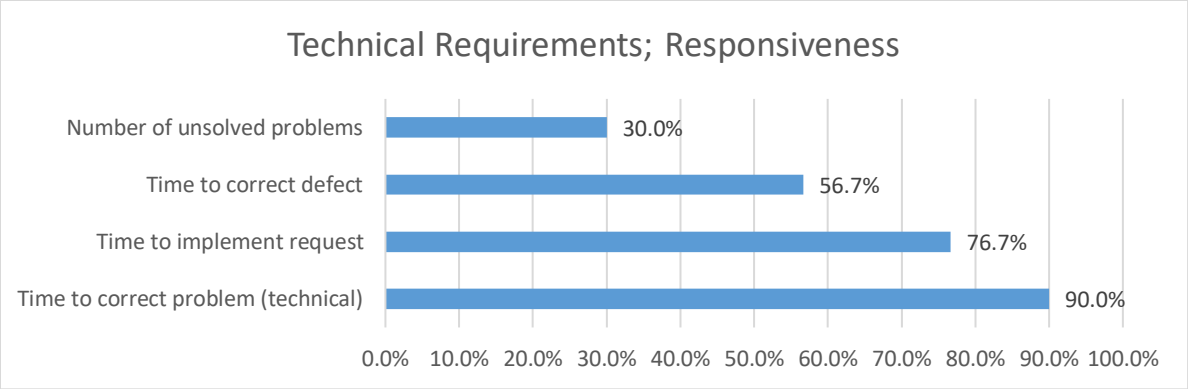

Figure 11. Technical requirements related to responsiveness

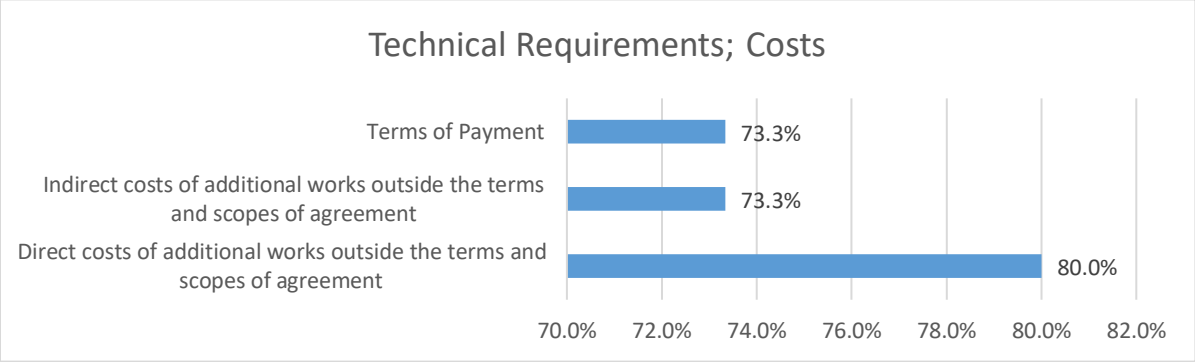

Figure 12. Technical requirements related to costs

After customer requirements and technical requirements (as two main house of quality component) are completely anayzed and prioritized, QFD is used to integrate customer requirements and technical requirements into development of a quality management strategy of aircraft MRO company.

7. Conclusion

In this research, we proposed a integrated method to develop quality management strategy using three methods that complement each other. Kano Model is used as a qualitative tool to analyze customer needs in depth, then AHP is used as a quantitative tool. These two integration methods provide an in-depth understanding of the customer's need for outsourcing aircraft maintenance. After that, technical requirements are analyzed by descriptive survey. All of those factors are then integrated to develop quality management strategies using the house of quality of QFD. The results of this study should be used as one of the reference that can be considered by the directors or board of management of the MRO aircraft companies in Indonesia to improve and expand its business.

Since the topic about aircraft maintenance outsourcing management is still new, future research should be done to improve knowledge about aircraft maintenance outsourcing management. Future research of this topic can discuss about the implementation phase of strategy developed in this research and it’s possible problems that may arise.

References

Al-kaabi, H., Potter, A., & Naim, M. (2007). An outsourcing decision model for airlines' MRO activities. *Journal of Quality in Maintenance Engineering, Vol. 13 Issue: 3*, 217-227.

Allen, R. (2017, October 20). *Aviation Outsourcing | Article.* Retrieved from www.outsourcing-center.com: http://www.outsourcing-center.com/2002-12-aviation-outsourcing-article-38204.html

Andersson, R. (1995). *QFD–the system for effektivare product—framtagning.* Lund, Sverige, Swedish.

Babayi, M. (2008). Relationship Kano model and QFD. *Journal of Management, 3(1).*

Boateng-Okrah, E., & Fening , F. (2012). TQM implementation: a case of a mining company in Ghana. *Benchmarking: An International Journal, Vol. 19 Issue: 6*, 743-759.

Bolar, A., Tesfamariam, S., & Sadiq, R. (2017). Framework for prioritizing infrastructure user expectations using Quality Function Deployment (QFD). *International Journal of Sustainable Built Environment 6*, 16–29.

Buzzell, R., & Gale, B. (1987). *The PIMS Principles: Linking Strategy to Performance, Free Press, New York, 1987.* New York City, USA: Free Press.

Cetinderea, A., Duran, C., & Yetisen, M. (2015). The effects of total quality management on the business performance: An application in the province of Kütahya. *Procedia Economics and Finance 23*, 1376 – 1382.

FAA. (2008). *Air carriers' outsourcing of aircraft maintenance.* Federal Aviation Administration.

Flottau, J. (2014). Major MRO provider expands. *Aviation Week & Space Technology*, (p. 74).

Garibay, C., Gutiérrez, H., & Fig, A. (2010). Evaluation of a Digital Library by Means of Quality Function Deployment (QFD) and the Kano Model. *The Journal of Academic Librarianship, Volume 36, Issue 2*, 125-132.

Gulati, R. (1995). Does familiarity bread trust? The implications of repeated ties for contractual choice. *Academy of Management Journal 38*, 85-112.

IATA. (2016). *Annual Review 2016.* Dublin: International Air Transport Association.

Indonesia's Ministry of Industry. (2016, April 12). Retrieved September 18, 2017, from Kementerian Perindustrian Republik Indonesia: http://www.kemenperin.go.id/artikel/14969/Indonesia-Agresif-Pacu-Industri-MRO-Terintegrasi

ISO. (2015). *Quality Management Principles.* Geneva: International Organization for Standardization.

Jingmin, W. (2006). *Key Points of Life-cycle Control and Analysis of Civil Aircraft Maintenance Costs.* Nanjing: Nanjing University of Aeronautics and Astronautics.

Kim, K.-J., Moskowitz, H., Dhingra, A., & Evans, G. (2000). Fuzzy multicriteria models for quality function deployment. *European Journal of Operational Research, Volume 121, Issue 3*, 504-518.

Liang, S., Croitoru, A., & Tao, C. (2005). A distributed geospatial infrastructure for sensor web. *Computers & Geosciences 31 (2)*, 221-231.

Machado, M., Araújo, M., Urbina, L., & Macau, F. (2016). A qualitative study of outsourced aeronautical maintenance: The case of Brazilian organization. *Journal of Air Transport Management 55*, 176-184.

McFadden, M., & Worrells, D. (2012). Global Outsourcing of Aircraft Maintenance. *Journal of Aviation Technology and Engineering 1:2*, 63–73.

McLaughlina, P., & Durazo-Cardenas, I. (2013). Cellular manufacturing applications in MRO operations. *Procedia CIRP 11*, 254-259.

Mizuno, S., & Akao, Y. (1994). *QFD: The Customer-Driven Approach to Quality Planning and Development.* Tokyo, Japan: Asian Productivity Organization.

Momme, J., & Hvolby, H.-H. (2002). An Outsourcing Framework: Action Research in the Heavy Industry Sector. *European Journal of Purchasing & Supply Management. 8*, 185-196.

Murray, J., & Kotabe, M. (2005). Performance implications of strategic fit between alliance attributes and alliance forms. *Journal of Business Research 58*, 1525-1533.

Pakizehkara, H., Sadrabadi, M., Mehrjardi, R., & Eshaghieh, A. (2016). The application of integration of Kano's model, AHP technique and QFD matrix in prioritizing the bank's substructions. *Procedia - Social and Behavioral Sciences 230*, 159 – 166.

Phillips, E. (2008). *Decade of growth ahead for MRO Aviation.* Aviation Week.

Poll, D. (2017). 21st-Century civil aviation: Is it on course or is it over-confident and complacent? – thoughts on the conundrum of aviation and the environment. *The Aeronautical Journal, 121(1236)*, 115-140.

Pyzdek, T., & Keller, P. (2013). *The Handbook for Quality Management; A Complete Guide to Operational Excellence.* New York City, USA: The McGraw-Hill Companies, Inc.

Rieple, A., & Helm, C. (2008). Outsourcing for competitive advantage: An examination of seven legacy airlines. *Journal of Air Transport Management 14*, 280-285.

Roberts, P. (2007). Quality Function Deployment. In *Product Excellence using Six Sigma.* Warwick, Coventy, UK: Warwick Manufacturing Group.

Saaty, T. (1980). *The Analytic Hierarchy Process.* New Yor, USA: McGraw-Hill.

Saaty, T. (2000). *Decision making for leaders – the Analytic Hierarchy Process for decisions in a complex world.* Pittsburgh: RWS.

Saaty, T. (2005). The Analytic Hierarchy and Analytic Network Processes for the Measurement of Intangible Criteria and for Decision Making. *Multiple criteria decision analysis: State of the art surveys*, 345-407.

Sadikoglu, E., & Olcay, H. (2014). The effects of total quality management practices on performance and the reasons of and the barriers to TQM practices in Turkey. *Adv Decis Sci*, 17.

Sakburanapech, A. (2008). *Development of a Relationship Management Framework and Related Performance Metrics for Outsourced Aircraft Maintenance*. Cranfield: Cranfield University.

Salgado, E., Salomon, V., & Mello, C. (2012). Analytic hierarchy prioritisation of new product development activities for electronics manufacturing. *International Journal of Production Research 50*, 4860-4866.

Shahin, A., & Zairi, M. (2009). Kano model: a dynamic approach for classifying and prioritizing needs of airline travellers with three case studies on international airlines. *Total Qual. Manag. Bus. Excell. 20 (9)*, 1003-1028.

Sireli, Y., Kauffmann, P., & Ozan, E. (2007). Integration of Kano's Model Into QFD for Multiple Product Design. *IEEE Transactions on Engineering Management (Volume: 54, Issue: 2*, 380-390.

Tang, R., & Elias, B. (2012). *Offshoring of airline Maintenance : implications for domestic jobs and aviation safety*. Congressional Research Service.

Verduyn, D. (2013). *Discovering the Kano Model.* Retrieved October 20, 2017, from http://www.kanomodel.com

Violante, M., & Vezzetti, E. (2017). Kano qualitative vs quantitative approaches: An assessment framework for products attributes analysis. *Computers in Industry 86*, 15-25.

Wibowo, A., Tjahjono, B., & Tomiyama, T. (2016). Towards an Integrated Decision Making Framework for Aero Engine MRO Contract Management in the Productisation Context. *Procedia CIRP 47*, 24–29.

Williamson, O. (1985). *The Economic Institutions of Capitalism.* New York: Free Press.

Williamson, O. (1991). Comparative economic organization: the analysis of discrete structural alternatives. *Administrative Science Quarterly 36*, 269-296.

Wyman, O. (2017). *Global Fleet & MRO Market Forecast Summary*. Flight Global.

Zhang, A. (2006). Transaction governance structure: theories, empirical studies, and instrument design. *International Journal of Commerce and Management 16*, 59-85.

Zong, L., Yu, S., & Li, B. (2013). The Model Building Research of Product Innovation Design Quality Based on QFD and KANO. *Applied Mechanics and Materials, Vols. 271-272*, 1467-1472.

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