



Supplier Poor Quality Cost Management Strategy

-A case study in one global designing and manufacturing company

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ABSTRACT

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In the agricultural industry, there are no mandatory requirements to run the business with a specific standardized quality system like IATF/TS16969 for the automotive industry or ISO13485 for the medical industry, quality in the supply chain are kept on a general level. Meanwhile, diverse culture, internationalization, unstable orders from end customers, low-quality concepts, organizational strategy, and low volume production, strong competition in the market, unpredicted pandemic, etc, increase the challenges especially when facing and solving the quality issue in the supply chain. Suppliers could not get the necessary information they need for analysis, and customers could not get the expected compensation for what they lost from the supply chain. These destroy the business, and confidence among stakeholders gradually goes against the win-win expectations. In international trading, the supply chain turns to be more complex than ever before, the cost of poor supplier quality plays an outstanding role in improving the business. To get a good strategy for suppliers, poor quality cost management became an important and imminent task for stakeholders all over the world.

The research will apply a qualitative methodology to collect the responses and information from internal stakeholders, then make an analysis. To provide an opportunity for the company with a strategy to supplier poor quality cost management. The offer shows in DMAIC methodology through one circular process, from defining the target to collect and measure the data to analysis to improvement action implementation and end by check the status compare to the original target. The study in this thesis is based on the commissioning company. Furthermore, this thesis also includes suggestions for the commissioning company in considering suitability and adjust to the current vision in favor of new potential customers.

Keywords: supplier quality, poor supplier quality cost, supplier quality strategy

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ABBREVIATIONS AND TERMS

A&T	Agricultural and Turf
AR	Augmented Reality
BOM	Bill Of Material
CSR	Corporate Social Responsibility
COGQ	Cost of good quality
COPQ	Cost of poor quality
COPSQ	Cost of Poor Supplier Quality
DPPM	Defective Part Per Million
EAT	Exhaust after treatment
HVAC	Heating Ventilation and Air Conditioning
IATF/TS16969	Quality management system for organizations in the automotive industry defined by International Automotive Task Force
ISO13485	Quality management system for medical device defined by International Organization for Standardization
ISIR	Initial Sample Inspection Report
IoT	Internet of Things
KPI	Key Performance Index
NPI	New Product Introduction
NCR	Non conformity Report
PPAP	Production Part Approval Process
QAA	Quality Assurance Agreement
QIP	Quality Improvement Project
R&D	Research and Design
SQ	Supplier Quality
SM	Sustainability Management
SQAA	Supplier Quality Assurance Agreement
SEC	Securities and Exchange Commission
TAMK	Tampere University of Applied Sciences
TR	Technical Review
US	United States
VR	Virtual reality
YTD	Year To Date

1 INTRODUCTION

Background of commissioner

Located in Finland, Commissioner is holding a history of over 75 years, with an international business focus on off-road diesel engine designing and manufacturing. It also designs and manufactures power generation with diesel engine.

In the long history, Commissioner has been a part of several corporations. Starting from 2004, Commissioner was acquired by Corporation Y which is an US global leading corporation in the design, manufacture and distribution of agricultural solutions. Corporation Y, with a history of 30 years, has acquired several off-road Vehicle businesses and agricultural businesses which has their independent history, supply chain as well as own system in running business before the acquisitions. Several companies owned by Corporation Y are the major customers to commissioner.

1.1 Thesis topic

As international business growing, supply chain became more complexity than ever because the trading rules, diverse custom taxes, longer supply chain, multiply cultures, time differences etc. As cost in supply chain is a critical factor to the whole business, quality of supplied goods or services which plays important role to reduce the whole cost as well. Obviously, when there is a non-conformity in the supplied goods or service, it consume resources to solve the problems. Thus, how to management the cost and quality in the supply chain, has been an interesting and critical topic in real life. Even Corporation Y is developing its global tools for supplier management against the past individual acquired companies had, there is enough space to improve the activities to instruct and optimize the process of handling of COPSQ with a clear, suitable strategy and development plan in favor of business thrive.

1.2 Current situation

Strategy is the approach selected to achieve specified goals in the future. As defined by Chandler (1962: 13) it is: 'The determination of the long-term goals and objectives of an enterprise, and the adoption of courses of action and the

allocation of resources necessary for carrying out those goals.’ The formulation and implementation of corporate strategy is a process for developing a sense of direction, making the best use of resources and ensuring strategic fit. (Mohamed-sabry, NA)

Cost is one of the 2 major reason for commissioner losing the business (Alexander Duray, November, 2019, P42).see Figure 1.The action to reduce cost has to be done in favour of and avoid losing customers. For most companies, these COQ ran in the range of 10 to 30 percent of sales or 25 to 40 percent of operating expenses. (Joseph M.Juran, Co-editor-in-chief. A. Blanton Godfrey, Co-editor in-Chief. 1998. PP251). In many manufacturing and service companies, purchases from suppliers can range from 50 to 80 % of manufacturing costs. The ability of the customer and supplier to control purchase costs has an enormous impact on the return to shareholder value and profitability (Gaikwad, L.M., Tele, S.N., Majali, V.S. *et al.* An Application of Six Sigma to Reduce Supplier Quality Cost. *J. Inst. Eng. India Ser. C*, 2016). It makes sense to reduce the COPSQ in the supply chain.

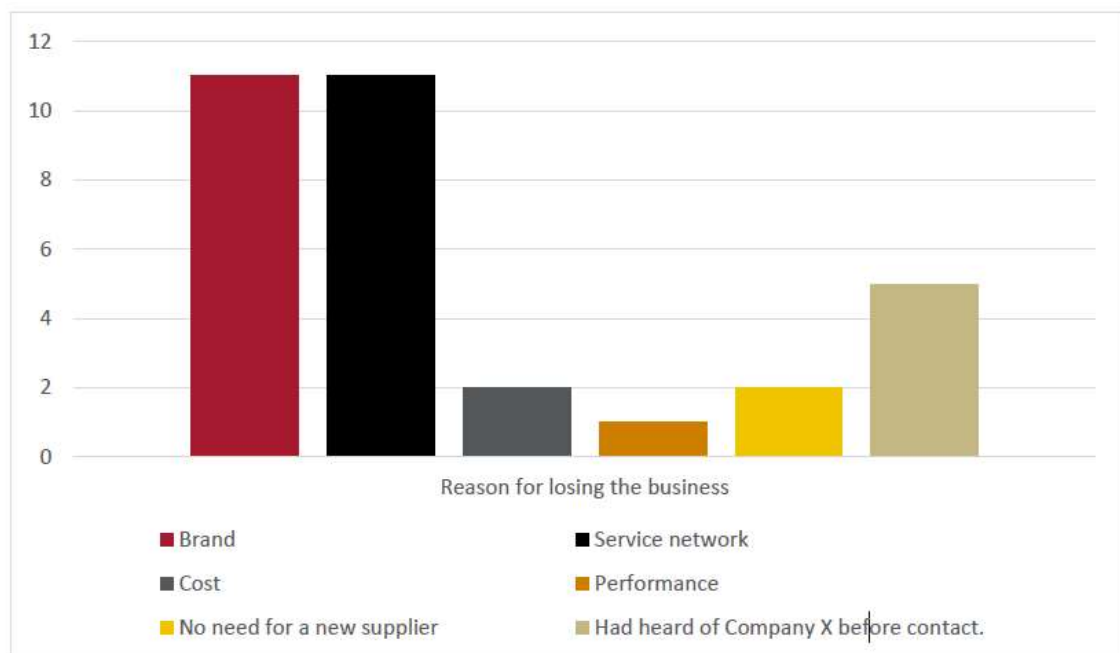


Figure 1. Reasons of Commissioner losing business (Alexander Duray, November, 2019)

Commissioner is missing a clear strategy for COPSQ management. Commissioner following the KPIs setting annually for COPSQ management means supplier recovery rate since 2016. There is also SAP introduced to collect some of

the COPSQ to claim to suppliers. While base on the definition of the COPSQ and Commissioner's global quality compensation claim cost category, see Appendix 1, there are some items missing in Commissioner's definition and activities compared to defined by Juran and Godfrey. (Joseph M. Juran, Co-editor-in-chief. A. Blanton Godfrey, Co-editor in-Chief. 1998. PP259-260). Besides these, other potential cost under COPSQ distribute by cost of quality category by Feigenbaum, A. V (1961), see Appendix 3, has not been considered, discussed and aligned.

Supplier recovery has been defined as a KPI in Commissioner along with Corporation Y. Supplier recovery only include the required compensation.

$$\text{Supplier recovery rate} = \frac{\text{Amount of COPSQ Commissioner received}}{\text{Total Amount of COPSQ claimed}}$$

In summary, the COPSQ Commissioner calculated is part of the COPSQ. This might not only affect the profit to Commissioner's finance performance but also lose the advantage to competitors. In the other side, leave less financial pressure to responsible supplier, the motivation of improve the quality level would not in a high level. Then supply might keep shipping non-conformities to Commissioner.

1.3 Thesis objectives, purpose, survey and research questions

The objective of this thesis is to improve the level of cost of poor supplier quality in the commissioner and later can be an experience sharing to Corporation Y.

The purpose is to design a strategic plan include, 1). Realize the current situation or management level in COPSQ, 2). What kind of level of COPSQ should be the long term target for Commissioner, 3). the means to reach the target. This would include recommended plan, critical factors, and stakeholders in responsible and follow ups in the concept of continuously improvement.

The survey will start with identify categorized stakeholders regarding which missing cost to current commissioner's practice and hidden cost shall be included into further COPSQ management. Stakeholders in this thesis, stakeholders could be categorized to internal, connected and external. Survey with list of questions

planned to send to all internal stakeholders, after get the responds, an analysis will be introduced. The survey to be organized, the research validation to avoid own stance or experience or expectations so that the outcome will not be affected. This to be discussed in details in Chapter 5.

This thesis will looking for answers to following questions:

What is a suitable strategy of COPSQ management for Commissioner?

What kinds of cost shall be taken into count for COPSQ management for the initial study in details for Commissioner?

What kind of development plan should be based on DMAIC methodology to Commissioner?

1.4 Thesis Contents

In Chapter 2. The theoretical framework will be introduced. Theoretical framework of cost of quality will be considered in the research. Briefly, Chapter 2 will introduce four categories of cost of quality. As well as contents of hidden cost of quality. Finally, introduce what shall be contained in the COPSQ to be investigated.

Chapter 3, is discussing current strategy and activities deeper in Commissioner. It starts introduce the importance of COPSQ, then maturity measurement to quality in organization and how it links with COPSQ. Finally, introduce the supplier quality level in DPPM and with basic comparison with one major competitor.

Chapter 4, is discussing the strategic COPSQ management options, later finalize the suitable one for commissioner and finalize the long term goal and how to recognize the current situation, then end with short introduction of the means to reach the long term goal.

In Chapter 5, with the analysis to the survey to internal stakeholders, conclude which items should be included at the beginning of stage, which missing costs and hidden costs from Commissioner's current practice should be counted and ask responsible supplier for compensation.

Chapter 6, offers the strategy of COPSQ management deployment to Commissioner in DMAIC methodology. Besides, useful notes included in every step. In the end, review whether the researched questions has been targeted or not.

Chapter 7, is discussing the further factors and limitation to the strategy plan and what shall be considered during implementation.

2 UNDERSTANDING COMMISSIONER'S BUSINESS ENVIRONMENT

This chapter will start from evolution of COQ, later introduce the definition of COPSQ in commissioner and the relationships with internal and external stakeholders including the roles in the business supply chain. Because there is certain relationship between supplier DPPM and COPSQ, in the end of this chapter, information is provided with comparison to one major competitor in supplier DPPM level and recent year improvement to supplier DPPM. The introduction will align the common understanding to the terms in the thesis and general view the position of Commissioner in the market and in the supplier quality improvement.

2.1 Concept of Quality

Of the many meanings of the word “quality,” two are of critical importance to managing for quality:

1. “Quality” means those features of products which meet customer needs and thereby provide customer satisfaction.
2. “Quality” means freedom from deficiencies—freedom from errors that require doing work over again (rework) or that result in field failures, customer dissatisfaction, and customer claims, and so on. (Joseph M.Juran, Co-editor-in-chief. A. Blanton Godfrey, Co-editor in-Chief. 1998. P26-27)

2.2 Cost of quality

“Quality costs” was first introduced as of “The Economics of Quality” in chapter I in Dr J.M Juran’s first Quality Control Handbook, which published in 1951 by McGraw-Hill. After that, Cost of quality with diverse descriptions of concepts to “Quality Costs” has been discussed in different literatures. With the development of quality management, the definition of quality costs has changed all the time in its evolution. The term “quality costs” has different meanings to different people. Some equate “quality costs” with the costs of poor quality (mainly the costs of finding and correcting defective work); others equate the term with the costs to attain quality; still others use the term to mean the costs of running the Quality department. (Joseph M.Juran, Co-editor-in-chief. A. Blanton Godfrey, Co-editor in-Chief. 1998. P251).The definition of cost of quality and its integral elements fluctuate from author to author, organization to organization, industry to industry

and country to country & to a certain extent it depends on the size of a QMS (Hwang and Aspinwall, 1996).

Unfortunately till nowadays, final alignments to definition of COQ is still missing. In Figure 2, there is a short list to COQ been discussed.

Item	Definition	Whom	When
1	Cost of quality includes 3 segments:Prevention cost, appraisal cost and failure cost	Feigenbaum, A. V. (Armand Vallin) 1 st edition P83	1961
2	COQ is defined as the costs of non-conformances.	Crosby, Philip, B.	1983
3	It is defined from “zero failure” viewpoint as the difference between actual costs and ideal costs, the latter being incurred if a product or service is produced right the first time	Doodstadt & Marti, (1990).	1990
4	Quality costs are expenses incurred for ensuring and assuring quality as well as loss incurred when quality is not accomplished.	(BS 6143: Part2, 1990; ASQC, 1971).	
5	the term “quality costs” means the cost of poor quality.	Joseph M.Juran and A. Blanton Godfrey	1998
6	Quality costs can be usually understood as the costs associated with the non-achievement of product or service quality as defined by the requirements of customers and society. Simply declared, quality cost is the cost of poor products or services	<i>C. Sudhahar, R. Suresh Premil Kumar, V. Senthil, S.R. Devadasan and R. Murugesh</i>	2009

Figure 2. Evolution of major definition to COQ

Many companies summarize these costs into four categories. These categories and examples typical subcategories are discussed in appendix 2 (Joseph M. Juran, Co-editor-in-chief. A. Blanton Godfrey, Co-editor in-Chief. 1998. PP253-256).

2.3 Cost of good quality and cost of poor quality

In this article, the term “quality costs” means the sum of the COGQ and COPQ. A stitch on time saves nine; someone has said very appropriately and wisely that an effort in time saves many more of future and evil should be nipped in the bud, so that much future trouble would be avoided. In the same way, in every walk of life, things must be set right in the very beginning to avoid much future troubles. Same could be applied to the quality, cost of quality. If it is invested rightly and timely for cost of good quality (COGQ) it will save nines of cost of poor quality (COPQ) on later stages. COGQ includes all resources to be used in maintain the normal quality system, appraise prevention and eliminate the nonconformity in the entire process from supply chain to internal and to customer side. (Syed Nadeem Abbas¹, Dr. Javed Ahmed², Muhammad Salman³, Syed Rehan Ashraf, Sep. 2015)

Quality costs, there is methodology used to define and measure where and what amount of an organization’s resources are being used for prevention activities and maintaining product quality as opposed to the costs resulting from internal and external failures. The Cost of Quality can be represented by the sum of two factors. The Cost of Good Quality plus the Cost of Poor Quality equals the Cost of Quality, as represented in the basic equation below:

$$\text{CoQ} = \text{CoGQ} + \text{CoPQ}$$

Quality costs include prevention costs, appraisal cost, internal failure costs and external failure costs (Joseph M. Juran, Co-editor-in-chief. A. Blanton Godfrey, Co-editor in-Chief. 1998. PP84-88)

Most agreement of definition of COPQ includes only Internal and have an inspection point, but never should you include prevention costs. (isixsigma.com).

Supplier could affect customer’s cost by providing non-conformal materials or services. In this article, COPQ includes internal and external failure costs, portion of appraisal costs as well as portion of prevention costs.

To demonstrate COPQ could include portion of prevention costs, one examples from Commissioner is showing below.

Supplier a supplies casting (cylinder head without machining) to Commissioner, after received the cylinder heads, Commissioner then machining them before assemble to engine in Commissioner. Casting production needs mould. Before the selection of the supplier, there was audit performed by SQE from commissioner, which under appraisal cost, as well as cost of mould (the price of casting cylinder head is mainly based on the annual volume and lifetime of the casting mould-e.g. 50K). Due to technical and process bottleneck, there will be inevitable casting defects during the production and supplier can not detect all of them before shipping. Commissioner then has an agreement with the Supplier, the overall casting defect cannot over 2%, means the casting mould shall provide no less than 49K good cylinder heads.

Once there is a defective rate for instance is 3%. Then there would be additional corrective actions to be taken in the supplier and SQE in commissioner will perform another audit to validate the actions is efficient to avoid the similar defect occur. The cost of the activity should under prevention cost, and meanwhile belong to cost of poor quality. Worst case can be the quality level in supplier A could not be able to meet minimum requirements from Commissioner, then another supplier will be developed or even the supplier will be replaced with another supplier. There will be activities like quality audit perform by SQE from commissioner to the new supplier B. The cost of the quality audit which belong to prevention cost also under COPQ.

Defined by Juran and Godfrey's (1998), see Figure 3, by the contribution of the root cause, cost of poor quality could be categorised to cost of poor supplier quality, when the root cause is under supplier's responsibility, and cost of poor internal quality cost, while that is within organizational responsibility instead of supplier.

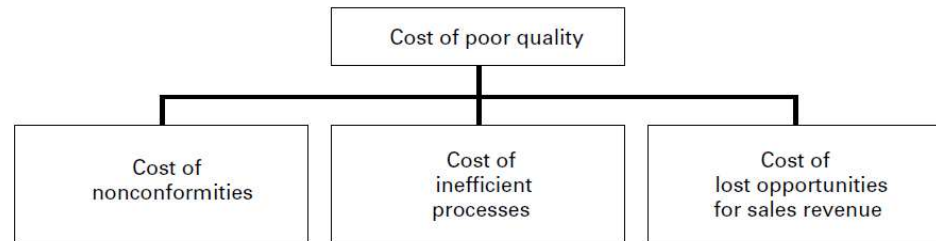


Figure 3. Components of the cost of the poor quality. Juran and Godfrey's (1998),

2.4 Introduction of Hidden quality cost

The cost of poor quality may be understated because of costs which are difficult to estimate. The "hidden" costs occur in both manufacturing and service industries and include in details in Figure 4 (Joseph M.Juran, Co-editor-in-chief. A. Blanton Godfrey, Co-editor in-Chief. 1998. PP259-260).

Item	Definition of Hidden cost by Joseph M.Juran, and A. Blanton Godfrey	In Commissioner Appendix B - Global Quality Compensation Claim Rates(Yes/No)
1	Potential lost sales	No
2	Costs of redesign of products due to poor quality.	No
3	Costs of changing processes	Yes
4	Costs of software changes due to quality reasons.	Yes
5	Costs of downtime of equipment and systems including computer information systems.	Yes
6	Costs included in standards because history shows that a certain level of defects is inevitable and allowances should be included in standards:	No
7	Extra indirect costs due to defects and errors. Examples are space charges and inventory charges.	No
8	Scrap and errors not reported.	No
9	Extra process costs due to excessive product variability (even though within specification limits):	No
10	Cost of errors made in support operations, e.g., order filling, shipping, customer service, billing	Yes
11	Cost of poor quality within a supplier's company. Such costs are included in the purchase price.	No

Figure 4. Hidden cost categories and practice in commissioner COPSQ management

These hidden costs can accumulate to a large amount. (Brown and Kane, 1978 report a multiplier effect of 3 or 4 times the reported failure cost.). Where agreement can be reached to include some of these costs, and where credible data or estimates are available, then they should be included in the study. Otherwise, they should be left for future exploration.

Progress has been made in quantifying certain hidden costs, and therefore some of them have been included in the four categories discussed above. Obvious costs of poor quality are the tip of the iceberg, see Figure 5. (Morgan Palmer, Nov 20, 2019, blog.etq.com)



Figure 5. COPQ in iceberg (Morgan Palmer, Nov 20, 2019, etq)

As the bigger percentage to the whole cost of poor quality, in any organizations include Commissioner, it affects the business margin significantly, in this article, one survey will be deployed to stakeholders to ask the opinion of necessary to count the loss and claim responsible suppliers or not.

2.5 Definition of COPSQ

Based on the category of quality costs, in general, COPSQ under COPQ, contains all possible extra costs when the product or service provided by supplier cannot meet customer's requirements, these costs included portion of appraisal costs and portion of prevention, as well as portion of, internal failure costs and external failure costs in customer side, thus, the contributes to all of them. See Figure 6.



Figure 6. COPSQ in quality cost

Commissioner Quality representatives (third party inspectors) may reject any defective goods that do not meet COMMISSIONER specifications. Any costs arising out of or in conjunction with a notification of defect shall be charged to the Supplier. These fees are outlined in Appendix B - Global Quality Compensation Claim Rates. (Commissioner, SQAA, 15.06.2020.Version 2. P7).

In the appendix, there defined the potential costs due to supplier fault, compared to Juran's instruction (Joseph M.Juran, Co-editor-in-chief. A. Blanton Godfrey, Co-editor in-Chief. 1998. PP259-260), the hidden cost under supplier responsibility shall include the items from 25 to 32 in the survey, were not considered in Commissioner global compensation claim list, See appendix 1.

2.6 Supply chain break down

To understand the potential costs caused by poor supplier quality, in commissioner, one primary diesel engine supply chain is going to show simply in below Figure 7, Generator with the similar situation to engine.

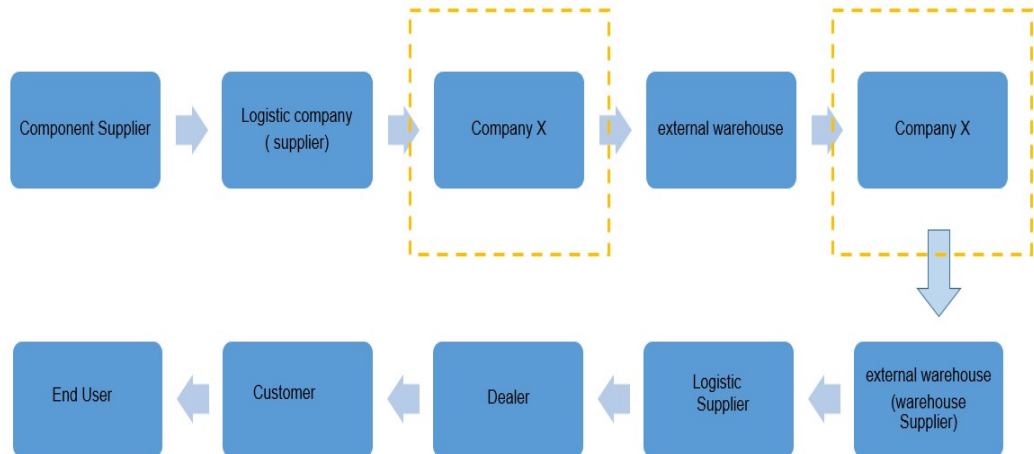


Figure 7. Potential Supply Chain Breakdown (Example of engine)

2.7 Roles of Commissioner with major external stakeholders

Based on the supply chain break down, the external stakeholders to Commissioner has been identified and shows in Figure 8, this part introduce further information among Commissioner and major external stakeholder.

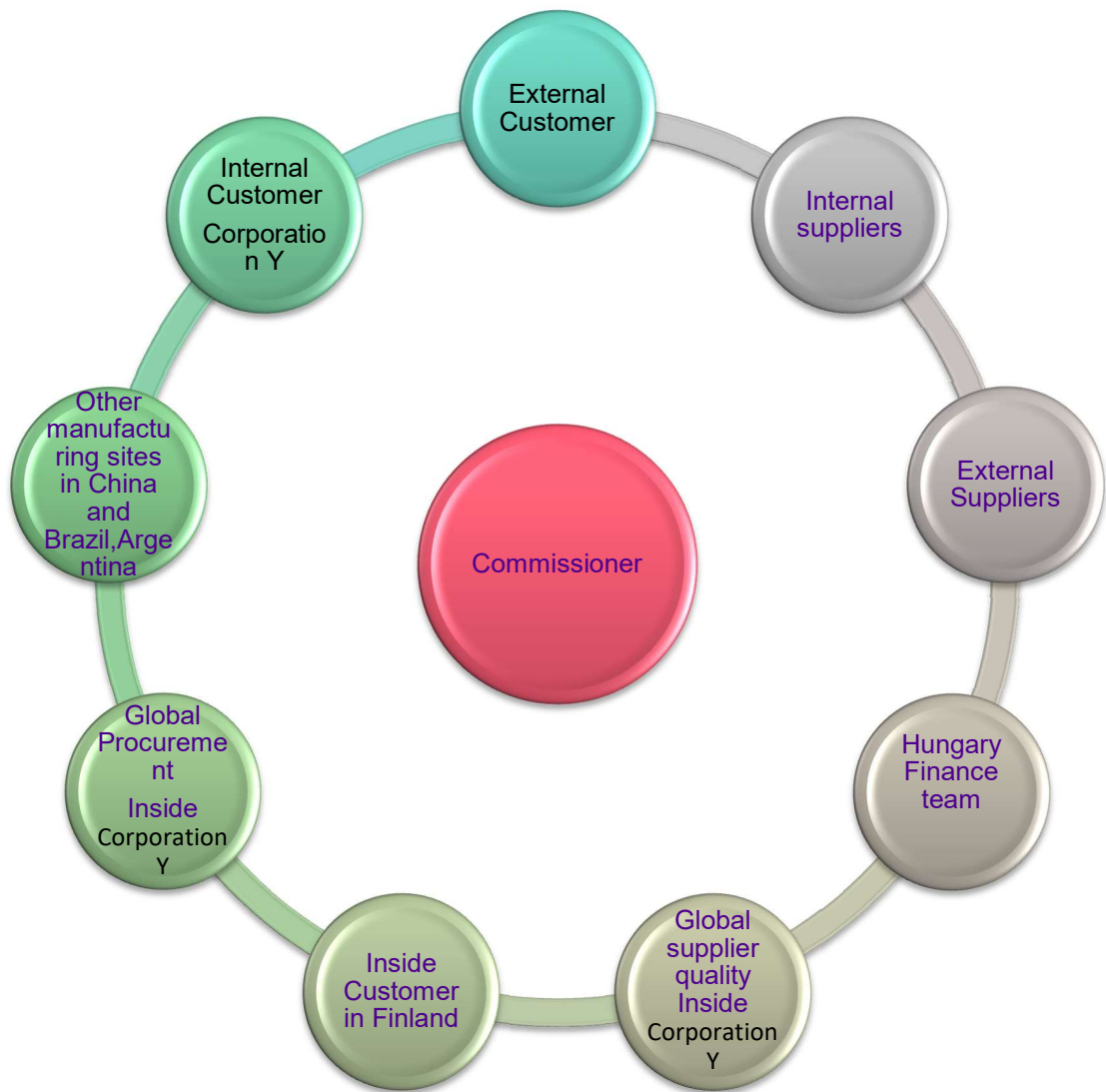


Figure 8. Commissioner with major external stakeholders

2.7.1 Internal customer

Based upon SEC filings made Start from Corporation Y acquired Commissioner in 2004, there is increase volumes from 19000 in Finland and 6.000 in Brazil to global volume which more than 61.000 engines until 2018 (Figure 9). The growth in volumes was largely driven by the Commissioner's increased share of Corporation Y's engine use. (Commissioner Presentation).

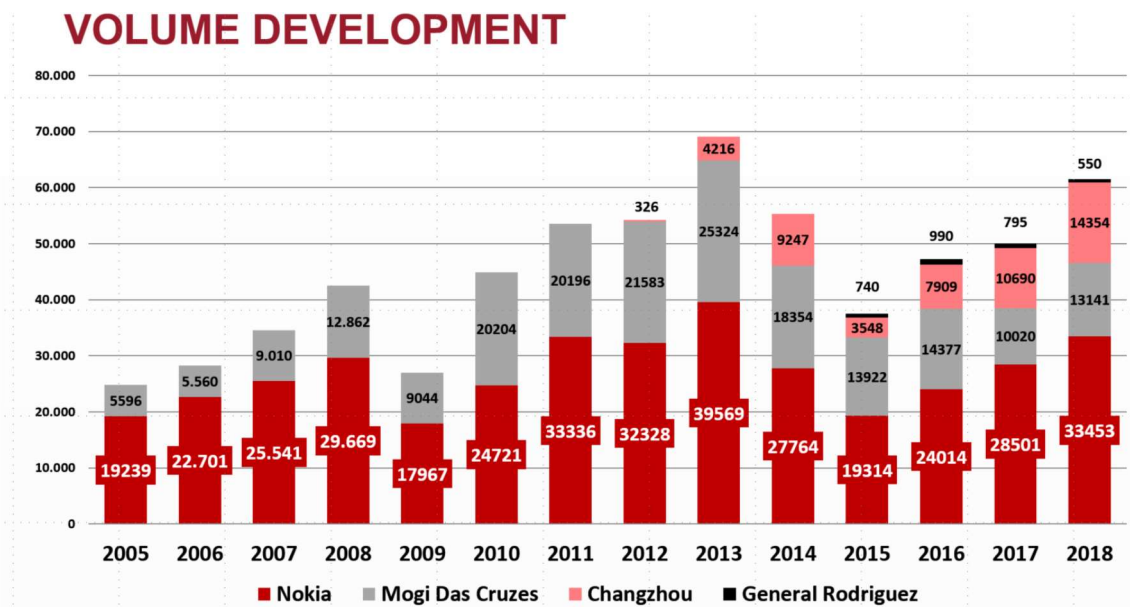


Figure 9. Commissioner's volume development (Commissioner Presentation)

2.7.2 Internal supplier

Company Z is the internal supplier to Commissioner. It supplies various components to Corporation Y and few to Commissioner. Based upon SEC filings made by the Chairman and Managing Director of Company Z who is currently a member of Corporation Y's Board of Directors holds 16.2% common stock which includes shares held individually (17,221 shares) and through Company Z and Company Z (12,150,152 shares). (2019 Company annual report.P30-31, P62). Based upon SEC filings made by the Chairman and Managing Director, Company Z, in which Corporation Y holds a 23.75% interest, manufactures and sells one of Corporation Y's branded equipment primarily in India, and also supplies tractors and components to Corporation Y for sale in other markets. (2019 Company annual report.P93). Commissioner is not buying much from Company Z (Purchasing record in Commissioner, 2018-2019), which as the strategic relationship with Corporation Y, it is potential business develop supplier to Commissioner and then is one of the major stakeholders shall be considered in COPSQ management.

2.7.3 External Customer

A significant part of our engines currently go to the group's internal customers. This will continue to be the case, but in addition to that, our engines will now also

be sold to the construction machinery market.(Commissioner intra news, September,2020).Commissioner has several external customers including forest machines and Marines (Commissioner, presentation).

2.7.4 Other manufacturing sites in Argentina, Brazil and China

Besides in Finland the Commissioner, there are 3 engine manufacturing sites without research and design function:

- Argentina. Founded in 2014 and with annual production capacity is 3,000 engines for local market.(Commissioner website)
- Brazil. The first delivery of 50 Complete Build Up engines was made for local customer in 1993. Current production capacity is approximately 30 000 engines annually. Cylinder blocks and cylinder heads are also manufactured at this plant.(Commissioner website)
- China. Production in this plant started in 2012 and moved in 2015 to the new premises. The production capacity is 30 000 engines per year.(Commissioner, website)

Commissioner which with the function of research and design, support these 3 sites regarding engineering topics. Besides, there are dot line supervision from Commissioner to other sites in several functions. (Commissioner, Organization Chart)

2.7.5 External Supplier

There are over 200 external suppliers, including commodity in casting forging, machining, plastic, rubber, resin, sealing, hardware&Fasteners, electrical and electronics, hydraulics, bearings, engines, EAT, cooling, HVAC, Metal fab, machined casting, engine component.

Most of these suppliers located in Europe, others are in North America and South America, Asia. The technologies as well as processes various in big range. The cultures in different countries are different to each other and play important roles in business as well.

2.7.6 Internal Customer in Finland

Inside of Corporation Y, there is another Company W is one of internal customers to Commissioner. Commissioner basically supply engines to Company W. Meanwhile, both companies has some common suppliers. To align criterial of labor cost and category of COPSQ which should be counted to the management between the 2 companies could show less confuses in front of the same suppliers.

2.7.7 The left stakeholders

Regarding the relationships between stakeholders from Global Team in Supplier quality, Procurement, Finance and counterparts in Commissioner , according to the organization chart in Commissioner and Corporation Y, Procurement and supplier quality function in Commissioner dot line report to Corporation Y and annual KPI define has to be aligned with each other. With the optimizing functions in Commissioner and Corporation Y, there are strength relationships between the business in Commissioner and finance team in Hungary.

3 COMMISSIONER'S CURRENT ACTIVITIES AND STRATEGY

There are three fundamental characteristics for strategy. First, it is forward looking. It is about deciding where you want to go and how you mean to get there. It is concerned with both ends and means. A good strategy is one that works, one that in Abell's (1993: 1) phrase enables organizations to adapt by 'mastering the present and pre-empting the future'. Per Boxall (1996: 70) explained: 'Strategy should be understood as a framework of critical ends and means.'

The second characteristic of strategy is the recognition that the organizational capability of a firm (its capacity to function effectively) depends on its resource capability (the quality and quantity of its resources and their potential to deliver results).

The third characteristic of strategy is that it aims to achieve strategic fit. (Mohamed-sabry, NA).

See Figure 10, Strategy could be optimized, that depends on how one organization define the period of the long term, organizations in the area of open competition, fast consumption, technology developing and buyer's market, typically have short period of long term definition than the others. It is a continuous process, mean, when the organization reach it long term goal A, the organization will look for and defined its long term goal B, then to final goal C with planned means. This part try to get the picture of the current position of commissioner in COPSQ management.

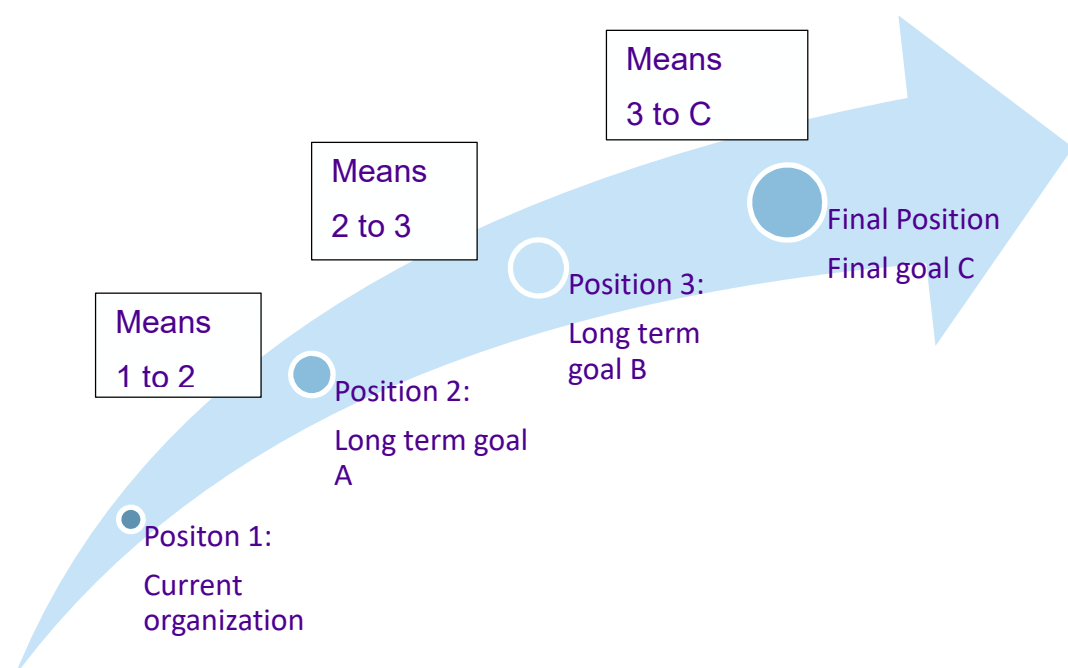


Figure 10. Strategy for organization

3.1 Why COSPQ matters

As a general rule, quality costs increase as the detection point moves further up the production and distribution chain. The lowest cost is generally obtained when non-conformances are prevented in the first place. (qualityamerica.NA).

The costs associated with poor quality suppliers are high. For one home appliance manufacturer, 75 percent of all warranty claims were traced to poor quality of purchased items. (Joseph M. Juran, Co-editor-in-chief. A. Blanton Godfrey, Co-editor in-Chief. 1998. P592)

So, in case of the failures could be reduced or even avoid from the products or services from supplier, the COSPQ and COPQ will reduced a big part.

The rule of 1/10/100 (G. Loabovitz and Y. Chang, 1992) indicates that in case of a quality problem is not solved when it happens, it will cost 10 times to solve later. If a problem is being detected in one organization, the cost to solve it would be 10 times than if it is detected and solved in the direct supplier side. While if the problem (caused by its direct supplier) is caught by its direct customer that would cost 100 times in its direct supplier. See Figure 11

When supplier would realize the huge amount of the cost from their customer and the rule, they are forced to pay attention and improve the quality of the products or services. As one of the major target to running a business is to make profit, while if the cost of the poor quality cause by the supplier, which need to compensate to the customers, that will affect the target much. It is cheaper to improve the quality and solve the problem before shipping or sending to customers.

For decades, the commissioner does not conclude the detail category and compensation rates of COPSQ to get compensation from suppliers. It is not only lead to reduction of financial performance, but also lost the opportunity to alarm supplier be aware of importance of the quality management and improvements in its processes. In commissioner's latest agreement, there are still some item missing which to be investigated in this article.

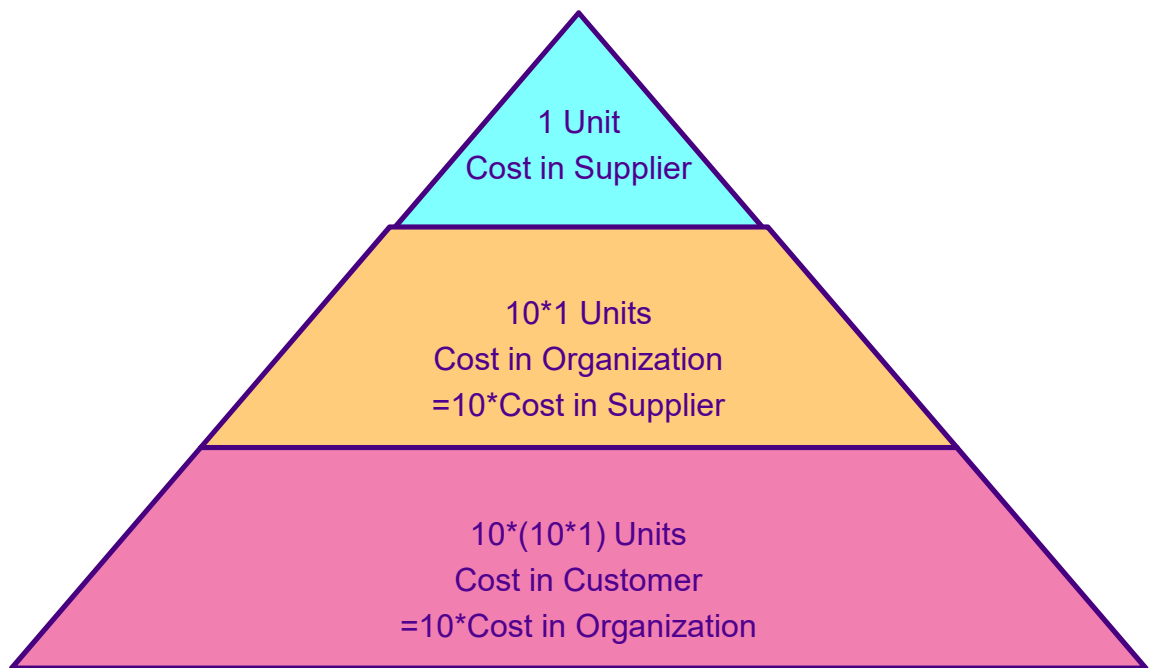


Figure 11. Rule of 1/10/100 through supplier to organization to customer.

3.2 Maturity measurement to quality management

Crosby, Philip B (1979) describes five stages to measure the maturity to quality management in organization. See Figure 12, the percentage of cost of quality (costs of non-conformances) to sales is one of the important indexes. To commissioner, the sale revenue is critical data and available ,while as major portion of the COPQ, COPSQ has to be statistic in a way to make the calculation to stakeholders especially management team, to realize the current position in the stage, then for further strategy plan and activities deployment.

38 THE UNDERSTANDING			39 THE QUALITY MANAGEMENT MATURITY GRID		
QUALITY MANAGEMENT MATURITY GRID			QUALITY MANAGEMENT MATURITY GRID		
Rater _____			Unit _____		
Measurement Categories	Stage I: Uncertainty	Stage II: Awakening	Stage III: Enlightenment	Stage IV: Wisdom	Stage V: Certainty
Management understanding and attitude	No comprehension of quality as a management tool. Tend to blame quality department for "quality problems."	Recognizing that quality management may be of value but not willing to provide money or time to make it all happen.	While going through quality improvement program learn more about quality management; becoming supportive and helpful.	Participating. Understand absolutes of quality management. Recognize their personal role in continuing emphasis.	Consider quality management an essential part of company system.
Quality organization status	Quality is hidden in manufacturing or engineering departments. Inspection probably not part of organization. Emphasis on appraisal and sorting.	A stronger quality leader is appointed but main emphasis is still on appraisal and moving the product. Still part of manufacturing or other.	Quality department reports to top management, all appraisal is incorporated and manager has role in management of company.	Quality manager is an officer of company, effective status reporting and preventive action. Involved with consumer affairs and special assignments.	Quality manager on board of directors. Prevention is main concern. Quality is a thought leader.
Problem handling	Problems are fought as they occur; no resolution; inadequate definition; lots of yelling and accusations.	Teams are set up to attack major problems. Long-range solutions are not solicited.	Corrective action communication established. Problems are faced openly and resolved in an orderly way.	Problems are identified early in their development. All functions are open to suggestion and improvement.	Except in the most unusual cases, problems are prevented.
Cost of quality as % of sales	Reported: unknown Actual: 20%	Reported: 3% Actual: 18%	Reported: 8% Actual: 12%	Reported: 6.5% Actual: 8%	Reported: 2.5% Actual: 2.5%
Quality improvement actions	No organized activities. No understanding of such activities.	Trying obvious "motivational" short-range efforts.	Implementation of the 14-step program with thorough understanding and establishment of each step.	Continuing the 14-step program and starting Make Certain.	Quality improvement is a normal and continued activity.
Summation of company quality posture	"We don't know why we have problems with quality."	"Is it absolutely necessary to always have problems with quality?"	"Through management commitment and quality improvement we are identifying and resolving our problems."	"Defect prevention is a routine part of our operation."	"We know why we do not have problems with quality."

Figure 12. Quality is free. The art of making quality certain. Crosby, Philip B (1979) PP38-39

3.3 COPSQ management in Commissioner

COPSQ management in Commissioner, include, definition of COPSQ category, collect data, and contact with suppliers for compensation. Along with these, it includes critical part of quality improvements. Suppliers are required to provide corrective actions but also are able to get instructions and supports from Commissioner in order to find solution to avoid the similar problem happen in further to reduce the COPSQ from the root. SAP and company portal has been developed and ongoing optimize for data collection as well as analysis. Meanwhile the negotiation between commissioner and supplier regarding QAA (Quality Assurance Agreement) has been started for years even not finalized agreement with some of them. Supplier performance of DPPM (Defective Part Per Million), PPAP (Production Part Approval Process) and NCR (Non conformity Report) in relation with COPSQ has been management through SAP and portal. This part will introduce supplier DPPM in commissioner and overview the situation with one of the main

competitors in agricultural business to get clear picture as of a base to propose realistic strategy later to Commissioner. Commissioner is missing the information of current position in amount of COPSQ, initially the Appendix 1 - Global Quality Compensation Claim Rates just officially come out in 2020 which included in QAA, to be aligned with suppliers to compensate the costs in certain category and rate. While there are not clear to some of the item, for example, in admin and handling cost, does not indicate which items would be included based on the survey in 5.1.6 and 5.1.7 in this thesis. There are other potential costs occurred during poor supplier quality issues not included, this article will investigate via a survey among stakeholders. There is annually goal setting for supplier quality department, the recovery rate from poor supplier quality issues, while that is not deployed into managerial amount of COPSQ. Meanwhile, even the rate increase, that might be not showing positive performance, as there are other costs not counted and these costs might increase accordingly, that is to say, the loss of the COPSQ might increase as well.

3.3.1 Supplier DPPM definition in Commissioner

Commissioner shares generally the same global instruction to calculate supplier DPPM with Corporation Y. See the formulation below (Supplier DPPM Calculation GSQ_G_019, P1)

$$\text{DPPM} = \frac{\text{Assessed, faulty units}}{\text{Delivered units}} \times 1.000.000$$

Assessed, faulty units are for example component parts which differ from the specification (specifications, drawings, regulations and so on), and which show deviation in the accompanying documentation (initial sample, test certificate and so on) or in the compliance with the packaging specification (only when parts are damaged). Will be included in the DPPM independent if the parts will be scrap, rework, or used (with the exception of deviation parts accepted because previous requirement from supplier, *not* detected by Commissioner previously) (Supplier DPPM Calculation GSQ_G_019, P1).

The instruction points out certain exclusion to calculate to DPPM. As indicated earlier, the second concept of quality. "Quality" means freedom from deficiencies—freedom from errors that require doing work over again (rework) or that result in field failures, customer dissatisfaction, and customer claims, and so on. (Joseph M. Juran, Co-editor-in-chief. A. Blanton Godfrey, Co-editor in-Chief. 1998. P26-27). Means all those cannot meet the requirement, shall be concluded to defectives. In the above 6 situations, as need extra rework as below, shall be considered to supplier DPPM. See Figure 13, the items not included to DPPM and rework needed in Commissioner.

Item	Currently not count to DPPM in commissioner	Requires in Commissioner
1	Parts with rust unless there is clear carelessness by the supplier.	Extra resources to remove the rusty away
2	Deviation request made by supplier or commissioner	Extra resources to evaluate the deviation
3	If the supplier warns that there is a problem (previous write requirement of deviation): not DPPM or some testimonial one.	Extra resources to evaluate the deviation
4	Packaging not according specification, but parts not damaged and according specifications.	Extra resources to evaluate the defects, might need rework or sorting or inspection
5	Initial Samples or Prototypes.	Extra resources to evaluate the situation, might need resources to change the package and inform supplier to correct the problem
6	Defective in Commissioner parts (component commissioner purchase from supplier then sell to customer or dealer directly)	Extra resources to handle the claims from customers or dealer

Figure 13. Items not included to DPPM and requires in Commissioner.

Besides, in case of Sort or rework at the expense of the supplier, Commissioner would not count all the defects to DPPM, instead, only count 10% of the defects. When the suspected component. In the case of Return material to supplier for actions, will ask defective quantity information from supplier to count to DPPM or calculate based on the defective percentage to get a quantity to DPPM. Those definitions encourage supplier respond fast to handle defective components, while possible is supplier might report fewer number to Commissioner to get better impression in front of customer. As, DPPM is one of the KPIs for suppliers, those whose have better KPIs would get higher possibilities to get new business or some kind of reward from Commissioner in annual supplier day. Based on the comparison, the supplier DPPM in Commissioner includes less defects during calculation compare to the concept from Joseph M.Juran and A. Blanton Godfrey. Means with that formula in Commissioner might get smaller number of DPPM.

3.3.2 Supplier DPPM trend in Commissioner

Supplier DPPM is one of the major annual KPIs in global supplier quality in Corporation Y as well as Commissioner. Specifically, there is no separate supplier DPPM for engine&Generation business or other agricultural business which mean Vehicles. Supplier overall DPPM has been decreased from 628 to 298 from 2017 to 2019 in Commissioner, see Figure 14.

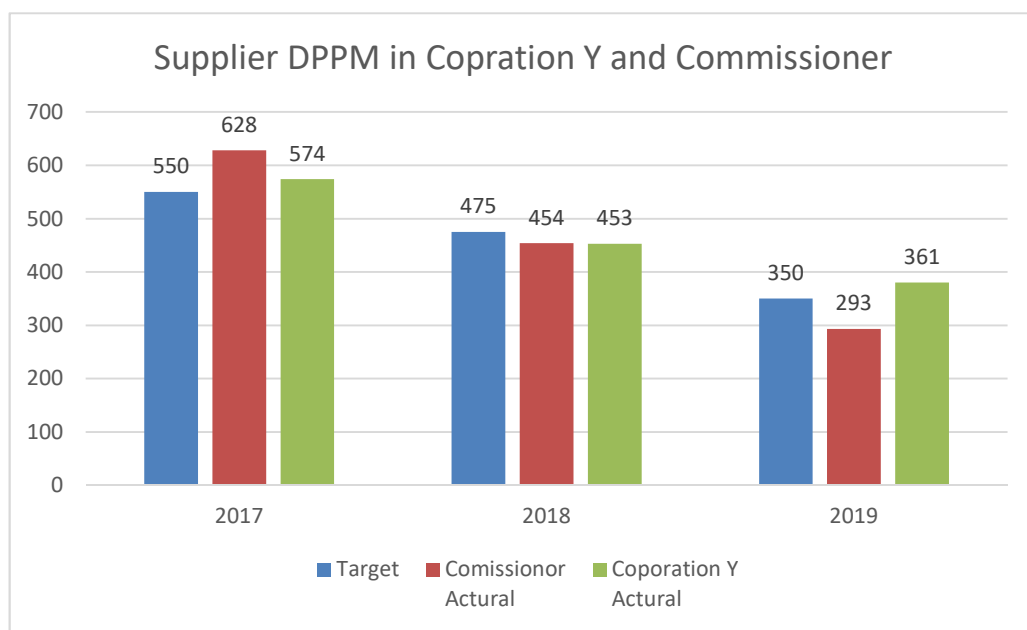


Figure 14. Supplier DPPM in Corporation Y and Commissioner

Due to factors of technology, equipment, human, material, method, environment, measurement, quality management level, applied in suppliers in different fields, quality control in different even the same commodity suppliers can be in different level. Commissioner with Corporation Y defined different DPPM targets for suppliers in different commodity. See one example in November 2019 in Figure 15.

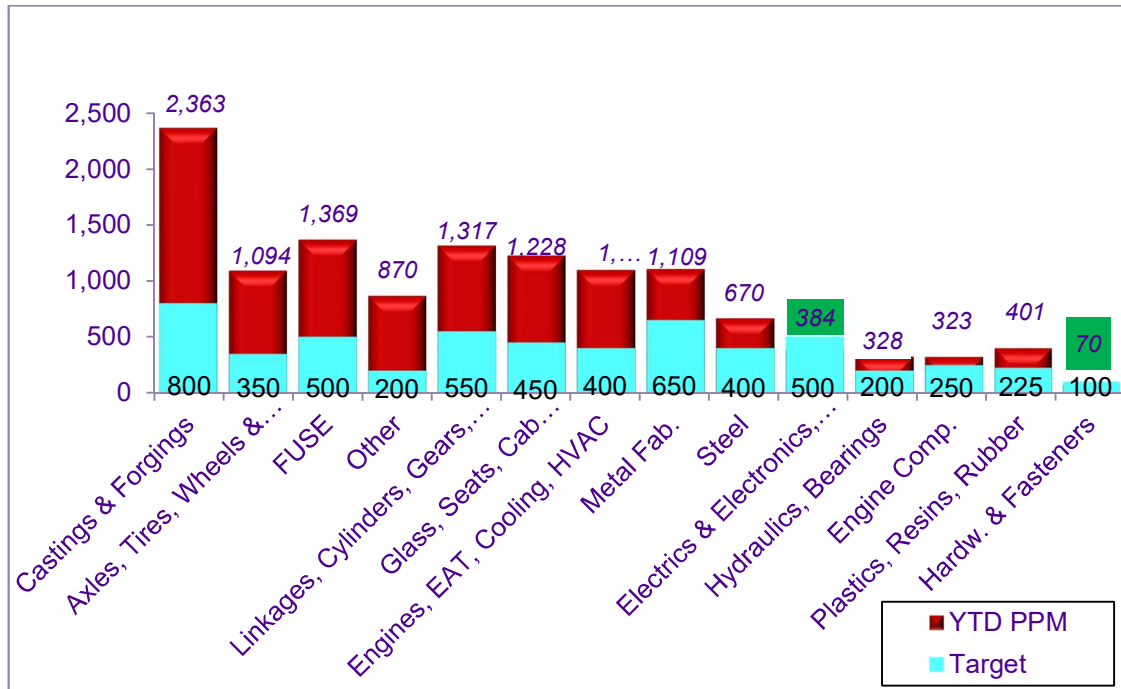


Figure 15. YTD supplier DPPM in different commodity November 2019 in Corporation Y (Including Commissioner)

3.3.3 Supplier DPPM compare to Competitor

As wrote by Director of global supplier quality in Commissioner, (July 8, 2019) “I learned below facts shared by Ex- Competitor A Supply management Executive during PUR workshop at Duluth last week. (AG and Turf division of Competitor A)

Facts:

- 1) Competitor A&T DPPM went down from 765 to 225 in 5 years (2007 - 2012), now DPPM is in range of 200-250.
- 2) A&T division has 2500 Suppliers that cater to 37 locations worldwide.
Compared Corporation Y has 6752 suppliers cater to 25 locations globally.(Director of supplier quality strategy, 11.09.2020)
- 3) \$10B Spend in 2012, now it's at around 12B (3 times more than Commissioner DM spend)

Let's get to 250 DPPM by 2020 together. Each and every commodity must meet set DPPM goal by 2020. (Supplier overall DPPM target changed to 300 due to COVID-19 pandemic)

"Do they have similar DPPM definition to us?" "Yes" the director confirmed. (July 8, 2019).

There is around 100DPPM gap for Commissioner to reach the level of the competitor A in 2019. Base on the information, the competitor A has big achievement in five years in supplier DPPM improvement. While from 2012 to 2019, 7 years passed, DPPM with no big changes (from 225 to range of 200-250). There are 2 major concerns

- 1) *As commissioner is mainly produce engine and generation, the product is different to vehicles or transmissions, whether the DPPM is comparable than competitor A in business A&T*
- 2) *If Corporation Y only take competitor A as the benchmarking regarding DPPM improvement, further study would be preferred to initiate*

Benchmarking, "The continuous process of measuring products, services, and practices against the company's toughest competitors or those companies renowned as industry leaders." (Camp 1994), is an important ingredient in strategic planning and operational improvement. To remain competitive, long-range strategies require organizations to adapt continuously to the changing marketplace. To energize and motivate its people, an organization must:

- Establish that there is a need for change
- Identify what should be changed
- Create a picture of how the organization should look after the change

Benchmarking achieves all three. By identifying gaps between the organization and the competition, benchmarking establishes that there is a need.

Recommendation to Commissioner would be apply THE 10-STEP BENCHMARKING PROCESS defined in (Joseph M.Juran, Co-editor-in-chief. A. Blanton Godfrey, Co-editor in-Chief. 1998. P344-359) with the help from 3rd party in gather the desired information from competitor in an ethical and legal manner. (Joseph M.Juran, Co-editor-in-chief. A. Blanton Godfrey, Co-editor in-Chief. 1998. P360)

4 DEVELOPING STRATEGIC OPTIONS FOR COMMISSIONER

Per the definition of strategy by Chandler, there are 3 key elements, where you are, where you are want to go and how can you be there in a long term scale. This part will discuss these three elements for Commissioner and then get optional strategies, then pick out the proposed one for Commissioner.

4.1 Long term goal

To introduce the long term goal in the strategy, first will discuss the optimum points for quality cost. There are 2 figures in Figure16 (a and b) to show different optimum points for quality cost defined by Juran, in his 4th edition, Juran's quality handbook. Both of them with the X axis stands for percentage of quality of conformance, means the percentage of product or service meet customer's requirements. Y axis stands for cost per good unit of product. There are 3 curves in both figure 15, a and b, which stand for the same meaning, total quality costs, failure costs and costs of appraisal plus prevention. The differences are, in left one figure a, when the quality of conformance increase from 0 to 100%, the total quality costs will first decrease to lowest, at this point, the total quality costs equal to failure costs plus costs of appraisal plus prevention reaches the perfect situation. After that total quality costs will increase significantly to infinity along with the quality improvement. While the failure costs decreased from infinity to zero after it reach 100% quality of conformance. Meanwhile, the costs of appraisal plus prevention increase from 0 to infinity. In figure total quality costs reach lowest point, when conformance of quality reaches 100%, the failure costs will disappear and costs of appraisal plus prevention is the unique contributor to total quality costs. The curves could be different looking while the trends will be the similar, because for different product or service, the cost per good unit product could be varies.

QUALITY COSTS

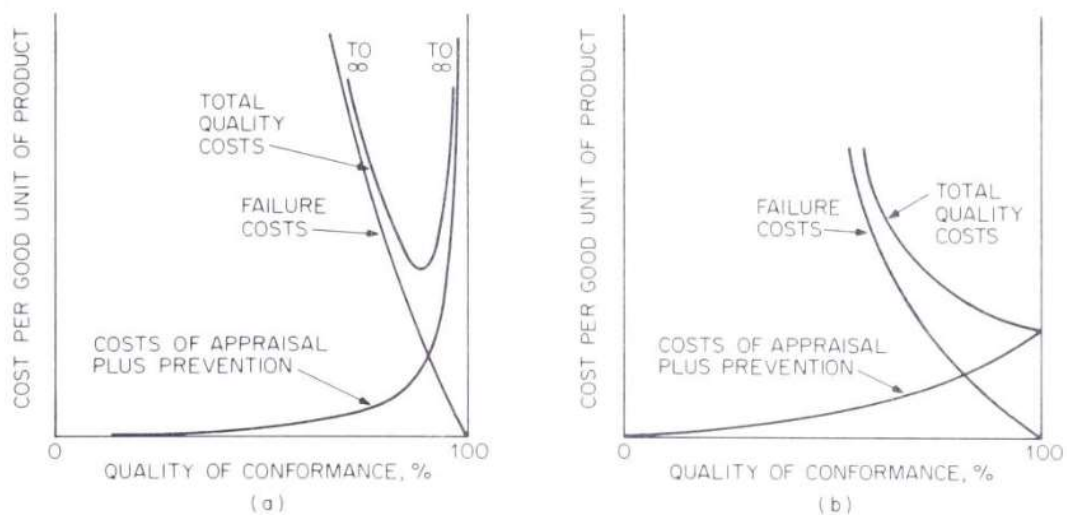


Figure 16. Model for optimum quality cost: (a) Traditional processes, (b) Emerging processes (P88)

The first Model in figure a, which called traditional processes by Juran, is suitable for these situations, main appraisal was performed by human which is not able to guarantee 100 percentage conform to quality.

The second model in figure b, which called emerging processes by Juran, is suitable for the condition when the new technology reduced the inherent failure rates of material and products. Robotics and other forms of automation reduced human error during production. (Automated processes do not have lapses in attention, do not get tired, etc)

While perfection is clearly the goal for the long run, it does not follow that perfection is the most economic goal for the short run, or for every situation. (Joseph M. Juran, Co-editor-in-chief. A. Blanton Godfrey, Co-editor in-Chief. 1998. P88)

In the supplier bases what Commissioner has, they cover both of the 2 models, means human relied and less automation in Model a and b with advanced technology can reduce human errors during production. Generally is in following,

- Model a, casting forging, machining, plastic, rubber, resin, sealing, hardware Fasteners (some low values without automatic inspection system), Electrical, Metal fab,
- Model b, Electronics, hydraulics, bearings, engines, EAT, cooling, HVAC, machined casting, engine component.

In conclusion, these 2 kinds of different Models shall be integrated and applied to Commissioner to manage COPSQ which is a part of COQ to reach the optimum conditions.

There are exceptions to the Model a and b defined by Juran. To Commissioner, as the sales and marketing team has been searching for customers in sectors where AGCO does not operate. The goal in the construction machinery industry is, for example, bulldozers, shovel loaders and excavators. (Commissioner Intra news 2020). Along with the strategy, aiming for strong brand was mentioned as well. Besides, excellent quality and reliability are the selling points of our engines (Account manager Commissioner 2020).

There has not define the meaning of excellent quality, the further study to the topic and whether customers or potential customers would like to pay more with higher quality, then for Commissioner, to reach 100% conformance of quality would be relevant topic as part of the long term goal.

In summary, in this part and with the instruction of five stages to measure the maturity to quality management in organization in chapter 3.2 in this thesis. The recommendation for commissioner, is first defined the stages 5 (reported 2.5%, actual 2.5%) as its long term goal. Then, statistic the COPSQ which in the portion of COQ, by define COPSQ for suppliers separately to 2 different kind of processes which should follow the concept of Model a and Model b in Figure 16 under quality costs. The optimum points have to be calculated and set as the long term goal.

4.2 Return on quality (Joseph M.Juran, Co-editor-in-chief. A. Blanton Godfrey, Co-editor in-Chief. 1998. P264)

Per Juran, quality improvement needs resources investment, and the investment must be justified by the blossoming benefits of improvement. The long-term effect of applying the cost of poor quality concept is shown in Figure 17.

Besides reduce the cost in supplier site, besides the COPSQ in Commissioner, there are also cost in supplier site due to the poor quality. It strengthen the cooperation, support to reduce the COPQ in Commissioner. Improve the quality level from research and design to process control then to customer service.

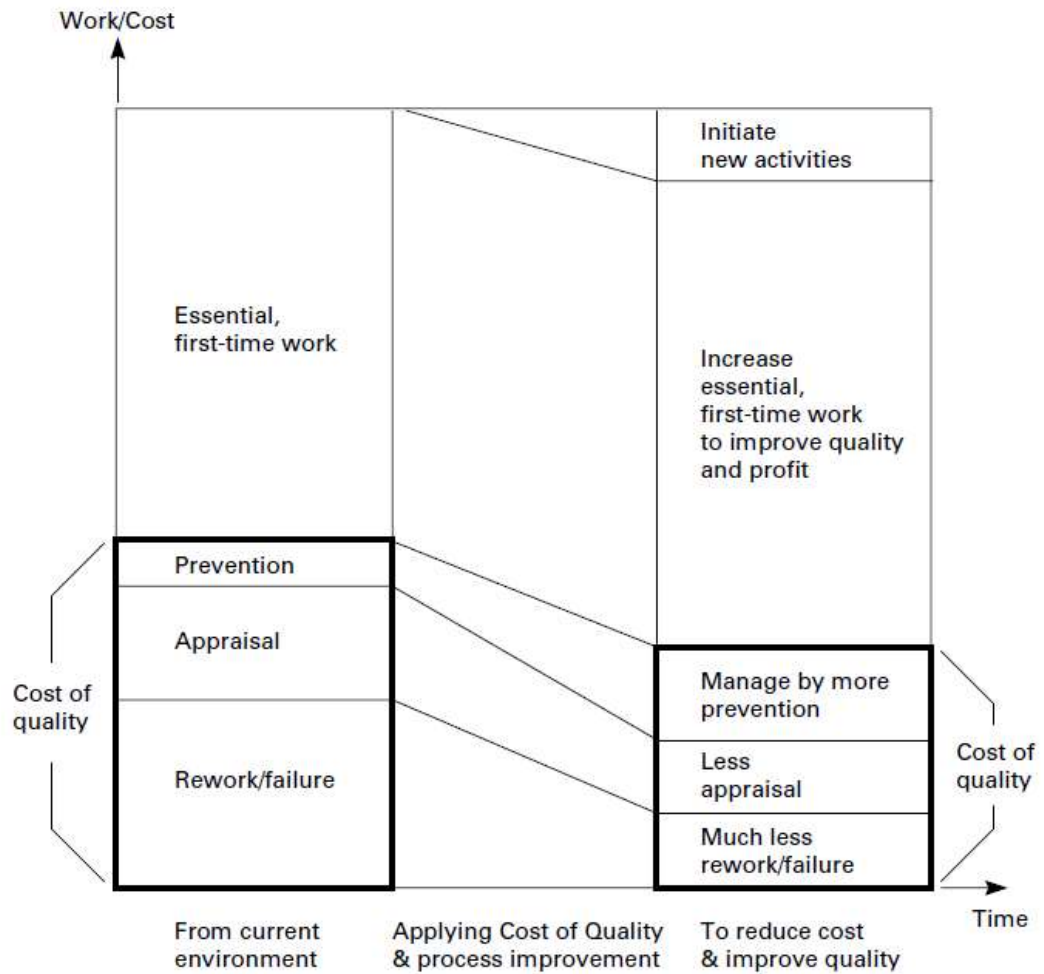


Figure 17. Effects of identifying cost of quality ((Joseph M.Juran, Co-editor-in-chief. A. Blanton Godfrey, Co-editor in-Chief. 1998. P264)

4.3 Realize current position

Figure 18 divides the total quality cost curve of Model a in Figure16 into three zones. A reduction in cost can be achieved by moving toward the optimum from either the zone of improvement or the zone of high appraisal costs.

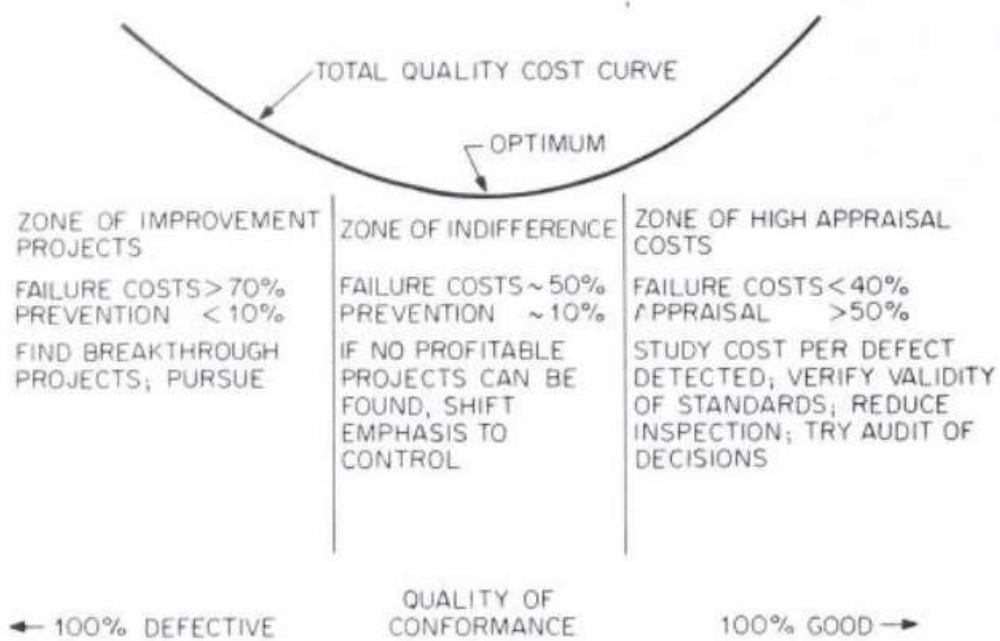


Figure 18. Optimum segment of quality cost model

4.3.1 Zone of improvement projects

Failure costs contribute over 70% while prevention cost occupy around 10% in total quality cost. Lots of space to reduce the quality cost especially failure costs by improving conformance of quality.

4.3.2 Zone of high appraisal cost

In this condition, the appraisal cost (more than 50% of the total quality cost) usually exceed failure cost (less than 40% of the total quality cost). When this happens, it is over appraisal control, normally the defective rate is super low and too much resources spend while the output or improvement compare to less, is small. There are opportunity to reduce the appraisal activities and costs even the failure cost increase, while the total quality cost decrease.

4.3.3 Zone of indifference

The failure costs are usually equal to sum of prevention (about 10% to total quality costs) and appraisal costs. The optimum has been reached in term of worthwhile quality improvement projects to pursue.

In Commissioner, there is no such information which zone of quality cost is located, COPSQ either.

To get the initial COPSQ data, following steps in Figure 19 are recommended to Commissioner based on 10 steps described by Juran,

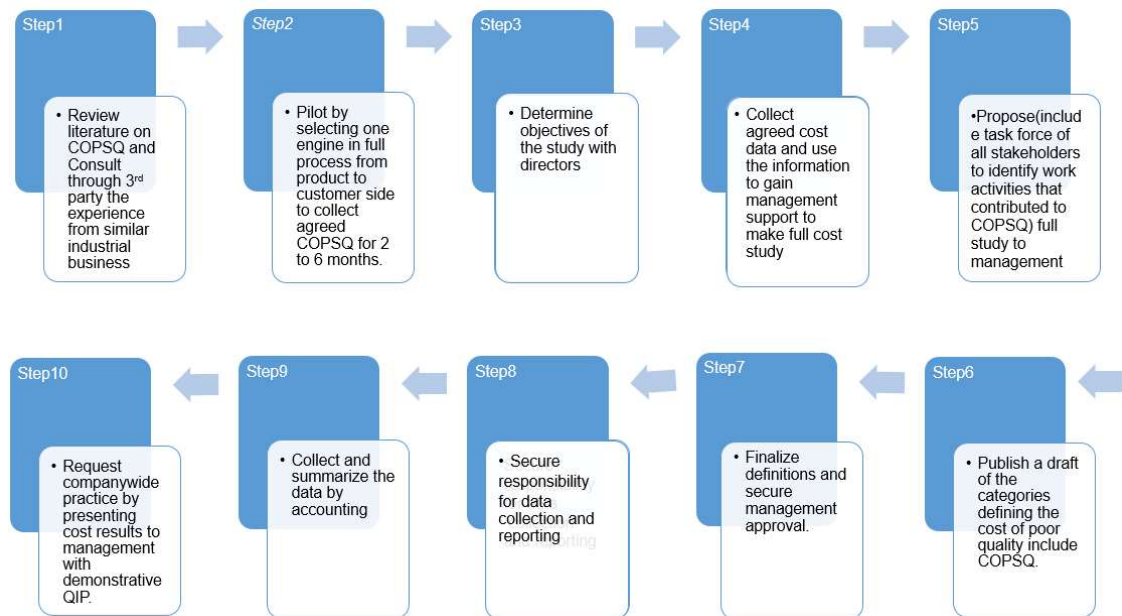


Figure 19. 10 steps recommend to Commissioner for initial COPSQ study

4.4 Means to reach long term strategy

The long term goal shall be broken down to annual target within Commissioner. There are three approaches to data collection and reporting are identified.

Quality costing which is one of the 3 approaches to data collection and reporting, is the failure, appraisal, and prevention approach described. (P260 Joseph M. Juran, Co-editor-in-chief. A. Blanton Godfrey, Co-editor in-Chief. 1998. P260)

To get the data of COPSQ is not the goal, instead, to get the COPSQ to reach the optimum points is. There has to be quality improvement in supplier side, to avoid the impact to the goal. With the collected data, Commissioner shall focus on quality improvements to optimize the COPSQ. With improvement in every year, Commissioner, shall adjust the target in following years, might be adjust the long term target after several years or reached the long term goal.

In later chapter 6, there is introduction how to deploy the strategy with DMAIC methodology.

5 SURVEY REGARDING MISSING COST AND HIDDEN COST PRACTICE

This part start with stakeholders identification to plan a survey with internal stakeholders in Commissioner to get the opinion which missing cost in COPSQ and hidden cost shall be counted to compensate to supplier. Meanwhile, it offers opportunity to open discussion to COPSQ. The missing cost has been clarified in Chapter 1.2, detail see Appendix 3, hidden cost has been discussed in chapter 2.4.

5.1 Stakeholders to COPSQ identifications

Due to the economic importance of stakeholders in creating and distributing value (Freeman et al.,2010; Mitchell et al.,2015; Venkataraman,2002),there is growing interest in theories that help to identify an organization's stakeholders. The stakeholders identification is important both to improve explanations of value creation generally, and of economic profit creation specifically (e.g., Barney, 2018).

Based on definition in the Professional Academy (2018) and CIPS (2014), stakeholders could be categorized to internal, connected and external stakeholders. See Figure 20, the stakeholders to an organization. Internal stakeholders are usually members of the organization. The following are some examples of who these stakeholders might be:

- Directors
- Managers
- Employees

In difference to market factors, stakeholders have different levels of interest and power towards a company, can either lead, support or likewise hinder any strategic directions, resulting in necessary compromising between the different groups (Johnson et al. 2017, 135–136).

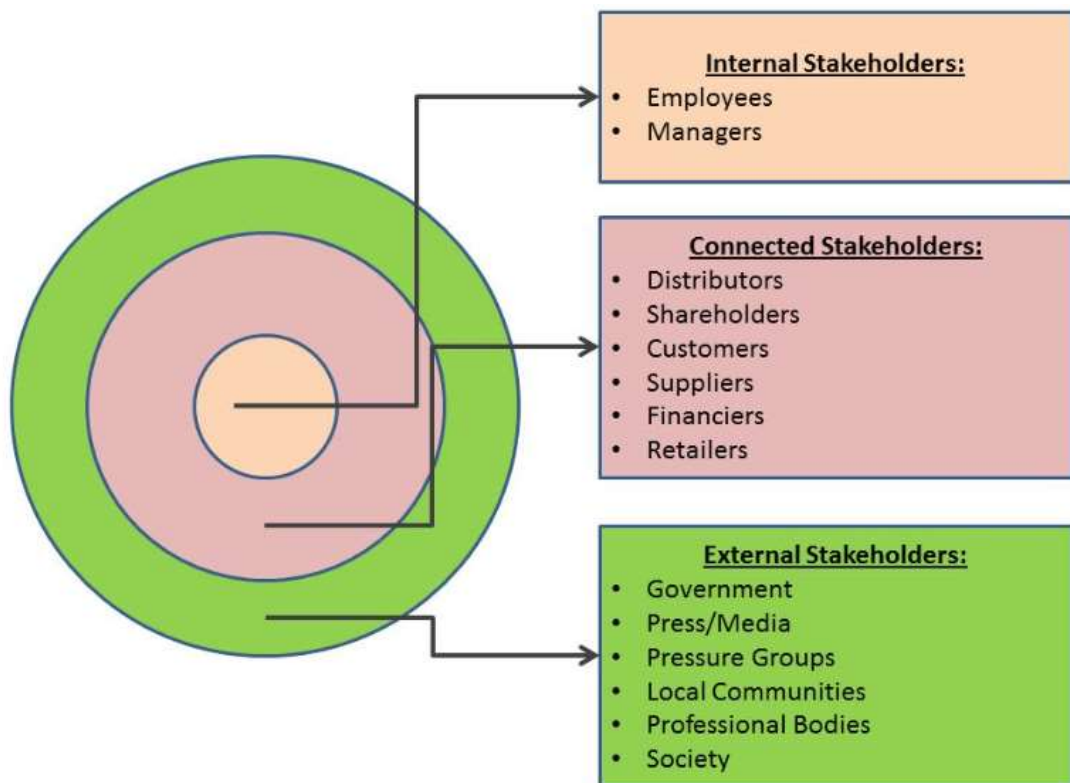


Figure 20. Stakeholders to one organization. Professional Academy (2018)

This thesis is trying to collect and analyse the responses from internal stakeholders, while to connected and external stakeholders, there has to be further research how to reach win-win cooperation with mutual understanding and agreements. Based on the approach of AMPIP applying in Commissioner in the product development and introduction from ideas to market, See Appendix 4. AMPIP introduction in Company. This includes the full process connecting external stakeholders and internal departments to any projects realization. In AMPIP indicates internal stakeholders participate in the full process, see Appendix 5. AMPIP internal stakeholders in 6 phases.

As the defective material from supplier, could in any stage of the 6 phases, then, possibility of COPSQ would generate and affect these internal stakeholders. In details, the cost related stakeholders in commissioner, would include, NPI quality, supplier quality, build quality, OEM quality, field quality, Marketing, sales, Procurement, logistic, warehouse, Project management, engineering, manufac-

turing, quality laboratory and incoming inspection. Overview of conducted internal stakeholder by department to Commissioner regarding COPSQ management can be found in Figure 21.

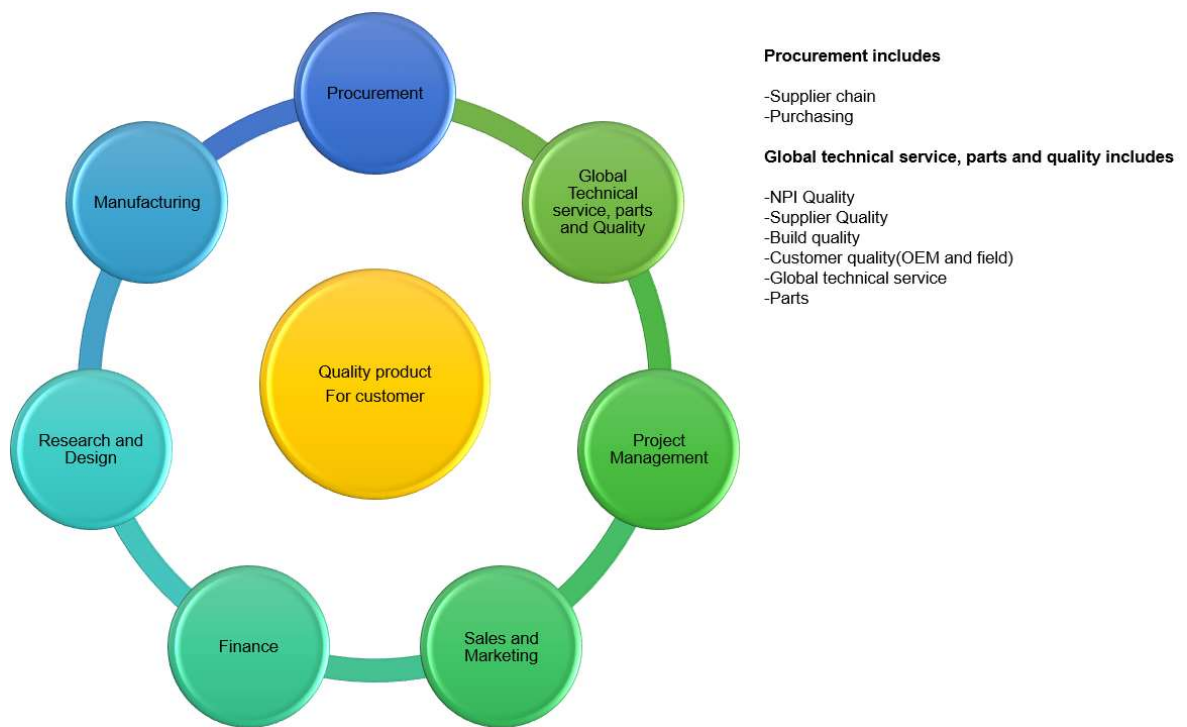


Figure 21. Internal stakeholder by department in Commissioner regarding COPSQ management

This study will make survey to all of the internal stakeholders, in questionnaires to collect data and summarize result as the basis of further analysis and recommendations.

5.1.1 Research validation

As is understandable, the researcher must avoid his or her own opinions and biases from affecting the research outcome. However unconscious bias is difficult to identify so clear measures must be taken to ensure objectivity, which also defines the credibility of the research. As such the researcher must take measures to ensure that bias is being removed as much as possible (Patton 2002, 50-51).

To eliminate the biases in the outcome from the thesis, there has been several factors been considered and optimization design in the survey.

Firstly, the bandwagon effect is a psychological phenomenon whereby people do something primarily because other people are doing it, regardless of their own beliefs, which they may ignore or override.(Linda and Charlie Bloom,11,Aug,2017 psychologytoday.com) Base on the theory, the respondents would ignore or override their own opinions when they know the others' opinions. is to get the realistic and honest opinions from respondents, the survey was set as anonymous and does not require any information(Age, years in the company, name, etc.) could identify the respondents. Besides, after or before respondents fill out the survey, it disable the possibility to review responds from any others. In these ways, others opinions to questionnaires will not affect every individual respondent by checking the feedbacks.

Second, the questionnaires has been send to internal stakeholders related to the specific processes in Commissioner. This would support to get the possible opinions to realistic situation and understanding from the owners of the processes, then to make better decisions.

Finally, there were 180 stakeholders been invited to the survey, and the respond rate is 48, which general response rate is 27%. After got the respond, the main stakeholders to specific field achieves 80% (25/31). The analysis takes the result mainly based on the responds from main stakeholders which avoid biases from non-critical stakeholders. In this way, to get credible conclusions for Commissioner.

5.1.2 Survey which item in the missing cost and hidden cost shall be included or not

48 Responds to the survey include the department in 12 functions of the internal stakeholders, 1 respond from finance, and respond by email. 8 females, 40males.See Figure 22.Total 30questions, which include 20 regarding missing COPSQ.9 questions for hidden costs, and 1 is voluntary and open opinions to COPSQ.

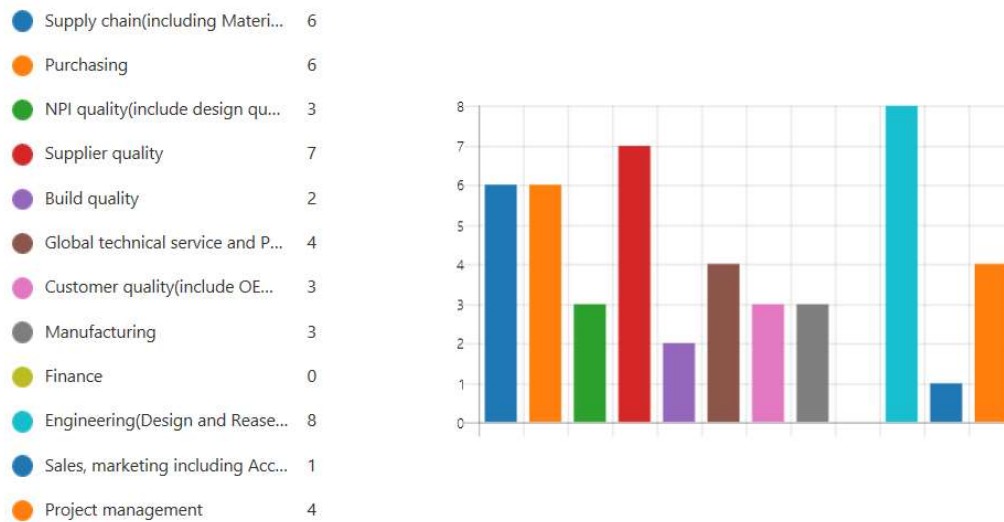


Figure 22. Respond overview by department

5.1.3 Result of the survey

In the missing COPSQ items, there are 7 items with positive feedback, the items shall be charge to supplier. Rate with positive respond (most likely and likely) takes around 75% in these responds. See the questionnaires in Appendix 6.

There are 6 items with almost same amount of opinion than the opposite side. The left items, there are 7 with negative responds (Most unlikely and unlikely).

For hidden cost, there are 8 questions, with 7 negative and 1 neutral feedback. Means, in general, most of responders would not like to count the hidden cost and charge suppliers.

5.1.4 Analysis of the result and conclusion

For the missing COPSQ:

1) 7 Positive responds (With higher rate of either most likely or likely).

Question 4, as the activities mainly focus in supplier side and based on the responsibility definition in Commissioner, so removed less relevant responds by department from original data. The Rate with respond most likely and likely to Most unlike and unlikely increased. Project management responders are only

hold positive opinions. Responders from supply chain, supplier quality and project management are top contributors to the positive response. At the opposite side, the majority with negative response contributed from Purchasing and is the only department with most unlikely feedback. For question 6, over half main stakeholder mean supply chain stay at opposite side, not willing to charge supplier the cost. There are 4 questions, supplier quality is the main contribution to opposite side in question 11. While supply chain is the main contribution with opposite feedback in question 12. Question 18, is a bit different, after adjusted, the shows a neutral result.

Over half of these responses, supplier chain (main responsibility is release series production orders to suppliers and make sure material arrive on time) and purchasing have different opinion to others, means would not like to charge supplier the relevant costs. The supplier chain and purchasing are under the same director in the commissioner.

2) 6 Neutral responses (With similar rate of either most likely or likely than most unlikely and unlikely). See Appendix 7 and Appendix 8. After adjust the responses, due to specific questions, Question 16 shall categorized to Positive responses, Question 19 to negative response.

3) 7 Negative responses (With lower rate of either most likely or likely than most unlikely and unlikely). After adjust the responses, question 15 shall categorized to neutral responses.

In summary, respondents prefer to ask compensation from supplier to those items which are visible, or called surface cost, to the costs behind, most of respondents do not prefer to charge suppliers.

Hidden COPSQ

From all the questions, the advantage does not stay with positive side. Respondents from purchasing department are commonly the main contribution in against to count the hidden cost to compensate suppliers. For the voluntary question, about the understanding of what should be included in administration cost, only

around 1/4 respondents provide correct answer. It shows the understanding to the same term in global procedure varies a lot. See Appendix 9.

Conclusion.

The 7 missing cost with positive response shall be measured and taken into account for COPSQ management for Commissioner.

The internal procedures should be updated by adding these items. Besides, a training to internal stakeholders is necessary, to address the updated items and clarify the detail terms in current procedures. As the stakeholders in connection and external are playing an important role, the suggestion would be to negotiate with them especially with customers and suppliers to make these items clear in the quality assurance agreement.

These hidden costs can accumulate to a large amount—sometimes three or four times the reported failure cost. Where agreement can be reached to include some of these costs, and where credible data or estimates are available, then they should be included in the study. Otherwise, they should be left for future exploration. (Joseph M. Juran, Co-editor-in-chief. A. Blanton Godfrey, Co-editor in-Chief. 1998. P260). The suggestion for Commissioner is not to include hidden cost study before mutual understanding and agreement to include them, then collect or estimate these data for managing. In terms of global procedures regarding COPSQ, necessary training needed to be given to stakeholder to achieve mutual understanding for correct and efficient communication.

6 STRATEGY DEPLOYMENT FOR COMMISSIONER

Strategic Planning (SP) is a systematic approach to defining long-term business goals and identifying the means to achieve them. Once an organization has established its long-term goals, effective strategic planning enables it, year by year, to create an annual business plan which includes the necessary annual goals, resources, and actions needed to move toward that future. (Juran's quality handbook, 5th edition, P362). As for Commissioner, the recommended long term goals has been defined, to reach the goal, there should be a way generated to reach it.

The strategic quality deployment process requires that an organization incorporate customer focus into the organization's vision, mission, values, policies, Strategies, and long- and short-term goals and projects. (Juran's quality handbook, 5th edition, P367).

Currently, Commissioner, as the sales and marketing team has been searching for customers in sectors where Corporation Y does not operate. The goal in the construction machinery industry is, for example, bulldozers, shovel loaders and excavators. (Commissioner Intra news 2020). Along with the strategy, aiming for strong brand was mentioned as well. Besides, excellent quality and reliability are the selling points of our engines (Account manager Commissioner 2020). While Commissioner is sharing the same vision, mission, values to Corporation Y, the recommendation for Commissioner, is to have separate vision state in below: Sustainable high-tech solutions to build the world and farmers feeding the world. The mission and values could stay the same while the organization has to be realize the customer base has been increased. They shall apply to all customers. The organization's vision, mission, and objectives should be clearly defined by senior management, then clearly communicated throughout the organization. (Juran's quality handbook, 5th edition, P425). After that updates, senior management means directors include CEO need communicate clearly within the company. The information could be shared in intra news, departmental meeting, and general training.

Creating a strategic plan that is customer-focused requires that leaders become coaches and teachers, personally involved, consistent, eliminate the atmosphere

of blame, and make their decisions on the best available data.(Juran's quality handbook, 5th edition, P367), per the statement segment 1.2, cost is one of the major focus factors to Commissioner. And reduce the cost backs up the activity of quality improvement in CSPSQ management systematically.

6.1 DMAIC Six Sigma Methodology

DMAIC refer to a data driven improvement cycle used for improving, optimizing and stabilizing business processes and designs. The DMAIC methodology follows the phases: Define measure, analyze, improve and control (R. Banuelas, J. Antony, P92–99 (2002)).It is a circle instead of one way improvement. See in Figure 23 below

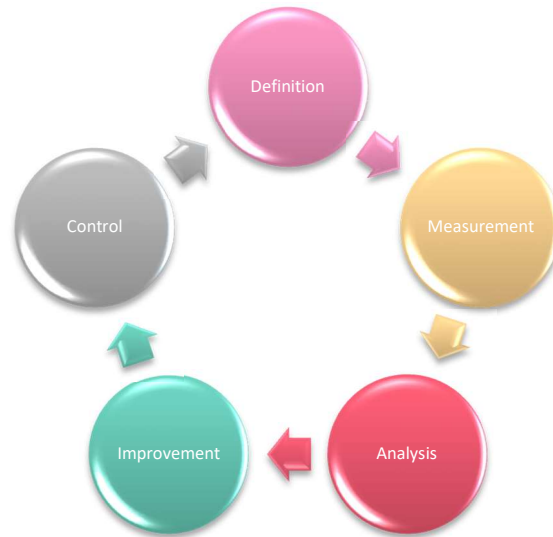


Figure 23. DMAIC improvement circuit

These steps are explained as follows in Figure 24.

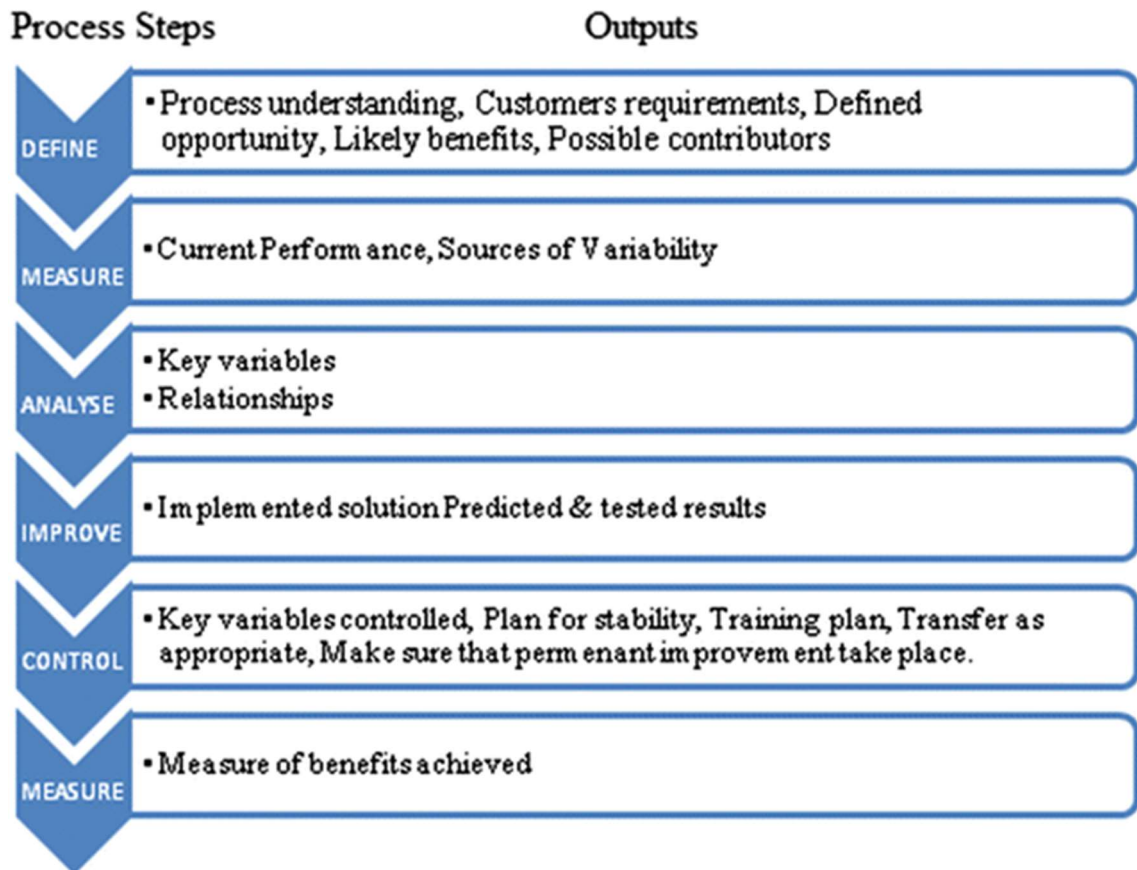


Figure 24. The DMAIC process and key outputs

DMAIC methodology provide a way to Commissioner in improving the quality level to its suppliers to reduce the COPSQ. In general, the recommendation to deploy the COPSQ strategy would include following 5 steps in DMAIC

6.1.1 Define

Technology can reduce human errors during production. Generally is in following,

- Set up executive council with clearly responsibility defined to avoid lost direction and lack of resources
- Set up plans with the breakdown long term goal into annually and set KPIs based on current estimation
- Revise vision of Commissioner and communicate within whole organization

A fundamental step in the establishment of any strategic plan is the participation of upper management acting as an executive council. (Joseph M. Juran, Co-editor-in-chief. A. Blanton Godfrey, Co-editor in-Chief. 1998. P373). KPIs set in stakeholders' in each department, will let the whole organization pay attention to

target and contribute to improvement .Meanwhile as the bonus link to the performance, there will be more motivation to pursue the goals. Besides, reward could encourage competitions among different departments, Per Juran, rewarding the right behaviors is required. . In Commissioner, there are SAP and its portal, are now showing certain COPSQ, the cost are going to show more clear, while is not possible to get the data show directly which part of the cost belong to, the suggestion is to have specific subcategories under these four categories with the agreement from directors levels. The communication between SAP and portal technical support team should be initiated by adding the categories for stakeholders to upload then for analysis without excess resources spend on.

It would takes long period and challenges to have each supplier have these cost agreement with Commissioner. Some need more resources include time and human to finish the negotiation, some might not possible to have one, some might to revise the agreement. Regarding quality assurance agreement, the current way in Commissioner could be continued, to those supplier who already have an existing signed one, the COPSQ could be collected and upload to SAP or portal, then supplier pay back the compensation or Commissioner deduct them from payment. To those negotiation of QAA ongoing or not started, before the agreement signed, the cost will be uploaded to SAP or portal, while there will be another negotiation case by case, in case of the supplier does not agree with the amount.

6.1.2 Measure

- Training in whole organization with the terms, necessary tools, for example DMAIC
- Make initial study of COPSQ with the recommended items in COPSQ without hidden cost in Portal or SAP with aligned allocate to the four categories.

It is necessary to collect these COQ beyond COPSQ, in reality, this help to push improvement to the internal processes. In the product design process, engineering and research would be realized when the design went wrong, there will cost generated and get pressure to perform the design better. In the process control, when the cost been collected, there will be pressure to optimize

the process design to balance the risk and secure quality. There is no doubt, supplier should not let the non-conformities escape to customer side, while base on the rule of 1/10/100 (G. Loabovitz and Y. Chang, 1992), if in the customer side, the non-conformities could be detected instead of escape to its customer, the cost would be 90 times less. In this perspective, supplier prefer customer has robust process control, the best would be, in customer side, any non-conformities could be detected as early as possible, while this might not the best option for customer, cause such process probably cost more in prevention and appraisal. In this step, the data of COPSQ should be collected and measured. We need to collect data on the cost of poor quality, analyse the data, and plan an improvement strategy that attacks chunks of the glacier rather than ice chips. (Joseph M.Juran, Co-editor-in-chief. A. Blanton Godfrey, Co-editor in-Chief. 1998. P252). Per Juran, a common language to key terms shall be trained to make the communication more precise. Beside on the processes in the data collection, Commissioner should arrange trainings to different departments, different level to avoid mistakes. Training material could be easily got by everyone within the organization.

6.1.3 Analyse

- Analyze the data collected and initiate improvement plans with systematic tools like 8D or DMAIC etc.
- Recognize the key variables and main contributors to achieve the target
- Identify the major sources for improvement

Identify opportunities for reducing customer dissatisfaction and associated threats to sales revenues. Some costs of poor quality are the result of customer dissatisfaction with the goods or service provided. This dissatisfaction results in a loss of current customers—“customer defections”—and an inability to attract new customers. Addressing the areas of dissatisfaction helps to improve retention of current customers and create new customers. (Joseph M.Juran, Co-editor-in-chief. A. Blanton Godfrey, Co-editor in-Chief. 1998. P252).

Measuring progress helps to keep a focus on improvement and also spotlights conditions that require removal of obstacles to improvements. . (Joseph M.Juran,

Co-editor-in-chief. A. Blanton Godfrey, Co-editor in-Chief. 1998. P252) Align quality goals with organization goals.

6.1.4 Improve

- Finalize the improvement plan
- Implement the plan and review the result to verify the efficiency
- Scoreboards publish to track achieved status

Per Juran, quality cost measurement and publication in form of scoreboards does not solve quality problems. It makes no provision to identify projects, establish clear responsibilities, provide resources to diagnose and remove causes of problems, or take other essential steps. New organization machinery is needed to attack and reduce the high costs of poor quality. Scoreboards, if properly designed, can be a healthy stimulus to competition among departments, plants, and divisions. To work effectively, the scoreboard must be supplemented by a structured improvement program. In addition, scoreboards must be designed to take into account inherent differences in operations among various organizational units. Otherwise, comparisons made will become a source of friction. (Joseph M.Juran, Co-editor-in-chief. A. Blanton Godfrey, Co-editor in-Chief. 1998.P251).Commissioner shall public its scoreboards in main offices as well as in manufacturing Kanban area with responsibility under exact department with the improvement plan, as cost is sensitive to business, in case of, not available, the publication shall be in smaller groups while has been in the agenda of regular management review meeting.

6.1.5 Control

- Standardize the effective actions, offer trainings to stakeholder
- Measure the achievement and compare to goals
- Set annual target for next year (another DMAIC)until it reach the long term target
- Measure the satisfaction from customers

Once an organization has established its long-term goals, effective strategic planning enables it, year by year, to create an annual business plan which includes the necessary annual goals, resources, and actions needed to move toward that future. (Joseph M. Juran, Co-editor-in-chief. A. Blanton Godfrey, Co-editor in-Chief. 1998, P362). A formal, efficient review process will increase the probability of reaching the goals. When planning actions, an organization should look at the gaps between measurement of the current state and the target it is seeking. The review process looks at gaps between what has been achieved and the target. (Joseph M. Juran, Co-editor-in-chief. A. Blanton Godfrey, Co-editor in-Chief. 1998. P379). The improvement is never a one-time deal, instead, continuous improvement should be always in mind of an organization.

6.2 Review

This thesis has targeted the following questions initiated beginning of the dissertation, answers has been provided and recommendations has been offered in above segments.

What is a suitable strategy of COPSQ management for Commissioner?

What kinds of cost shall be taken into count for COPSQ management for the initial study in details for Commissioner?

What kind of development plan should be based on DMAIC methodology to Commissioner?

7 DISCUSSION

The study in the thesis provide a recommendation to Commissioner to COPSQ management, this has been concluded based on theories which could backup. While in practise, as the world is changing faster than ever, the global warming may affect the business, upgrade of engine family might affect the optimum point in cost control, and new technologies might drive the improvements, even the changes and risk we cannot predict, like, COVID-19 pandemic we are facing now. When considering and implement the strategy, it is also recommended we shall consider the changes around and renew the plans accordingly.

The management team has to make proper decisions which items shall be included in the further development stage of COPSQ and to claim to supplier or inform supplier without claim.

Quality culture perfection and incentives in commissioner

In favor to the business value of customer focus stated in below,

"We create excellent solutions for our customers by carefully listening to their needs and exceeding their expectations."(Commissioner Website)

Within the organization, the recommendation is to encourage the good behaviors with contribution to well implement this value in practice by rewarding. Be always keep in mind the next process is the customer to the previously one. In many business, the quality is more important than cost in slogan than in practice. Commissioner should avoid running in that way.

Legal risks

when extend the content in COPSQ in QAA, as there is position of legal service inside of organization, to avoid possible risks in the business with suppliers, it is necessary to get the legal participate in finalizing the agreement.

Quality improvement and CSR

With quality improvement to reach optimized COPSQ to make COQ achieve optimum point. From financial point of view, the result support reduction of cost from

supplier to Commissioner, and enhance the competition in the market, they could get more opportunities to get new customers or increasing orders from existing customers. While this activity might not only face the resistance because of it breaks the regular way of people making things, but also might be so, the improved processes or change to automation from manual work, reduced the demand of human labours in the organization, relevant person might be afraid of losing jobs to against the improvement. This would also affect the CSR of Commissioner and its suppliers. This thesis did not answer the question, how Commissioner should find a way to make the balance.

Application of advanced technology

5G technology could help production operations in the manufacturing industry become more flexible and efficient, while enhancing safety. This would enable manufacturers to enhance “smart factories,” which leverage automation, artificial intelligence, augmented reality, and IoT. This next gen wireless technology might also result in increased adoption of augmented reality (AR), as 5G networks offer the high bandwidth and low latency required for sustained augmented image quality. In a factory setting, this means AR could support training, maintenance, construction, and repair. (Cbinsights, March 19, 2019)

VR has been applied into many businesses, in optimize the full business from product design, processes design to implementation and improvements.

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APPENDICES

Appendix 1. Commissioner's global supplier quality compensation category

	<u>EME</u>	<u>NA</u>	<u>SA</u>	<u>AP</u>
	Euro	USD	Reais	Yuan
1. Labor Cost (in cost/Hour) (calculated based on activities below)				
a. Inspection, validation & testing	100	110	265	465
b. Sorting	60	110	265	280
c. Rework	80	110	265	280
2. Admin & handling cost	130	150	265	800
3. Assembly Line shutdown Cost /min	340	600	1,360	443
Introduce the Cost based in hours (related to above rates per BU), will be done at the discretion of each BU, and depending on each situation				
- PPAP Rejected (to check). (Currency/PPAP)	6 hours Rate 1.a			
- PPAP not upload in APEX and missing documents	3 hours Rate 1.a			
-Fixed cost per reworked tractor (internal logistics) (Currency/tractor)	2 hours Rate 1.c			
- Change Process without inform (6000 euros) (Currency/part number)	60 hours Rate 1.a			

Appendix 2. Quality cost in four categories and examples typical subcategories

Item	Category	Examples of subcategories
1	Internal failure cost	<p>1).Failure to meet customer requirements and needs</p> <ul style="list-style-type: none"> -Scrap and Rework under internal and supplier's responsibilities besides the costs to the buyer of resolving supplier quality problems. -Lost or missing information -Failure analysis -one hundred percentage sorting inspection -Reinspection, retest -Changing processes -Redesign of hardware and software -Scrapping of obsolete product -Scrap in support operations -Rework in internal support operations -Downgrading <p>2.)Cost of inefficient processes</p> <ul style="list-style-type: none"> -Variability of product characteristics -Unplanned downtime of equipment -Inventory shrinkage -Variation of process characteristics from "best practice" -Non-value-added activities

2	External failure cost	<p>1.) Failure to meet customer requirements and needs</p> <ul style="list-style-type: none"> -Warranty charges: Complaint adjustment: Returned material: Allowances: Penalties due to poor quality: Rework on support operations: Revenue losses in support operations: <p>2.) Lost Opportunities for Sales Revenue.</p> <ul style="list-style-type: none"> -Customer defections: -New customers lost because of quality: -New customers lost because of lack of capability to meet customer needs:
3	Appraisal cost	<p>These are the costs incurred to determine the degree of conformance to quality requirements. Examples are</p> <ul style="list-style-type: none"> Inspection and test from incoming to in process to final Document review: Balancing Product quality audits: Maintaining accuracy of test equipment Inspection and test materials and services: Evaluation of stocks:
4	Prevention cost	<p>These are costs incurred to keep failure and appraisal costs to a minimum. Examples are</p> <p>Quality planning: This includes the broad array of activities which collectively create the overall quality plan and the numerous specialized plans. It includes also the preparation of procedures needed to communicate these plans to all concerned.</p> <p>New-products review: Reliability engineering and other quality-related activities associated</p>

		<p>with the launching of new design.</p> <p>Process planning: Process capability studies, inspection planning, and other activities associated with the manufacturing and service processes.</p> <p>Process control: In-process inspection and test to determine the status of the process (rather than for product acceptance).</p> <p>Quality audits: Evaluating the execution of activities in the overall quality plan.</p> <p>Supplier quality evaluation: Evaluating supplier quality activities prior to supplier selection, auditing the activities during the contract, and associated effort with suppliers.</p> <p>Training: Preparing and conducting quality-related training programs. As in the case of appraisal costs, some of this work may be done by personnel who are not on the payroll of the Quality department. The decisive criterion is again the type of work, not the name of the department performing the work.</p> <p>Note that prevention costs are costs of special planning, review, and analysis activities for quality.</p> <p>Prevention costs do not include basic activities such as product design, process design, process maintenance, and customer service.</p> <p>The compilation of prevention costs is initially important because it highlights the small investment made in prevention activities and suggests the potential for an increase in prevention costs with the aim of reducing failure costs. The author has often observed that upper management</p>
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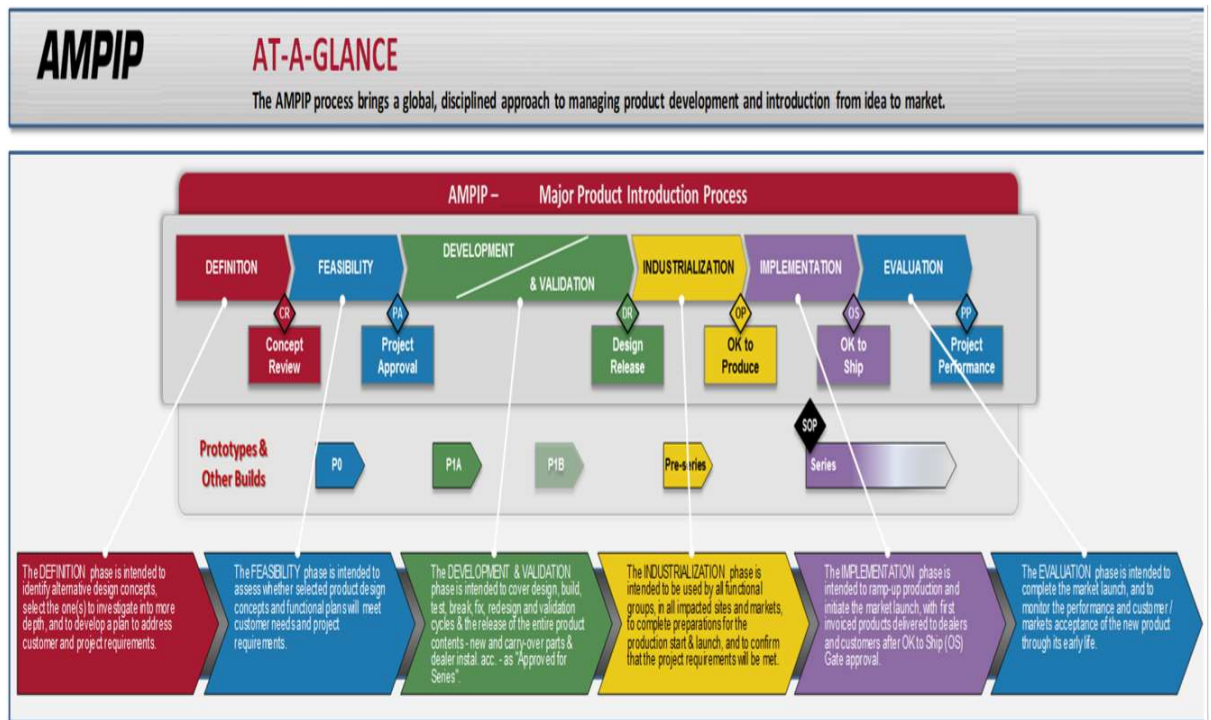
Appendix 3. Missing cost statistic in Commissioner in four categories

COPSQ distributions		Items	
Internal cost	Commissioner	<ol style="list-style-type: none"> 1. Labour cost, in sorting, inspection, test, validation and reworking 2. Admin and handling cost 3. Assemble line shut down cost 4. PPAP rejected 5. PPAP not upload to AEPX and missing documents 6. Change process without inform 7. Expenses for the return of non-conforming parts 8. Expense of taking appropriate corrective action (replacement delivery, sorting out defective parts, reworking, repair, extra shifts, rush shipment, etc.) 9. Any costs incurred by AGCO to remedy the harm. 	These activities in commissioner side

	Missing cost	<p>Cost of tooling worn out cost</p> <p>Wasted shipping cost.(ship the NOK parts to commissioner)</p> <p>New cost of shipping to get good material</p> <p>New Jig or tool cost</p> <p>Depreciation of fixed (Inspection)assets</p> <p>Traveling cost</p> <p>Indirect material cost, such as Label, boxes, pen, gloves, training material, labor cost for next shipments tighten inspection.(sampling size will increase after the defect find)</p> <p>Extra administration cost(the sorting delayed inspector's normal work, someone else have to coordinate around to make the normal work done)</p> <p>Cost of place for sorting (Like rent the workshop) and supply, include water, electricity, heating</p> <p>–Extra direct material used (Glue, screws, etc.)</p> <p>Assembly or test process delay</p> <p>Avoidable process loss</p> <p>Downgrading cost.</p> <p>Cost of coordinate supply of affected material from other suppliers</p>	
External cost	Commissioner	<p>Labor cost, in sorting, inspection, test, validation and reworking</p> <p>Admin and handling cost</p> <p>Assemble line shut down cost</p> <p>Fixed cost per reworked tractor</p>	These activities in external of Commissioner

	Missing cost	Wasted shipping cost	
Appraisal cost	Commis-sioner	Labor cost in test, validation Admin and handling cost	These activ-ities in ex-ternal of Commis-sioner
	Missing cost	Depreciation of fixed (Inspection)as-sets and maintain the accuracy of the test or measuring equipment Direct and indirect material applied in the test, like fuel, electricity, screw, sealing washers, glue, gloves New Jig or tool cost Travelling cost Product quality audit cost	
Prevention Cost	Commis-sioner	None	
	Missing cost	Cost of extra supplier audit to confirm corrective actions been taken Travelling cost Cost of qualifying potential suppliers to replace part or whole business from current supplier's and qualify PPAP from new supplier(s) Cost of quality planning or re-quality planning Cost of qualifying the supplier and samples approvals Training to the supplier Redesign cost	

Appendix 4. AMPIP introduction in Commissioner



Appendix 5. AMPIP internal stakeholders in 6 phases

AMPIP

AMPIP – Major Product Introduction Process

Deliverable	AMPIP – Major Product Introduction Process					
	Phase 1 Definition	Phase 2 Feasibility	Phase 3 Development & Validation	Phase 4 Industrialization	Phase 5 Implementation	Phase 6 Evaluation
Project Charter	Sign-off					
Project Change Baseline	Final					
New Product Specification (NPS)	Preliminary	Sign-off	Update/ Re-approve			
Prototype and Other Builds Disposition Plan	Preliminary	Final	Update	Update	Update	
Business Case	Preliminary	Final	Track	Track	Track	Post launch assessment
Marketing Business Plan	Preliminary	Final	Review	Execute	Execute	Execute
Design and Release for Series Plan	Preliminary	Final	Execute	Execute	Execute	Close
Validation Tracking Report	Status Report	Status Report	Status Report	Status Report	Status Report	Close
Control Model Target Costs	Initial	Final	Track & Achieve	Track & Achieve	Track & Achieve	
Supplier Assignment Plan	Preliminary	Intermediate	Final	Execute	Execute	Post launch assessment
Service Parts Launch Readiness	Ph1 Elements	Ph2 Elements	Ph3 Elements	Ph4 Elements	Ph5 Elements	Ph6 Elements
Technical Services Launch Readiness	Ph1 Elements	Ph2 Elements	Ph3 Elements	Ph4 Elements	Ph5 Elements	Ph6 Elements
Quality Plan	Ph1 Elements	Ph2 Elements	Ph3 Elements	Ph4 Elements	Ph5 Elements	Ph6 Elements
Manufacturing Plan	Preliminary	Footprint / Update	Final	Execute	Execute	Post launch assessment
Project Schedule	Milestones	Final / Detailed	Update & Execute	Update & Execute	Update & Execute	Lessons Learned
Project Risks	Preliminary	Assess & Mitigate	Assess & Mitigate	Assess & Mitigate	Assess & Mitigate	Transfer to Ops
Project Reports	CR	PA	DR	OP	OS	PP

A	R	C	I
Accountable	Responsible	Consulted	Informed
The one ultimately answerable for the thorough completion and sign-off of the deliverable or task, and who delegates the work to other responsible team members. (*)	Those who work for the completion of the deliverable or task.	Those whose opinions are sought, typically subject matter experts, and with whom there is two-way communication.	Those who are kept up to-date on progress, often only on completion of the deliverable or task, and with whom there is just one-way communication.

Version3 Oct 23, 2015

(*) Only one A- Accountable person specified for each task or deliverable row. Whenever a project team member is Accountable and Responsible at the same time, AR is used.

Appendix 6. Survey of which missing cost include hidden cost shall be claimed to supplier

Required

1. What is your gender?

Required to answer

Single choice

Female

Male

2. Which function are you from

Required to answer

Single choice

Supply chain (including Material planer, foreman, etc.)

Purchasing

NPI quality (include design quality)

Supplier quality

Build quality

Global technical service and Parts

Customer quality (include OEM and field)

Manufacturing

Finance

Engineering (Design and Research)

Sales, marketing including Account manager

Project management

3. For defective materials from and caused by suppliers, would you agree we should claim suppliers the following (Question 4-23) cost?

Single choice

4. Cost of life reduction of mould/tooling owned by us (for example, casting mould/tooling with life span of producing 50K, we agreed supplier can have 2% defects, while due to supplier fault, they produce 5% defects, shall we claim the cost of Mould/tooling means $(5\% - 2\%) * 50K * \text{Total mould/tooling price}$?

Required to answer

Single choice

- Most likely
- Likely
- Unlikely
- Most unlikely

5. Cost the period of storage to the suspect or defective part. (For renting workshop, the rent cost of the area, lightening, electricity used e.g. warming, cooling etc.)

Required to answer

Single choice

- Most likely
- Likely
- Unlikely
- Most unlikely

6."Waste shipping cost", example, supplier send 1000pcs material with 500pcs defects, the shipping cost paid by us is 150Euro, should we claim supplier $150/2=75$ Euros.

Required to answer

Single choice

- Most likely
- Likely
- Unlikely
- Most Unlikely

7. Cost of new jig and tooling in sorting or reworking

Required to answer

Single choice

- Most likely
- Likely
- Unlikely
- Most unlikely

8. Cost of worn out toolings&jigs in sorting or reworking

Required to answer

Single choice

Most likely

Likely

Unlikely

Most unlikely

9. Cost of depreciation of fix assets for inspection in sorting

Required to answer

Single choice

Most likely

Likely

Unlikely

Most unlikely

10. Cost of depreciation of fix assets and maintain the accuracy of the test or measuring equipment for inspection in appraisal/evaluation the defect or problem

Required to answer

Single choice

Most likely

Likely

Unlikely

Most unlikely

11. Cost of evaluate deviation request from supplier (Supplier could not deliver material within specification, and supplier contact us to evaluate the possibility to use the material or not)

Required to answer

Single choice

Most likely

Likely

Unlikely

Most unlikely

12. Cost of traveling to supplier or 3rd party for solving the quality issue including validate efficiency of the corrective actions in supplier side

Required to answer

Single choice

Most likely

Likely

Unlikely

Most unlikely

13. Cost of traveling to audit potential supplier before select and qualify, to replace part or whole business from current supplier's and qualify PPAP from new supplier(s) when cause of current supplier non-conformity issue

Required to answer

Single choice

Most likely

Likely

Unlikely

Most unlikely

14. Cost of qualifying potential suppliers to replace part or whole business from current supplier's and qualify PPAP from new supplier(s) when cause of current supplier nonconformity issue

Required to answer

Single choice

Most likely

Likely

Unlikely

Most unlikely

15. Cost of Indirect material cost, such as Label, boxes, gloves, training material in sorting, reworking or testing

Required to answer

Single choice

Most likely

Likely

Unlikely

Most unlikely

16. Cost of extra material consumed, e.g. sealing washers, fuel, gasket, glue, screw, counterparts sorting, reworking or testing

Required to answer

Single choice

- Most likely
- Likely
- Unlikely
- Most unlikely

17. Cost of product quality audit, e.g., Inspector have to inspect more than normal after the defect found (inspection sampling size will increase after the first batch defect found)

Required to answer

Single choice

- Most likely
- Likely
- Unlikely
- Most unlikely

18. Cost of coordinating supply of affected material (e.g. counterparts to the defective material) from other suppliers or the same supplier

Required to answer

Single choice

- Most likely
- Likely
- Unlikely
- Most unlikely

19. Cost of Downgrading: The difference between the normal selling price and the reduced price due to quality reasons.

Required to answer

Single choice

- Most likely
- Likely
- Unlikely
- Most unlikely

20. Cost of training to supplier relevant to non-conformity

Required to answer

Single choice

- Most likely
- Likely
- Unlikely
- Most unlikely

21. Cost of Unplanned downtime of equipment: Loss of capacity of equipment due to failures.

Required to answer

Single choice

- Most likely
- Likely
- Unlikely
- Most unlikely

22. Avoidable process losses: The cost of losses that occur even with conforming product. e.g. "Overfill" of containers (going to customer from supplier) due to excessive variability in filling and measuring equipment

Required to answer

Single choice

- Most likely
- Likely
- Unlikely
- Most unlikely

23. Cost of quality planning or re-quality planning

Required to answer

Single choice

- Most likely
- Likely
- Unlikely
- Most unlikely

24. Do you agree we should claim suppliers the following cost (Question 25-32) which are difficult to estimate, if the defects are caused by suppliers

Single choice

25. Potential lost sales, (due to non-conforming, customer cancel the original order or in further reduce or not increase purchase engines or generators

Required to answer

Single choice

- Most likely
- Likely
- Unlikely
- Most unlikely

26. Costs of redesign of products due to poor quality.

Required to answer

Single choice

- Most likely
- Likely
- Unlikely
- Most unlikely

27. Costs of downtime of equipment (internet Server) and systems including SAP, etc.

Required to answer

Single choice

- Most likely
- Likely
- Unlikely
- Most unlikely

28. Extra indirect costs due to defects and errors. Examples are space charges and inventory charges (storage to the suspect or defective part).Renting cost etc.

Required to answer

Single choice

- Most likely
- Likely
- Unlikely
- Most unlikely

29. Cost of resource supply include water, electricity, heating for sorting, rework, test or inspection

Required to answer

Single choice

- Most likely
- Likely
- Unlikely
- Most unlikely

30. Scrap and errors not reported. For example, operator just leave it to general scrap with identification of material defect for low value material, like screw, rubber hose, another is, there are 2 kinds of failures, internal failure and supplier failure, while scrap as of internal failure before or without realizing supplier failure

Required to answer

Single choice

- Most likely
- Likely
- Unlikely
- Most unlikely

31. Supplier's company. Such costs are included in the purchase price. (For example purchase agreement approve supplier to produce with equipment A with certain cost, might be so, the equipment cannot produce sufficient good material, supplier has to buy new equipment B which might affect the further purchase price)

Required to answer

Single choice

- Most likely
- Likely
- Unlikely
- Most unlikely

32.6. Costs included in standards because history shows that a certain level of defects is inevitable and allowances should be included in standards: a. Extra material purchased: The purchasing buyer orders 6 percent more than the production quantity needed. b. Allowances for scrap and rework during production:

History shows that 3 percent is “normal” and C1:C32 accountants have built this into the cost standards. One accountant said, “Our scrap cost is zero. The production departments are able to stay within the 3 percent that we have added in the standard cost and therefore the scrap cost is zero.” Ah, for the make-believe “numbers game.”

c. Allowances in time standards for scrap and rework: One manufacturer allows 9.6 percent in the time standard for certain operations to cover scrap and rework.

d. Extra process equipment capacity: One manufacturer plans for 5 percent unscheduled downtime of equipment and provides extra equipment to cover the downtime.

Required to answer

Single choice

- Most likely
- Likely
- Unlikely
- Most unlikely

33. Which item is the closest to your understanding of "Admin and handling costs" when talking about handling non conformity by suppliers

Required to answer

Single choice

- A. The costs shall consider admin and handling among quality (supplier quality, Build quality, OEM, field quality), manufacturing, logistic including warehouse (own warehouse and outsourcing warehouse), customer service, customers, dealer
- B. A+ The costs in admin and handling among Purchasing Material planner (making the purchase orders to supplier), sales and marketing (communicate with customers)
- C. The cost shall consider admin and handling among all stakeholders through the supply chain from purchasing(issue the purchasing order) ,material planner, Logistic company to outsourcing warehouse, own warehouse, quality inspection, quality handling, manufacturing(assembly, testing, painting, packing, repair), customer service, sales and marketing(communicate with customers)customers, dealer

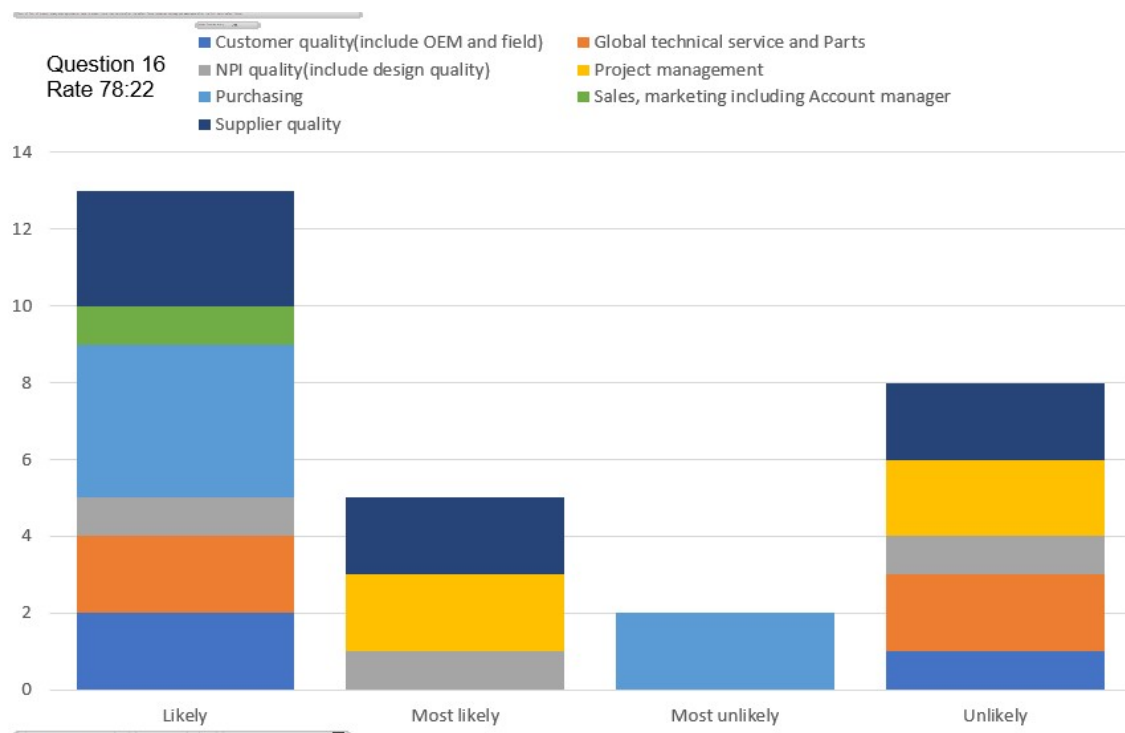
34. (Voluntary) any suggestions to the items to compensate from supplier(s)?

Required to answer

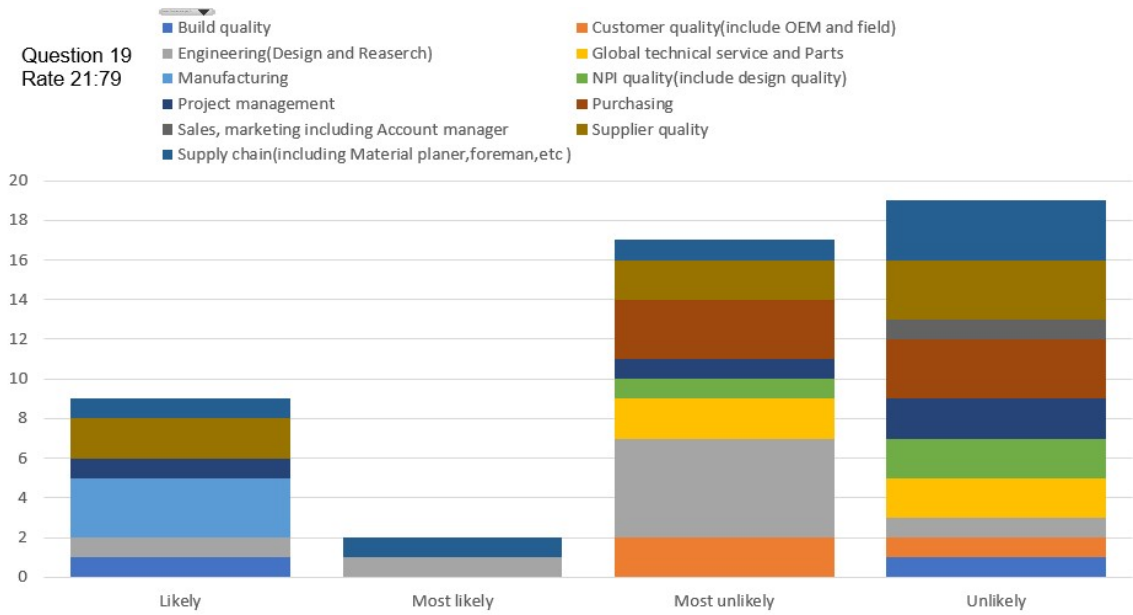
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Appendix 7. Adjusted respond to question 16



Appendix 8. Adjusted respond to question 19



Appendix 9. Respond to understanding of admin and handling costs

RESPOND TO UNDERSTANDING OF ADMIN AND HANDLING COSTS"

