The Impacts that the Cost of Quality has On South African's Defence Industry

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Abstract

The purpose of this paper is to evaluate how the cost of quality affects the defense sector in South Africa. The high cost of poor quality is one of the reasons why South Africa's military industry's profits and exports are decreasing. Costs of poor quality (COPQ) affects production efficiency and profitability to customer satisfaction and public reputation. To assess the impact of the cost of poor quality on a company's productivity, profitability, and customer satisfaction, the interview questions were created and distributed to four different military firms to collect data that would allow the researcher to assess the COPQ's influence on each company's productivity. The interview also assisted the researcher in documenting the primary or common causes and effects of poor quality in the defense sector, allowing the author to effectively suggest a strategy to reduce the sources of poor-quality costs in military businesses. To identify and categorize internal and external failure costs from various defense organizations as well as to establish a method for evaluating the cost of poor quality to estimate the impact on an organization, the data entry forms in table 1 to table 4 below were created to record all the poor-quality costs incurred in 2020 that were recorded in each company's database. This helps the researcher calculate the cost of poor quality in 2020 for each company and determine the impact on the company's profitability. The outcomes of the research indicate that the cost of poor quality influences the defense industry's profitability, productivity, and customer satisfaction. According to the research, a company's productivity, profitability, and customer satisfaction can increase if the cost of poor-quality decreases.

Keywords

Cost of poor Quality, Customer satisfaction, Profitability, Productivity and Defense industry.

1. Introduction

In recent years, the defense industry has placed a strong emphasis on marketing and operations management, and they are unconcerned about the high cost of poor quality, which has a significant influence on an organization. To survive and thrive in today's competitive environment, every business must prioritize quality. Customer satisfaction and beyond is a major endeavor in strategy makers' objectives. To overcome these problems, is critical to aim for greater quality product at a minimum cost (Mantri &Juju 2015).

According to SA committee on defense, the Defense Industries have a significant economic influence on South Africa. The Maritime, Aerospace and Defense Industries Association compared South African Defense Industry numbers for 2019/20 to those from 2016/17. Revenue decreased by R7 billion, from R19.5 billion to R12.5 billion; exports decreased by nearly 50%, from R12 billion to R6.5 billion; and R&D investment decreased from R1.7 billion to R6.5 billion (pmg.org.za, n.d.).

High Poor quality cost is one of the challenges that some of South African defense industries are facing and is influencing organizations productivity, profitability, and customer satisfaction. Customer satisfaction is directly linked to quality. According to (Biadacz, 2020). Customers who are pleased with an organization's service and product will give it a higher rating in reviews than those that do not provide high-quality goods or services.
The high cost of poor quality is one of the reasons why South Africa's military industry's profits and exports are decreasing. Costs of poor quality (COPQ) affects production efficiency and profitability to customer satisfaction and public reputation. (pmg.org.za, n.d.).

Some of South Africa's military sector is presently suffering financial difficulties, with employees being retrenched and global customers being lost. Companies have not yet developed the essential knowledge of the cost of poor quality. To successfully minimize the cost of poor quality, companies must correctly assess the costs associated with poor quality. The main aim of the study is to evaluate the impact that the cost of quality has on South Africa's defense industry.

1.1 Objectives

To fulfill the investigation's goal, the following objectives were studied:

- To evaluate and categorize internal and external failure costs from various defense organizations as well as establish a method for evaluating the cost of poor quality to estimate the impact on an organization.
- To evaluate poor quality affects to company's profitability.
- To evaluate how poor quality affects a company's productivity.
- To identify the main causes and consequences of poor quality in the defense industry.

2. Literature Review

Concepts of Cost of Poor Quality

In the literature, there are numerous concepts of quality costs. When it comes to quality costs, many researchers and authors from numerous scientific departments try to describe the topic in different ways. However, because the idea of cost of poor quality come close to their structure, both quality management philosophy and economic practice frequently describe expenses in terms of their structure. Characteristics of the most significant authority in this field's concepts are regularly discussed. (Biadacz 2020).

The COPQ method can help you achieve better results (Chopra and Garg, 2012). To improve customer satisfaction, organizations must handle COPQ as a combined method and a process for long term, focusing on costs issues (Teli et al., 2017). COPQ has a straight influence in a company's ultimate financial target, and even a slight decrease in COPQ can boost profitability dramatically (Sahu 2013). On a minor scale of defense industry, measuring quality costs is highly significant besides valuable. It is also assisting in the definition of specific quality standards and, as a result, enhances quality (Chopra and Garg 2011). (Lari and Asllani 2013), (Garza-Reyes et al., 2014), (Teli et al., 2017), (Marzuki and Wisridani, 2014), (Dror, 2010) and (Psomas et al., 2018) have all discussed the advantages of utilizing COPQ systems, as well as the issues and challenges that come with implementing a quality cost system. A quality management support system, according to (Lari and Asllani, 2013), would help the organization to better acquire and assess data on quality costs. Guinot et al. 2016 indicated that If a standard quality cost approach is provided, such a support system can also be used. However, many studies to date have revealed that only a small percentage of businesses use COPQ data. Three reasons for the limited implementation of COPQ, according to Dale and Pursglove, are a lack of understanding of COPQ concepts and principles, a lack of data, and a lack of interest in quality costs on the part of managers.

Classification of COPQ

According to (Defeo, 2017) many businesses aim to improve their financial situation by discovering cost-cutting opportunities in their business operations. When it comes to adjusting processes and reducing costs, the most common mistake firms make is failing to consider customer satisfaction and product quality. Companies should use COPQ as evidence of what improvements should be done and why. Reduced COPQ will improve the financial situation regardless of whatever operation is affected (Defeo 2017). According to (Defeo, 2017), the costs were divided into three groups: appraisal, Internal failure and external failure and inspection costs. See figure 1. In comparison with Feigenbaum Sort the costs into three groups: appraisal, Internal failure and external failure and appraisal and inspection costs.

The importance of measuring and using poor quality cost

Poor quality cost, according to (Teli et al. 2013), is a best way to improve management and staff views of mistakes. The following are some ways that a poor-quality cost can help: Attracting managers and engaging with them in monetary terms provides them with knowledge they can value, transforms content from an idea to a practice that is cost effective and time-efficient the impact on an employee's prospective achievement is higher if he or she changes their perspective regarding failures and the malfunctioning piece of machinery is eliminated.

A bit of metal is discarded in one scenario, while a bill is thrown away in the other. Employees must be aware of the financial consequences of their errors. Increasing the return on problem-solving efforts for poor quality, high-cost issues so that remedial activity can be concentrated on the most effective solutions. By focusing on the total process's poor-quality cost, sub-optimization can be avoided (Teli et al. 2013).

Consequences of poor quality and its impact in an organization

The cost of poor quality involves not just product problems, but also costs related to corporate procedures, practices, or activities that result in defects or errors. Poor quality may damage a company's reputation, sabotage customer relationships, and have serious operational and financial implications. Consider the financial and logistical implications of continued billing. Poor quality may have a significant impact on any company, whether it sells goods or services. Poor quality can lead to a loss of reputation, loss of business and a loss of trust. Poor quality generally causes clients to lose faith in the product or service, prompting them to seek out other options (Guest 2017). Errors might result in incorrect product delivery, resulting in chargebacks, higher freight expenses, and even lost revenues. Mistakes at the product development stage, on the other hand, might result in one of many additional expenses. If the first samples are unsatisfactory, more money will be spent on couriers and redevelopment, resulting in production delays, chargebacks, and rejected orders. (Guest 2017) and (Lari and Asllani 2013).

Impact on organization's profitability

Efficiency grows profitability. When workers are involved in a work environment that emphasizes cooperation and strives for high-quality products, the company works more effectively than when quality is a last-minute consideration. Poor quality may have a significant negative influence on a company's bottom line. This might be caused by a lack of financial, human, and physical or intellectual resources needed to accomplish business tasks. For example, Boeing delivered a product that fail to conform to requirement, resulting in significant costs. All the shortcomings should be resolved, resulting in unbillable hours and delivery of free components and services (Barquet et al. 2013). These out of the box failure have both long- and short-term consequences for the brand, as well as revenue. With the implementation of an effective and high-quality QMS platform, this may be avoided in the future. It is possible to eliminate errors and identify patterns (Barquet et al. 2013). Furthermore, all subsequent financial litigations will have a major impact on Boeing's bottom line.

3. Methods

A mixed method that includes both qualitative and quantitative methods was used to successfully investigate and recommend a strategy to minimize the sources of the cost of poor quality in defense companies, focusing on the review that was published between 2010 and 2020 about the cost of poor quality. The researchers selected to focus on what is thought to be the most thorough review to date. The author looked at a sample of 30 publications from Google Scholar, Research Gate, and the University of Johannesburg data source for the review. The most important findings from publications published between 2010 and 2021 for this study are the percentage of articles categorized as empirical research involving human participants' vs no empirical research. The percentage of papers classified as quantitative, qualitative, or mixed techniques is also important. The proportions in such publications are compared to the proportions found in papers regarding the cost of poor quality published between 2010 and 2021.

4. Data Collection

Interviews, surveys, and records (COPQ reports) were chosen as tools to collect data for this study.

5. Results and Discussion

The findings supported the current idea that quality and production are tightly connected. According to the research, productivity improves as defects, scrap, and rework (poor quality) decrease. As a result, as quality improves, so does productivity.

Cost of poor-quality impact to Profitability

Figure 1 to 4 depicts a typical Pareto diagram for the cost of poor quality. The COPQ are displayed in ascending sequence, starting with the Total cost of poor quality on the left which shows 90% of the budgeted quality cost at

Hensoldt were used, which shows that the company COPQ is still within the target. A Pareto diagram includes a few components that constitute a significant portion of the total.

Total of COPQ (ZAR) = P+F+A
Hensoldt optronics 2020 total COPQ=R40, 590,706
2020 COPQ target=45,590,706 Revenue in 2020= R1.5 billion
K=100M
Total Revenue(R) - Total COPQ (COPQ) - other expenses (K) = Profit (P)
R+ (-COPQ+K) =Profit
1500M – (40, 590,706+100M) =P
P=R 1,359 409 6567
40, 590,706/1,359 409 656*100=2.9% of the profit
COPQ/Revenue in 2020*100=percent of the revenue
40, 590,706/1500M*100=2.7% of the revenue

This shows that Hensoldt quality is outstanding as is being estimated by expert that the cost of quality can be 5 to 30% of the revenue which can also affect the company profit.
RDM 2020 total COPQ=R46, 315,781 R=463M
Approximately 10% of the 2020 revenue.
Denel dynamics 2020 total COPQ=R48, 473,631 R=242.4M
Approximately 20 % of the 2020 revenue.
SAAB 2020 total COPQ=R41, 560,231. R323M
Approximately 15 % of the 2020 revenue

Table 1. Hensoldt Cost of Poor Quality in 2020 (COPQ)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL	Average
Total Cost of Poor Quality	2,820,855	2,712,004	2,734,818	1,516,475	3,003,048	3,972,390	4,166,046	2,158,803	4,405,162	2,707,283	3,529,557	6,864,263	40,590,706	3,382,559
Prevention Costs	1,549,400	1,409,612	1,475,432	1,232,645	1,776,357	1,840,319	1,838,374	1,555,122	1,810,883	1,694,050	1,766,331	1,425,431	19,373,956	1,614,496
QA Admin, Training	1,549,400	1,409,612	1,475,432	1,232,645	1,776,357	1,840,319	1,838,374	1,555,122	1,810,883	1,694,050	1,766,331	1,425,431	19,373,956	1,614,496
Appraisal Costs	19,194	19,889	131,872	-	13,630	6,700	37,997	-	88,031	104,360	96,159	30,018	547,850	45,654
Appraisal Expenses (Internal)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vendor Control	-	-	6,500	-	6,500	21,450	6,175	4,550	53,300	-	11,050	-	109,525	9,127
Measurement / Gauge Control	19,194	19,889	131,872	-	13,630	6,700	37,997	-	88,031	104,360	96,159	30,018	547,850	45,654
Failure Costs (CNQ)	1,252,261	1,282,503	1,127,514	283,830	1,213,061	2,125,371	2,289,675	603,681	2,506,248	908,873	1,667,067	5,408,814	20,668,900	1,722,408
Internal Failure Costs	588,247	591,999	334,088	100,100	566,626	1,391,927	613,559	546,666	1,143,021	811,035	656,192	3,518,164	10,861,623	905,135
Scrap	65,789	78,769	75,493	-	60,440	94,889	163,065	70,503	89,060	297,821	194,326	2,709,893	3,900,048	325,004
Rework Production Orders	335,258	319,530	75,295	-	334,586	1,085,137	251,594	275,963	817,361	277,913	204,466	622,371	4,599,475	383,290
Obsolescence's	104,000	104,000	98,800	98,800	104,000	109,200	114,400	104,000	83,200	72,800	106,600	81,900	1,181,700	98,475
Internal Failure Analysis	83,200	89,700	84,500	1,300	67,600	102,700	84,500	96,200	153,400	162,500	150,800	104,000	1,180,400	98,367
External Failure Costs	664,014	690,504	793,426	183,730	646,436	733,444	1,676,117	57,015	1,363,227	97,838	1,010,875	1,890,651	9,807,277	817,273
Warranty Charges/Costs	571,714	638,504	733,626	183,730	560,636	642,444	1,638,417	185	1,307,327	40,638	988,775	1,878,951	9,184,577	765,381
External Failure Analysis	92,300	52,000	59,800	-	85,800	91,000	37,700	57,200	55,900	57,200	22,100	11,700	622,700	51,892

COPQ components	HOSA Cost of poor quality in ZAR
Total Cost of Poor Quality in 2020	40,590,706
Prevention Costs	19,373,956
QA Admin, Training	19,373,956
Appraisal Costs	547,850
Appraisal Expenses (Internal)	-109,525
Vendor Control	109,525
Measurement / Gauge Control	547,850
Failure Costs (CNQ)	20,668,900
Internal Failure Costs	10,861,623
Scrap	3,900,048
Rework Production Orders	4,599,475
Obsolescence's	1,181,700
Internal Failure Analysis	1,181,700
External Failure Costs	9,807,277
Warranty Charges/Costs	9,184,577
External Failure Analysis	622,700

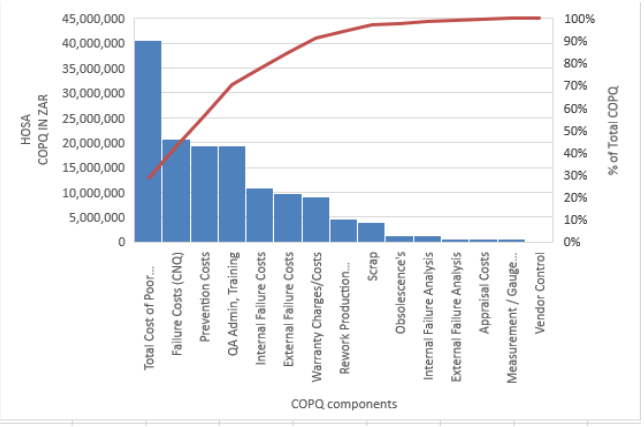

Figure 1. Hensoldt COPQ Pareto analysis

Based on the figure 1 failure cost at Hensoldt which is R20 668,900 is higher than prevention cost which is R19 373,956 and total failure cost average from January to December in Hensoldt is R 3,382,559 , The average Costs of defects in products or services prior to shipment or handover to the customer contributed more with R 905,135 (internal failure), while remaining defects discovered after shipment or handover to the customer contributed an average cost of R817,273(External Failure Costs). The costs involved in service to customers under warranty contracts contributed more to the failure cost of R765,381. As a result, it can be concluded that in Hensoldt, warranty charges contributed more to the failure cost in 2020, possibly due to out-of-the-box failure from the client, with all repair or rework occurring after sales and late delivery penalties.

Table 2. RDM Cost of Poor Quality in 2020 (COPQ)

	Jan Feb Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL	Average
Total Cost of poor Quality	**4,835,087 2,019,529 3,124,578**	**3,188,215**	**3,125,604**	**3,240,215**	**3,740,244**	**1,671,925**	**4,250,477**	**4,685,537**	**8,331,647**	**4,102,724**	**46,315,781**	**3,859,648**
Prevention Costs	**1,122,419 1,543,462 1,473,069**	**1,564,397**	**1,402,688**	**1,549,124**	**1,388,062**	**1,359,586**	**1,341,588**	**1,415,868**	**1,561,080**	**1,020,587**	**16,741,930**	**1,395,161**
QA Admin, Training	1,122,419 1,543,462 1,473,069	1,564,397	1,402,688	1,549,124	1,388,062	1,359,586	1,341,588	1,415,868	1,561,080	1,020,587	16,741,930	1,395,161
Appraisal Costs	**435,095 562,873 590,696**	**567,496**	**497,805**	**398,156**	**444,846**	**406,161**	**357,111**	**521,370**	**556,992**	**235,511**	**5,574,111**	**464,509**
Appraisal Expenses (Internal)	358,107 350,038 399,300	373,287	406,164	314,917	376,209	242,343	260,295	317,090	404,184	195,694	3,997,629	333,136
Vendor Control	65,991 122,971 74,818	95,110	67,434	55,519	64,310	97,038	90,306	80,502	36,256	12,214	862,470	71,873
Measurement / Gauge Control	10,997 89,864 116,578	99,098	24,207	27,720	4,327	66,780	6,510	123,777	116,552	27,602	714,012	59,501
Failure Costs	**3,277,572 -86,807 1,060,814**	**1,056,322**	**1,225,110**	**1,292,935**	**1,907,336**	**- 93,821**	**2,551,778**	**2,748,299**	**6,213,575**	**2,846,626**	**23,999,740**	**1,999,978**
Internal Failure Costs	**477,399 627,511 935,854**	**695,828**	**682,588**	**758,825**	**956,187**	**695,978**	**74,581**	**2,330,289**	**3,578,355**	**2,518,790**	**14,332,186**	**1,194,349**
Scrap	40,999 118,199 152,027	174,393	34,891	337,377	96,330	188,333	68,688	150,255	1,311,228	291,987	2,964,708	247,059
Rework Production Orders	211,552 217,168 483,971	259,051	335,289	180,552	552,681	260,589	- 195,404	1,901,897	1,980,963	2,070,668	8,258,978	688,248
Obsolescence's	108,688 103,824 106,256	70,544	106,488	101,856	131,176	99,216	99,216	126,776	94,324	71,656	1,220,020	101,668
Internal Failure Analysis	116,160 188,320 193,600	191,840	205,920	139,040	176,000	147,840	102,080	151,360	191,840	84,480	1,888,480	157,373

External Failure Costs	**2,800,174 714,318 124,960**	**- 360,494**	**542,522**	**534,110**	**951,149**	**- 789,799**	**2,477,197**	**418,010**	**2,635,220**	**327,836**	**9,667,554**	**805,630**
Warranty Charges/Costs	2,731,534 830,478	- 304,174	433,402	458,430	877,229	- 851,399	2,440,237	310,650	2,561,300	290,876	8,725,954	727,163
External Failure Analysis	- 68,640 116,160 124,960	56,320	109,120	75,680	73,920	61,600	36,960	107,360	73,920	36,960	941,600	78,467

Table 2 and figure 2 shows that the total failure cost average from January to December at Rheinmetall Denel Munition is R 1,999,978 which the average Costs of defects in products or services prior to shipment or handover to the customer contributed more with R 1,194,349 (internal failure), while remaining defects discovered after shipment or handover to the customer contributed an average cost of R805,630 (External Failure Costs).

COPQ components	RDM Cost of poor quality in ZAR
Total Cost of Poor Quality in 2	46,315,781
Prevention Costs	16,741,930
QA Admin, Training	16,741,930
Appraisal Costs	5,574,111
Appraisal Expenses (Internal)	3,997,629
Vendor Control	882,470
Measurement / Gauge Contro	714,012
Failure Costs (CNQ)	23,999,740
Internal Failure Costs	14,332,186
Scrap	2,964,708
Rework Production Orders	8,258,978
Obsolescence's	1,220,020
Internal Failure Analysis	1,888,480
External Failure Costs	9,667,554
Warranty Charges/Costs	8,725,954
External Failure Analysis	941,600

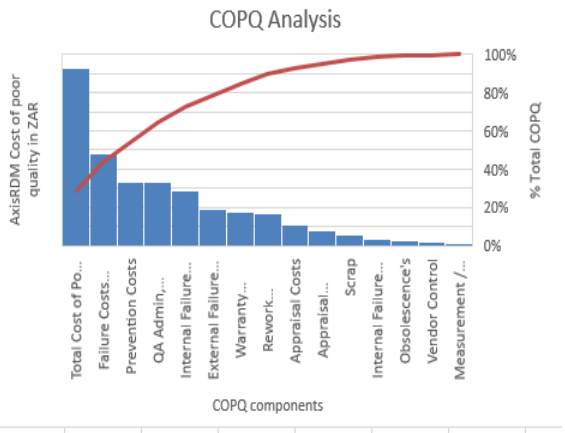

Figure 2. RDM COPQ Pareto analysis

Table 2 and figure 2 shows that the total failure cost average from January to December at Rheinmetall Denel Munition is R 1,999,978 which the average Costs of defects in products or services prior to shipment or handover to the customer contributed more with R 1,194,349 (internal failure), while remaining defects discovered after shipment or handover to the customer contributed an average cost of R805,630 (External Failure Costs). The costs involved in service to customers under warranty contracts contributed more to the failure cost of R 727,163. As a result, it can be concluded that in Rheinmetall Denel Munition, warranty charges contributed more to the failure cost in 2020, possibly due to out-of-the-box failure from the client, with all repair or rework occurring after sales and late delivery penalties. For this company to minimize the external failure cost they must invest more in preventative action and Appraisal Costs.

Table 3. Denel Cost of Poor Quality in 2020 (COPQ)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL	Average
Total Cost of Quality	**3,385,043**	**3,843,157**	**3,596,847**	**4,741,722**	**4,409,947**	**3,367,318**	**1,977,781**	**4,093,354**	**4,451,821**	**3,945,763**	**5,829,203**	**4,831,676**	**48,473,631**	**4,039,469**
Prevention Costs	**1,641,545**	**1,560,661**	**1,117,498**	**1,270,860**	**1,020,255**	**1,239,173**	**1,458,970**	**1,468,990**	**1,750,721**	**2,043,810**	**1,619,995**	**1,216,452**	**17,408,930**	**1,450,744**
QA Admin, Training	1,641,545	1,560,661	1,117,498	1,270,860	1,020,255	1,239,173	1,458,970	1,468,990	1,750,721	2,043,810	1,619,995	1,216,452	17,408,930	1,450,744
Appraisal Costs	**227,923**	**273,502**	**256,719**	**346,990**	**235,823**	**129,062**	**302,698**	**267,211**	**231,096**	**370,853**	**290,330**	**114,132**	**3,046,340**	**253,862**
Appraisal Expenses (Internal)	227,923	121,898	156,714	177,159	140,485	84,291	174,468	158,519	102,027	176,827	172,832	36,406	1,729,550	144,129
Vendor Control	-	100,918	74,958	65,120	69,810	28,926	85,034	86,918	50,072	97,803	84,251	68,358	812,170	67,681
Measurement / Gauge Control	-	50,686	25,047	104,712	25,527	15,845	43,195	21,774	78,997	96,223	33,247	9,368	504,621	42,052
Failure Costs	**1,515,575**	**2,008,993**	**2,222,631**	**3,123,871**	**3,153,868**	**1,999,084**	**216,113**	**2,357,153**	**2,470,004**	**1,531,100**	**3,918,878**	**3,501,092**	**28,018,362**	**2,334,864**
Internal Failure Costs	**427,747**	**920,355**	**834,257**	**620,727**	**1,483,906**	**910,877**	**770,632**	**1,013,869**	**1,589,397**	**742,145**	**916,273**	**708,497**	**10,938,684**	**911,557**

Scrap	50,405	424,580	237,031	257,390	349,477	281,622	246,866	209,840	509,828	58,374	148,494	110,215	2,884,124	240,344
Rework Production Orders	113,893	193,880	331,928	108,614	840,336	301,645	160,269	462,825	762,473	314,739	417,011	463,841	4,471,455	372,621
Obsolescence's	120,889	122,375	84,018	99,843	114,573	107,610	88,937	124,724	118,216	154,312	118,448	62,281	1,316,225	109,685
Internal Failure Analysis	142,560	179,520	181,280	154,880	179,520	220,000	274,560	216,480	198,880	214,720	232,320	72,160	2,266,880	188,907
External Failure Costs	**1,087,827**	**1,088,638**	**1,388,374**	**2,503,144**	**1,669,962**	**1,088,207**	**554,518**	**1,343,284**	**880,607**	**788,955**	**3,002,605**	**2,792,595**	**17,079,678**	**1,423,307**
Warranty Charges/Costs	892,467	997,118	1,305,654	2,436,264	1,559,082	994,927	653,078	1,172,564	838,367	690,395	2,884,685	2,697,555	15,815,998	1,318,000
External Failure Analysis	195,360	91,520	82,720	66,880	110,880	93,280	98,560	170,720	42,240	98,560	117,920	95,040	1,263,680	105,307

Table 3 and figure 3 shows that the total failure cost average from January to December at Denel is R2,334,864, which is 57.8% of the total cost of quality and the average Costs of defects discovered after shipment or handover to the customer contributed an average cost of R 1,423,307 (External Failure Costs contribute 35.24% of total cost of quality in year of 2020 at Denel). while remaining defects discovered prior to shipment or handover to the customer contributed an average cost of R911,557 (internal Failure Costs contribute 22.57% of total cost of quality).

COPQ components	Denel Cost of poor quality in ZAR
Total Cost of Poor Quality in 2020	48,473,631
Prevention Costs	17,408,930
QA Admin, Training	17,408,930
Appraisal Costs	3,046,340
Appraisal Expenses (Internal)	1,729,550
Vendor Control	812,170
Measurement / Gauge Control	504,621
Failure Costs (CNQ)	28,018,362
Internal Failure Costs	10,938,684
Scrap	2,884,124
Rework Production Orders	4,471,455
Obsolescence's	1,316,225
Internal Failure Analysis	2,266,880
External Failure Costs	17,079,678
Warranty Charges/Costs	15,815,998
External Failure Analysis	1,263,680

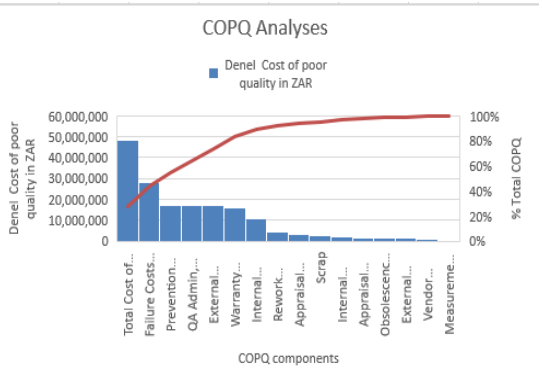

Figure 3. Denel: COPQ Pareto analysis

The costs involved in service to customers under warranty contracts contributed more to the failure cost of R 1,318 000. As a result, it can be concluded that in Denel, warranty charges contributed more to the failure cost in 2020, possibly due to out-of-the-box failure from the client, with all repair or rework occurring after sales and late delivery penalties. For this company to minimize the external failure cost they must invest more in preventative action and Appraisal Costs.

Table 4. SAAB Cost of Poor Quality in 2020 (COPQ

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL	Average
Total Cost of Poor Quality	**2,867,695**	**3,882,413**	**3,726,107**	**3,436,129**	**3,663,259**	**3,565,676**	**2,883,587**	**3,336,845**	**3,753,612**	**3,228,810**	**4,264,484**	**2,951,614**	**41,560,231**	**3,463,353**
Prevention Costs	**1,105,907**	**1,282,723**	**1,531,239**	**1,457,326**	**1,442,988**	**1,373,628**	**1,581,047**	**1,335,714**	**1,651,624**	**1,335,410**	**1,710,755**	**906,448**	**16,714,808**	**1,392,901**
QA Admin, Training	1,105,907	1,282,723	1,531,239	1,457,326	1,442,988	1,373,628	1,581,047	1,335,714	1,651,624	1,335,410	1,710,755	906,448	16,714,808	1,392,901
Appraisal Costs	**154,176**	**159,290**	**162,113**	**106,194**	**308,985**	**264,557**	**211,372**	**240,379**	**210,780**	**348,230**	**313,119**	**175,432**	**2,654,626**	**221,219**
Appraisal Expenses (Internal)	68,952	45,646	15,737	64,081	158,857	122,701	58,198	39,322	78,377	174,630	216,615	127,293	1,170,408	97,534
Vendor Control	49,790	61,917	60,482	7,040	80,978	100,118	102,564	128,955	90,332	39,538	52,474	22,097	796,286	66,357
Measurement / Gauge Control	35,434	51,728	85,893	35,074	69,150	41,738	50,610	72,102	42,071	134,061	44,029	26,043	687,932	57,328
Failure Costs (CNQ)	**1,607,612**	**2,440,399**	**2,032,755**	**1,872,609**	**1,911,287**	**1,927,492**	**1,091,168**	**1,760,752**	**1,891,208**	**1,545,170**	**2,240,610**	**1,869,733**	**22,190,797**	**1,849,233**

Scrap	139,000	220,848	170,035	92,940	392,229	273,874	346,689	110,580	206,403	230,216	393,118	496,107	3,072,038	256,003
Rework Production Orders	73,951	177,686	74,935	300,372	520,924	510,490	-39,143	219,544	515,553	-101,286	283,212	228,359	2,764,597	230,383
Obsolescence's	102,625	100,483	442,280	81,687	119,402	101,347	105,016	114,329	87,623	108,065	114,371	17,063	1,494,290	124,524
Internal Failure Analysis	133,760	211,200	174,240	163,680	165,440	188,320	190,080	246,400	223,520	281,600	279,840	133,760	2,391,840	199,320
External Failure Costs	**1,158,276**	**1,730,183**	**1,171,265**	**1,233,930**	**713,292**	**853,462**	**488,526**	**1,069,899**	**858,110**	**1,026,575**	**1,170,070**	**994,445**	**12,468,032**	**1,039,003**
Warranty Charges/Costs	1,029,796	1,619,303	1,060,385	1,168,810	651,692	783,062	411,086	1,041,739	798,270	889,295	1,067,990	901,165	11,422,592	951,883
External Failure Analysis	128,480	110,880	110,880	65,120	61,600	70,400	77,440	28,160	59,840	137,280	102,080	93,280	1,045,440	87,120

Table 4 and Figure 4 shows that the total failure cost average from January to December at SAAB is R 3,463,353 and the average Costs of defects discovered after shipment or handover to the customer contributed an average cost of R 1,039,003, while remaining defects discovered prior to shipment or handover to the customer contributed an average cost of R810 230 The costs involved in service to customers under warranty contracts contributed more to the failure cost of R 11,422,592.

COPQ components	SAAB Cost of poor quality in ZAR
Total Cost of Poor Quality in 2020	41,560,231
Prevention Costs	16,714,808
QA Admin, Training	16,714,808
Appraisal Costs	2,654,626
Appraisal Expenses (Internal)	1,170,408
Vendor Control	796,286
Measurement / Gauge Control	687,932
Failure Costs (CNQ)	22,190,797
Internal Failure Costs	9,722,765
Scrap	3,072,038
Rework Production Orders	2,764,597
Obsolescence's	1,494,290
Internal Failure Analysis	2,391,840
External Failure Costs	12,468,032
Warranty Charges/Costs	11,422,592
External Failure Analysis	1,045,440

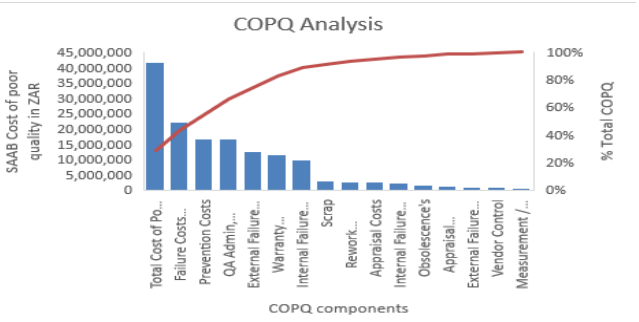

Figure 4. SAAB COPQ Pareto analysis

As a result, it can be concluded that in Denel, warranty charges contributed more to the failure cost in 2020, possibly due to out-of-the-box failure from the client, with all repair or rework occurring after sales and late delivery penalties. For this company to minimize the external failure cost they must invest more in preventative action and Appraisal Costs.

6. Conclusion

This research only focused on South Africa defense companies. Costs of poor-quality affects defense companies' production efficiency, profitability, customer satisfaction and public reputation. To identify and categorize internal and external failure costs from various defense organizations as well as establish a method for evaluating the cost of poor quality to estimate the impact on an organization. The study confirm that poor quality affects a company's profitability, productivity, and customer satisfaction.

In military firms, excessive rework has a significant influence on organizational performance. However, frequent rework occurrences, as well as their impact on performance and productivity, should not be considered unavoidable. The development of proper awareness as well as organized procedures for rework management may significantly improve the unfavorable results associated with rework.

Company profitability and Quality have a strong relationship, according to this research. In fact, for every given profitability, better quality yields a larger return on investment. Furthermore, increases in productivity of the company, capabilities to meet customer needs, or even other quality characteristics result in higher sales and market share. Customers who are happy with the company's quality are more likely to have positive feelings about it than those who do not receive high-quality items. Customers who are dissatisfied with a company's quality are more inclined to

complain and criticize. Customer loss can occur because of poor quality in an organization, and this can also have an impact on the company's brand image when marketing new consumers.

The study also identifies that the most main causes of poor quality in south Africa defense sector contribute in COPQ include Scrap, rework production Orders, cost of monitoring & managing component obsolescence and Warranty Charges/Costs. The study also reveal that some employees struggle to measure COPQ, they require help doing the measures. It's also possible that the staff don't have the ability to accomplish it. Most of it is mostly due to a shortage of resources. One participant agrees, pointing out the issue of resources needed to use the measurements. Even though many measures are taken, due to the absence of time and resources to evaluate them, they are not completely utilized. Some businesses also have the mindset that "they don't need to measure." Measuring the success of a firm is especially important if it is doing well.

The study supports the idea of (Guest, 2017) that Poor quality can lead to a loss of reputation of the company, loss of business and a loss of trust from the customer. Poor quality generally causes clients to lose faith in the product or service, prompting them to seek out other options. Poor quality can cost an organization a large sum of money. Employees would waste their time on inefficient processes and resolving issues on a regular basis if quality is not a proactive strategy.

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Biographies

Khathutshelo Mushavhanamadi is a Senior Lecturer, highly Knowledgeable Academic and a Business Professional, an Esteemed Leader who's highly Focused and Committed with a Consistent track record. As an out of the ordinary dynamic individual, she appeals to an astute can-do positive attitude focused on creative solutions which always propels her to challenge convention. Dr Mushavhanamadi holds a PHD Degree in Engineering Management and possess extensive experience in the Academic, Research, Consulting & Advisory Industries. An Esteemed Leader in the Training & Development Space of ERP, Operations Management, Production Planning and Control & Project Management. Her research interests involve green supply chain management, operations management issues, production planning and control, operations management, and Quality.

Ambani Mofamade is a Hensoldt South Africa Quality Controller with experience in quality, design, manufacturing, after-sales service, and validation engineering. Throughout many quality initiatives, he has demonstrated a consistent capacity to improve quality in production areas and documentation, reducing compliance risks. Effective at improving functional improvements minimizing quality costs. He formerly worked at Rheinmetall Denel Munition in Potchefstroom, one of the world's premier military corporations. He worked as a quality assurance technologist, a senior quality assurance inspector, and an intern mechanical engineer. He graduated from Vaal University of Technology with a National diploma and baccalaureus Technologiae in Mechanical Engineering, and a baccalaureus Technologiae in Operations Management, as well as a postgraduate diploma in operations management.