

A study on the factors that affect the implementation of COQ

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## ABSTRACT

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Cost of quality (COQ) is usually understood as the sum of the price paid for prevention of poor quality and the cost incurred due to product and service failure. It is a significant cost driver that firms need to control effectively in order to sustain competitive advantage. Nevertheless, the literature suggests that only very few firms in fact track and report quality cost data and use it for management control purposes. The lack of the COQ use among the companies is frequently blamed on the implementation difficulties which can easily deter the organizations from undertaking a systematic analysis of their quality costs. In spite of that, there is only little research-based literature that addresses the practicalities of implementing COQ. Furthermore, none of the research studies so far has gone into the depth of the issue in order to investigate factors that affect the implementation of COQ in organizations.

The main objective of this thesis is thus to thoroughly examine the use, the practicalities and the obstacles in implementing the COQ programs. A worldwide-launched questionnaire was used to gather the data from the quality professionals in the companies of various sizes, industrial sectors and geographical locations. A series of focused semi-structured personal interviews with managers and persons responsible for quality in several multinational companies were carried out in order to add the depth to the investigation, to validate the questionnaire and to verify the results. Graphical representations were generated to analyze the results and to determine the positive and negative impacts of various factors on the COQ implementation. Moreover, the areas on which each specific type of company, industry and department should concentrate in order to maximize the success of the COQ implementation were highlighted. The findings of this thesis can be used by companies to help in developing quality improvement processes and in increasing their effectiveness.

## Table of Contents

List of Figures .....	vii
List of Tables.....	ix
<b>Chapter 1: Introduction</b>	<b>1</b>
<b>Chapter 2: Literature Review</b>	<b>5</b>
2.1 Definition and typologies	5
2.1.1 Composition of COQ and COQ elements	8
2.1.2 List of engineering COQ elements	11
2.2 Alternatives COQ models	13
2.2.1 Advantages of using COQ	17
2.2.2 Disadvantages of using COQ	24
2.2.3 Summary	26
2.3 Implementation	28
2.3.1 Summary	33
<b>Chapter3: Identification of research gaps</b>	<b>34</b>
<b>Chapter 4: Research Methodology</b>	<b>40</b>
4.1 Steps involved in carrying out an experimental exploratory questionnaire	41
4.2 The survey method	44

4.3 Questionnaire structure and its development	47
4.4 Preparing the questionnaire	48
4.4.1 Data collection using questionnaire	51
4.5 Interviewing methodology	53
4.5.1 Data collection using Interviews	55
4.6 Using Pareto’s principle for data validation	56
4.7 Procedure to make raw data to fine data	58
4.7.1 Data extraction methodology using the raw data	60
4.8 Vensim PLE representation	64
4.8.1 Causal diagram using Vensim PLE	65
4.9 Data analysis and Graphical measurements	69
4.10 Procedure to obtain the output	72
4.10.1 Obtaining output using Likert scale analysis	73
4.11 Summary	76
<b>Chapter 5: Results and discussion</b>	<b>78</b>
5.1 Impact on factors that affect the implementation of COQ with respect to organizational departments	82
5.2 Impact on factors that affect the implementation of COQ with respect to job titles	94
5.3 Impact on factors that affect the implementation of COQ with respect to organizational revenue	104

5.4 Impact on factors that affect the implementation of COQ with respect to workforce size	109
5.5 Impact on factors that affect the implementation of COQ with respect to employee experience	113
5.6 Impact on factors that affect the implementation of COQ with respect to industries	117
5.7 Impact on factors that affect the implementation of COQ with respect to countries	128
5.8 Summary	139
<b>Chapter 6: Concluding remarks</b>	<b>141</b>
6.1 Research questions answered	146
<b>Chapter 7: Contribution</b>	<b>150</b>
7.1 Future Direction	152
<b>References</b>	<b>153-165</b>
<b><u>Appendices</u></b>	
<b>Appendix A:</b> [Graphical Representation Models]	166-172
<b>Appendix B:</b> [Causal diagrams]	173-224
<b>Appendix C:</b> [Questionnaire]	225-244
<b>Appendix D:</b> [Relationship aiding causal Analysis]	245-259

## List of Figures:

Figure 1: Fiegenbaum's PAF model	7
Figure 2: Relationship between TCOQ and ROQ	16
Figure 3: Factors and measures of quality costs program implementation	22
Figure 4: Getting efficient with conformance related COQ	32
Figure 5: Steps involved in carrying out an experimental questionnaire	42
Figure 6: Objectives of questionnaire	43
Figure 7: Respondent categorization for questionnaire	48
Figure 8: Pareto principle	57
Figure 9: Interview categorization	59
Figure 10: Fine data analytics-Implementation of COQ	61
Figure 11: Fine data analytics-Implementation of COQ- option yes	62
Figure 12: Fine data analytics-Conversion to fine data from raw data	62
Figure 13: Fine data analytics-Implementation of COQ- option no	63
Figure 14: Graphical analysis for a type of organization and its affinity to implement COQ	64
Figure 15: Causal representation using Vensim PLE	67
Figure 16: Graphical results of important factors for implementation of COQ	71
Figure 17: Graph for implementation of COQ amongst different types of industries	80
Figure 18: Graph for implementation of COQ amongst other categories	81
Figure 19: Graphical results representation of engineering department using Vensim PLE	88
Figure 20: Causal representation for finance department	90
Figure 21: Causal representation of sales team	92
Figure 22: Causal representation of HR department	93

Figure 23: Graph for implementation of COQ based on Job Title	95
Figure 24: COQ implementation amongst top level management	100
Figure 25: Causal representation of large revenue organization	106
Figure 26: Graph for implementation of COQ based on types Organization Revenue	107
Figure 27: Causal representation of highly experienced personnel	110
Figure 28: Graph for implementation of COQ based on Number of employees	112
Figure 29: Causal representation of low experienced employees	113
Figure 30: Graph for implementation of COQ based on years of experience	115
Figure 31: Causal representation of organizations with large human resources	117
Figure 32: Graph for implementation of COQ based on types Industries	120
Figure 33: Causal representation of Electronics manufacturing organizations	123
Figure 34: Causal representation of Information technology based organizations	127
Figure 35: Number of respondents from each country	132
Figure 36: Causal representation of organizations across the USA	134
Figure 37: Causal representation of organizations across the Europe	139
Figure 38: Causal representation of organizations across the Asia	141
Figure 39: Conclusive evidence	150

## List of Tables

Table 1: Composition of quality cost elements	9
Table 2: List of engineering elements that composite in COQ	12
Table 3: Organizational composition and Interviews	35
Table 4: Demographic data categorization	52
Table 5: Interview data categorization	54
Table 6: Relational representation of engineering department using Vensim PLE	68
Table 7: Design weight factor analysis	75
Table 8: Design weight factor sample calculation	75
Table 9: Industrial categorization	79
Table 10: Implementation of COQ amongst other categories	80
Table 11: Organizational composition and Interviews	118
Table 12: Evidence on factors that affect the implementation of COQ – Industry types	141
Table 13: Evidence on factors that affect the implementation of COQ – Department types	142
Table 14: Evidence on factors that affect the implementation of COQ – Hierarchy based	144
Table 15: Evidence on factors that affect the implementation of COQ – Revenue types	145
Table 16: Evidence on factors that affect the implementation of COQ – Experience	145
Table 17: Evidence on factors that affect the implementation of COQ – HR size	147

## **Chapter 1: Introduction**

**Cost of quality (COQ)** is one of the most complex yet intuitive methods available in the business world today. The definition for COQ is not the price of creating a quality product or service. It is the cost of not creating a quality product or service. COQ is a financial measure of the quality performance of an organization [45]. It is essentially a measure of lack of quality and can also be termed as cost of bad or poor quality. The question of **why do we need COQ** can be answered using the reason that, understanding cost of quality helps organizations develop quality conformance as a useful strategic business tool that improves their product's services and brand image [28]. This is vital in achieving the objective of providing a successful and high quality product or service. COQ is primarily used to understand, analyze and improve the quality performance. COQ can be used by low level personnel as well as top level management to measure quality standards. It can be used as a regulatory measure to study an organization's quality measure [5].

Based on the various works done before on COQ, the main reasons behind **why COQ is considered a good method** are [102]:

- The COQ statistics are more willingly acknowledged since they go through in depth analysis.
- The COQ system helps justify and steer investments in prevention activities, which lowers quality costs.
- The COQ system helps identify quality improvement efforts and investments.
- The COQ technique helps identify performance measures in the areas of customer satisfaction, production, and design to better target indirect quality costs [136].

Based on these factors COQ has been considered and used as one of the most significant tools in the business world to obtain the needed quality. But it is also a well-known fact that even with several advantages associated with a technique such as COQ; many organizations still fail to recognize them and do not use the technique [62]. There have not been many publications based on the reasons as to why there are many organizations **not willing to implement a technique like the COQ** and gain the advantages that it brings along with it. COQ also has some problems associated with it. Some of the reasons behind why COQ is considered a problematic process are that [140]:

- The usage of COQ is usually based on the company's revenue and turnover and only companies with high revenue can implement it.
- The usage of COQ is considered a risk if the size of the company is too small or if the company is in its developing stage.
- Usage of COQ is usually affected by the lack of knowledge on how to use it. [134].
- COQ needs complex accounting and computer systems to track the effects of implementation [134].
- COQ needs tools to collect, organize, filter, and report quality costs which most organizations lack.

Even though there are clear evidences about the usefulness of COQ and several authors in the past point out why the usage of COQ is not very high, but the reasons behind how these factors were causing the difficulties in the implementation of the technique were never highlighted. The fact that all the organizations tend to know about the various advantages in using a technique such as COQ but still abstain from using it is very surprising. Past literatures research highlights

the point that the COQ technique helps in identifying the key factors that help the organization decide whether to make certain business changes, yet there is no conclusive proof on which are the factors that the organizations need to concentrate on [102]. **Hence the idea behind this thesis is to find out what are the factors that affect the organizations decision to implement the COQ technique in a positive manner and negative manner.** Some factors may also be considered as hindrance in one type of an organization and as an advantage in another [5]. My thesis will shed light on these factors and elucidate how certain types of organizations need to focus on specific types of factors. The thesis will also show the important factors that when concentrated upon would lead to significant benefits. Hence this thesis will help in understanding on how the various factors affect the overall implementation of COQ.

The thesis is comprised of 6 chapters, of which the **first chapter** is an introduction to COQ and its definition. The **second chapter** contains the literature review which gives in depth analysis on the definition and typologies on COQ. This section also contains information about the COQ elements and composition of COQ. This chapter also contains the idea behind COQ and a general discussion on other alternative models. The various advantages, disadvantages and criticisms with regards to COQ are also added in this section to give more support to the existing theory. The implementation of COQ forms a core part of this section as it describes all the perspectives and uses with regards to COQ as highlighted by several authors in the past. The purpose of the **third chapter** is mainly to identify the existing research gaps based on the works of authors that have produced closely related work as that of this thesis. This chapter will also shed light on the research questions that will help close the gaps that are found in the existing implementations with respect to COQ. The **fourth chapter** consists of the methodology used to answer the research questions and to find out the various factors that affect the implementation

of COQ. This section also contains a brief introduction to the uses of a questionnaire and survey. The reasons as to why to use a specific type of questionnaire and what advantages are gained by its use are also a major component of this chapter. This chapter is finally closed with a detailed description of what is being analyzed and how it is done in order to obtain the factors that affect the implementation of COQ. The **fifth chapter** contains a comprehensive discussion on the results obtained from the methodology used for this thesis. The **sixth chapter** comprises of the conclusion that is derived from this thesis and the answers to the research questions. The thesis is finally concluded with a contribution and future directions in the **seventh chapter** that would complete the whole thesis and enable the reader to understand the idea behind factors affecting the implementation of COQ.

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## Chapter 2: Literature Review

### 2.1 Definition and typologies:

According to quality expert Philip Crosby [45], quality is free. Most of the things that require additional money to perform are due to reasons of **not doing it right the first time**. Conferring to Crosby, quality is quantified by the Cost of Quality, which is the disbursement of non-conformance (The expenses related of doing things wrong). J.C. Brittain [81] perceived the cost of poor quality as **“the sum of all costs that would disappear if there were no quality problems”** is comparable to Crosby’s. Suggestions about COQ first appeared in the 1930s in the work based on some authors [128]. To a lesser extent in [101], [44] and [68] some authors formalized the concept of COQ developed out of the works of other authors [85], [62] and [152] who had similar views on COQ (i.e.) **“Quality is free” formed the background for all the works** mentioned which was completely based on Crosby’s analysis.

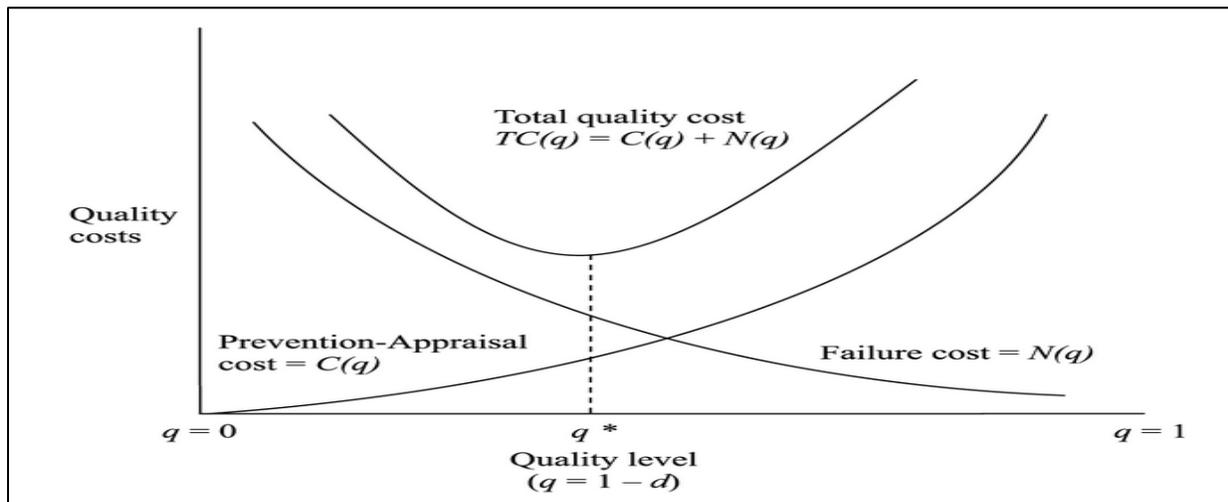
The definition and categories of quality costs may be given differently by diverse authors. Some use the terms “quality costs”, “costs of quality,” “economics of quality,” “poor quality cost,” “price of non-conformance,” or “cost of poor quality” [8 and 51]. The American Society for Quality (ASQ), Quality Cost Committee defined ‘quality costs’ as a measure of the costs specifically associated with the achievement or non-achievement of product or service quality [78]. The total of the quality costs includes prevention costs of non-conformance to requirements, appraising costs of product or service for conformance to requirements, and failure costs of products not meeting requirements [33]. The ASQ Committee, recognized in 1961, functioned to solemnize and to endorse the use of COQ [28]. The committee and several authors came up to the conclusion that P-A-F (Prevention-Appraisal-Failure model) model serves as the

backbone for all COQ concepts, and hence defined the four most important parts of the COQ technique:

- **Prevention costs** are “the costs of all activities specifically designed to prevent poor quality in products and services” [63]
- **Appraisal costs** are “the costs associated with measuring, evaluating, or auditing products or services to assure conformance to quality standards and performance requirements” [63]
- **Internal failure costs** are “the costs resulting from products or services not conforming to requirements or customer/user needs (which) occur prior to delivery or shipment to the customer” [32] and
- **External failure costs** are “the costs resulting from products or services not conforming to requirements or customer/user needs (which) occur after delivery or shipment of the product, and during or after furnishing of a service to the customer” [75].

As the quality function evolved from inspection (quality control) to more preventive activities (quality assurance), quality cost collection was expanded into prevention, appraisal, and failure costs. Failure costs are divided into two subcategories: internal and external. This has been the standard categorization used by industry and service since the 1950s as described by [36], [70], [36] and [33]. Bottorff [28] states that the cost of poor quality is no different than other costs endured during a project, hence COQ can be automated, accounted, restrained, and investigated just like any other cost based technique.

There are also other considerations based on definitions as some authors [162, 28, 57 and 116] feel that Quality costs have been traditionally defined as; **all expenditures associated with ensuring that products conform to specifications or with producing products that fail to follow these standards while in production** [80]. These authors [162, 28, 57 and 116] classify quality cost models in their study into four categories: P-A-F (prevention-appraisal-failure) or Crosby's model, incidence cost models, process cost representations, and activity-based costing (ABC) models (refer to figure 1). However, in the literature, extensive discussion on the definition and working of quality costs is primarily based on P-A-F categorization [16, 153 and 130]. Finally, some authors [80 and 92] also feel that COQ can be defined as the quality related expenditures that are related to costs associated with improving quality.



*Figure 1: Fiegenbaum's PAF model*

Today, COQ systems are defined as an essential tool in managing quality. In fact, COQ has been incorporated and identified as one of the key definitions behind the conception of bodies of knowledge such ASQC (American Society for Quality Control) [28 and 40] and the PMBOK. The Institute of Organization Auditors, the American Production and Inventory

Control Society [16] and numerous business and engineering graduate schools worldwide have defined COQ based on their curricula as **“COQ is a system that allows organizations and implementers avoid physical and financial roadblocks that are usually not seen by other methods”**. Based on all these ideas it is clear that several authors and organizations have a good idea on what COQ is, and how effective it can be. These definitions form the background for all the various analyses that are going to be used for the following sections.

### **2.1.1 Composition of COQ and COQ elements:**

According to Johnson [97] once an association has recognized and defined its cost classifications, it must recognize the cost elements essential to estimate its COQ. Quality cost fundamentals are the comprehensive tasks, happenings, functions and expenses that make up the quality concepts. Quality cost elements fluctuate substantially in varied situations. Organizations may place the same elements in different cost categories, and define elements differently and this makes it difficult to perform assessments across organizations [117]. Despite the attractiveness of inter-organizational assessments, the advantages of tailor-making the set of cost elements and their functional definitions to one common structure has more advantages than by having cost elements split according to the needs of an organization [117].

The analysis based on the work of several researchers [162, 57, 90 and 81] of quality cost categories from various sources reveal that prevention cost and appraisal cost values vary little amongst businesses. Most companies have prevention and appraisal costs associated to the sales revenues. Hence it can be concluded that sales revenue is a critical COQ element. On the contrary, a number of previous studies [30 and 32] showed that appraisal costs were higher than prevention costs, when expressed in association with sales revenues. Also, failure costs are the

highest cost of the three in the quality costs category [80]. Hence we can see that all 3 components of COQ have some association with the sales revenue cost element. Based on these ideas the following COQ elements composition table (refer to table 1) is formed for each of the 3 components.

*Table 1: Composition of quality cost elements*

<b>Prevention Costs</b>	<b>Internal Failure Costs</b>
Systems development. Quality engineering, Quality training, Quality circles. Statistical process control. Regulation of prevention activities. Quality data gathering, analysis, and reporting. Quality improvement projects. Technical support provided to suppliers. Audits of the effectiveness of the quality system.	Net cost of scrap. Net cost of spoilage. Rework labor and overhead. Re-inspection of reworked products. Retesting of reworked products. Downtime caused by quality problems. Disposal of defective products. Inquiry of the source of defects in creation.

<b>Appraisal Costs</b>	<b>External Failure Costs</b>
Assessment and scrutiny of incoming materials. Test and inspection of in-process goods. Final product testing and inspection. Articles used in challenging and inspection. Regulation of testing and inspection activities. Depreciation of test equipment. Maintenance of test equipment.	Cost of field servicing and handling complaints. Warranty repairs and replacements. Upkeeps and proxies beyond the warranty period, Product recalls. Obligation arising from malfunctioning products. Proceeds and payments arising from quality problems. Lost sales due to reputation for poor quality.

Similarly there are several authors [117, 23, 8 and 57] who believe that no process is made up of one single object or single concept, and the same goes with COQ composition. The COQ process is a technique that has several levels of complication and its composition can have

multiple levels of significance factors. The other types of cost that compose the COQ process [19].

- **Direct failure costs**, which portray the direct financial magnitude of every failure that is exposed before the product is delivered and all the other costs connected with claims, rejects, assurance administration, etc. [19]. As a consequence difficulties are often revealed after the product is delivered and failure has already taken place.
- **Consequence costs**, which are additional costs like management, turbulences in current and associated processes, supplementary planning, etc. [8]. These costs are a part of the failure costs through an abridged costing approach.
- **Lack of (process) efficiency costs**, which are costs due to inadequate process enactment compared to chief competitors or theoretical depictions of the system, determined through competitive or functional benchmarking [19].

In terms of various terminologies suggested in the past, **discretionary costs** are the summation of prevention and appraisal expenditures [90]. It is considered that the idea behind quality cost monitoring is not only directly related to financial terms but also related in terms of reliability of the product or service through improvements that keep growing continuously. In addition to providing the customer with the best value for money, it is equally important to continue to improve the level of sustainability in order to improve the market share [76]. This follows from a well-known axiom of one satisfied customer bringing in many more customers as a result of high quality products or services (normally 1:10). This qualitative term is known as the **effect of consistency** [90]. The failure of consistency means failure of quality. Even though

all these facts have been passed down in time by some authors [117, 23, 8 and 57], the main idea of why COQ affects the various results and are the reactions for different types of organizations is not provided.

These above COQ elements provide the identity that helps in finding out the key elements, which help in the implementation of COQ.

### **2.1.2 List of engineering COQ elements:**

In this approach, group of authors [119,164 and 167] generate a large list of conceivable cost elements connected with different purposes, activities or procedures. In addition to the brainstorming, the minimal group procedure [36], Pareto scrutinizes and causal illustrations are other common and useful techniques for measuring COQ. Cooperatively, these methods have the ability of getting workers involved in classifying cost essentials. There are 2 major types of COQ elements the engineering type and the non-engineering type. The main reason for considering the engineering type is due to the non-fuzzy nature of the elements. It can also be measured either mathematically or qualitatively. These are the reasons behind why the engineering elements are considered with respect to COQ [119]. Based on table 2 the literature and discussions held between the investigator and COQ practitioners indicate that participative methodologies such as those noted above are both anticipated and mutual [54]. Kowalski and Walley [145] feel that it is important, however, that the parties included want to contribute and are inspired to subsidize their ideas. Furthermore, if a COQ curriculum is to be an accomplishment, personnel who are entreated to record COQ elements must believe that their writing happenings will not be used in contradiction of them. The reasons behind the lesser usage of non-engineering elements are because of the variety of possible elements that may not only be individualistic but in many cases

very biased. This bias changes the overall assumption of what are the key factors that affect implementation of COQ [119]. It is to avoid these confusions that those involved in implementation processes, distinguish the process as an aid that helps them to select processes and advance in quality perspectives.

*Table 2: List of engineering elements that composite in COQ*

<b>Price of Non-Conformance</b>	<b>Appraisal Cost</b>	<b>Price Of Conformance</b>
<ul style="list-style-type: none"> <li>• Design specification reviews</li> <li>• Service design qualification</li> <li>• Design support activities</li> <li>• Design feasibility studies</li> <li>• Preparation of design manuals /procedures</li> <li>• Design and development of quality measurement and control equipment</li> <li>• Product qualification</li> <li>• Personnel qualification</li> <li>• Packaging qualification</li> <li>• Vendor surveillance and rating/qualification</li> <li>• Drawing checks</li> <li>• Supplier evaluation</li> <li>• Preventive maintenance</li> <li>• Verify workmanship standards</li> <li>• Review of test specifications</li> <li>• Failure effects mode analysis</li> <li>• Pilot production runs</li> <li>• Customer interface</li> <li>• Safety review/operator safety</li> <li>• Technical manuals</li> <li>• Pre-production reviews</li> <li>• Defect prevention program</li> <li>• Schedule reviews</li> <li>• Process reviews</li> <li>• First piece approval</li> <li>• Agency approval</li> <li>• Prototype inspection and test</li> <li>• Receiving sample testing</li> <li>• In-process sample testing</li> <li>• Final sample testing</li> <li>• Laboratory analysis and test</li> <li>• Fault insertion test</li> </ul>	<ul style="list-style-type: none"> <li>• Design quality progress reviews, evaluation and characterization</li> <li>• Scrap/rework tracking/reporting</li> <li>• Vendor quality tracking</li> <li>• F/O tracking system audits</li> <li>• Appraisal/resolution</li> <li>• Production test</li> <li>• Department/function quality measurement tracking</li> <li>• Laboratory acceptance testing</li> <li>• Testing set-up of inspection and test</li> <li>• Personnel appraisal</li> <li>• Accumulation of cost data</li> <li>• Purchasing appraisal costs</li> <li>• Process control</li> <li>• Outside endorsements and certifications</li> <li>• Field performance evaluation</li> <li>• Prototype inspection and test</li> <li>• Post-project reviews</li> <li>• Production specification conformance analysis</li> <li>• Process control acceptance</li> <li>• Packaging inspection</li> <li>• Status measurement and reporting</li> <li>• Conformance analysis</li> <li>• Software changes</li> <li>• Engineering and drafting time spent on redesign work</li> <li>• Material review activities</li> <li>• Time spent expediting purchase orders</li> <li>• Premium freight owing to</li> </ul>	<ul style="list-style-type: none"> <li>• Design corrective action</li> <li>• General notes</li> <li>• Dimensions/tolerances</li> <li>• Revision block</li> <li>• Title block</li> <li>• Work crafting</li> <li>• External detailing</li> <li>• Lines/arrows</li> <li>• Subcontract/format</li> <li>• Sectional reviews</li> <li>• Documentation revisions owing to errors</li> <li>• Supplier-caused losses</li> <li>• Troubleshooting</li> <li>• Remedial engineering</li> <li>• Show down time</li> <li>• Purchased material reject disposition costs</li> <li>• Extra operations</li> <li>• Field service</li> <li>• Complaint investigations/customer or user service</li> <li>• Retrofit costs</li> <li>• Recall costs</li> <li>• Liability costs</li> <li>• Equipment breakdown/repairs</li> <li>• Work performed but not used</li> <li>• Equipment/materials purchased but not used</li> <li>• Unplanned (unnecessary) visitors</li> <li>• Engineering errors and omissions</li> <li>• Owner-operator changes</li> <li>• Vendor errors and omissions</li> <li>• Contractor changes</li> </ul>

<ul style="list-style-type: none"> <li>• Engineering audits</li> <li>• Training for special testing</li> <li>• Customer/user perception surveys/clinics</li> <li>• Contract/document review</li> <li>• Field trials</li> <li>• Purchase order technical data reviews</li> <li>• Supplier quality planning</li> <li>• Maintaining engineering files</li> <li>• Process capability studies</li> <li>• Hazard/operability studies</li> <li>• Economic analysis/studies</li> <li>• Building code studies/reviews</li> <li>• Materials of construction studies</li> </ul>	<ul style="list-style-type: none"> <li>late issue of drawings</li> <li>• Engineering time spent on failure analysis</li> <li>• Repair and redesign owing to incorrect materials specified</li> <li>• Wasted prefabrication owing to inaccurate design</li> <li>• Design changes after initial approval</li> <li>• Delays caused by incomplete engineering drawings</li> <li>• Engineering travel and time on problems</li> <li>• Premium freight costs</li> <li>• Rework</li> </ul>	<ul style="list-style-type: none"> <li>• Remedial work associated with warranties and guarantees</li> <li>• Wasted man-hours resulting from late start of meetings</li> <li>• Costs from errors in scheduling</li> <li>• Engineering change order</li> <li>• Purchasing change order</li> <li>• Corrective action costs</li> <li>• Service after service</li> <li>• Consumer affairs</li> </ul>
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## 2.2 Alternatives COQ models:

**Poor quality cost (PQC) model** has been developed to overcome some of the problems in previous models such as the TCOQ (**Total cost of quality**) and QFD (**Quality Function Deployment**) [62 and 74]. The term poor quality cost has been used to show that prevention and appraisal costs have been left out compared to Feigenbaum's PAF model, since they are problematic to measure and have limited solicitation in the strategic resolution process. However, it is still significant to measure these key factors for internal operational routine in each department. The direct component consists of cost categories that are usually scrutinized and superficial in nature. They contain the factors that provide cost based benefits to the company, whereas the subsidiary element comprises costs that are first perceived by the customer [18], but consequently returned to the company as lost market dividends. The basis for both elements is consumer requirements, essentials and potentials.

**TCOQ** is nothing but the sum of all costs associated with poor quality or product failure, including rework, scrap, and warranty costs and costs incurred in preventing or resolving quality problems. The major difference between the COQ and the TCOQ technique is that,

TCOQ does not include costs associated with maintenance and quality training that usually form the core of most organizations. This as a result brought the use of COQ into existence. **QFD** was developed to bring this personal interface to modern manufacturing and business. The major use of QFD was to understand customer requirements, maximizing the positive quality while implementation and to create a comprehensive quality system that can provide the best possible quality and customer satisfaction. The one main part that was missing in QFD was the complexities involved in including specific features based on implementation and finding out the needed level of performance after implementation.

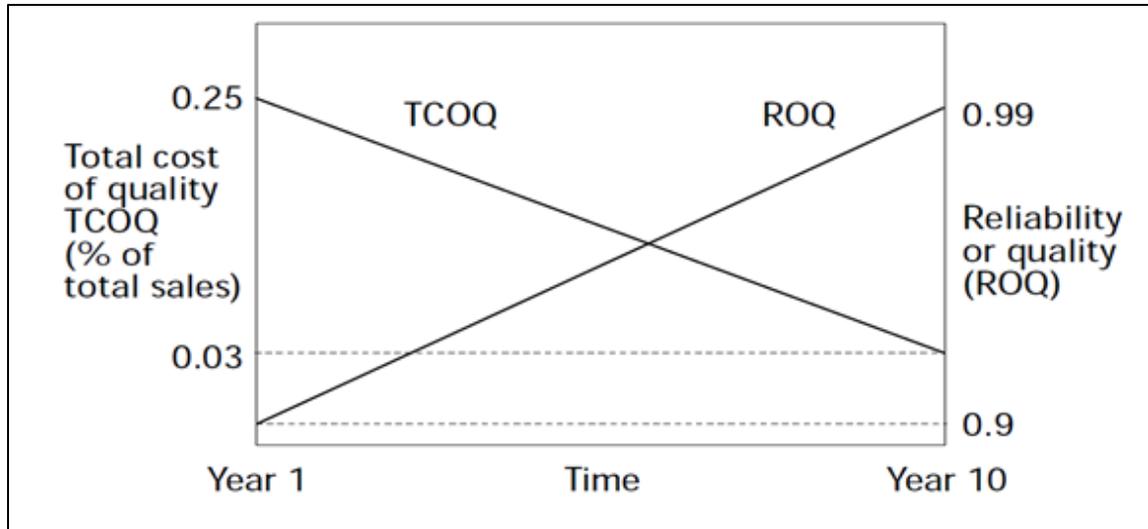
The **PQC** system is based on tools and performances that should be present in an organization that wishes to be a world class manufacturer [134]. The idea epitomizes the company's ideal essentials with internal gatherings, where traditional quality cost systems are mainly based on apportioning costs due to scrap, failures and rework. The basis of the new quality cost systems are client requirements, needs and expectations publicized through surveys of customers, customer complaints and supplementary varieties of customer feedback [69].

**Reliability of quality (ROQ)** is defined as: "The ability of quality to maintain its agreed level and conform to stipulated requirements" and it is another commonly used quality cost technique which works along with TCOQ. The letdown of quality that is estimated using the ROQ is that if the product or service fails to meet quality and cost requirements [90] then the whole system is considered a failure (refer to figure 2). It indicates that normally at the start of a quality cost program the TCOQ is high. As the program progresses this high value should decrease. A higher value of TCOQ is associated with lower deterrence and higher appraisal and failure costs in this situation. Variation in delivered quality is normally practiced or, in other

words, more chances of getting bad results based on quality are observed [90]. This result means that when TCOQ is great, the ROQ is considerably shorter and when TCOQ is low ROQ is high. It is recognized that TCOQ versus time relationship, based on measured values, is non-linear.

In this context, an empirical relationship between **ROQ and TCOQ** would follow a law of the type which describes the reliability of items when the failure rate is constant [89]. The alteration between the goals of a TCOQ program and those of cost decline programs are not always strong. The former (i.e. TCOQ) is aimed at improving the quality (like ROQ) whereas the latter is a financial exercise to reduce the heavy losses in the business [89]. No doubt advancement in ROQ will also result in a leaner organization, which is one of the major points as to why several organizations choose to implement COQ. Even though the objectives were simple the idea behind the link between TCOQ and ROQ is not specified by other authors.

**Customer experienced costs**, which are costs brought on the customer as a result of unacceptable quality supplied by the producer. This element is usually based on the identical costs and is considered as a part of internal failure costs at the producer [117]. Intangible costs, which contribute to the customer displeasure costs and costs associated with loss-of-reputation. Consumer dissatisfaction costs transpire when a customer abstains from repurchasing an invention due to dissatisfaction with the product's that the same producer previously produced and was a highly defective one [117]. **Loss-of reputation costs** ensue when the customer abstains from buying any products from the manufacturer, founded on poor experience with one unambiguous product. The latter reflects the customer's attitude towards the establishment rather than toward explicit merchandise [62].



*Figure 2: Relationship between TCOQ and ROQ*

**Environmental costs**, which are budgets due to the short- and long-term environmental conclusion of the product. Customer requirements have been deciphered to key process constraints by using another quality cost model such as QFD. A key process limitation is a process parameter that directly influences the self-actualization of customer requirements. The QFD matrix can also be used to appraisal intangible quality costs and lack of (process) proficiency costs [119 and 43]. The quality cost for each cost component (except intangible costs) should have been measured through the **Taguchi loss function**, using actual performance of each vital process parameter, and how the company meets customer requirements, is considered as a contribution [54]. This enables the company to forecast quality costs at the current performance level, and also represent how changes in performance due to quality development efforts will stimulate total quality costs. This also allows the company to decide which processes amongst the ones that are commonly used would be most suitable for the organization to use and this serves as a pre-check for the organization to choose appropriately.

A mainstream of the quality specialists [12] feel the common foundations for the defining for quality costs are based on its elements **percentage of sales turnover, total substantial costs, total manufacturing costs and employment costs** [35]. Very few quality consultants discuss other types of ratios, such as; internal failure cost to average production costs, warranty prices to sales turnover, supplier's appraisal cost to acquired quantifiable cost, manufacturing appraisal costs to fabrication cost and external failure costs to sales revenue [12]. In the literature based on some authors [115, 13 and 96], there are some rarely used COQ defining indices such as: **aggregate quality cost as a percentage of sales revenues; substantial costs; total manufacturing costs; and employment hours**. There are other quotients such as internal failure cost equated to the run-of-the-mill percentage of production costs, warranty costs as an average proportion of sales, supplier appraisal costs as a percentage of obtained material costs, manufacturing appraisal costs as a percentage of production costs and quality occupation investment costs as a percentage of aggregate quality cost [69].

### **2.2.1 Advantages of using COQ:**

The core values of COQ are based on the following sets of properties that help show the usefulness of this technique and also help identifying the decision factors that help the organization decide whether to implement a technique such as COQ or not. The following factors are considered the main advantages of using COQ:

#### **a) Flexibility:**

COQ can be applied at any body in an organization.. Any enterprise can apply COQ; there are costs of poor processes in service industries as well as costs of measuring quality levels

(appraisal) and investments to prevent unfortunate consequences [146]. Most prominently, the rudiments of COQ are meant to be applied in the context of each association [146]. As a reason for this, these procedures can remain applied to many types of organizations, and aid in improvement approaches [146].

**b) Cost reduction via prevention:**

Organizations can manage their improvement programs with a balance of prevention activity cost, extent movement cost, and concomitant costs [146]. Augmented and progressed prevention activities are used to first attack failure costs, and then reduce appraisal [146]. The company is making this service available to assist a great numbers of manufacturers that have aggressively expanded their globally-distributed manufacturing systems, mistakenly thinking lower labor costs will directly correlate with higher turnover limitations [64]. Tannock says, “In recent years several companies have been called in to re-engineer test-intensive assembly lines throughout the world because of the high failure rates in functional performance of reject products from assembly lines “[134].

This simply shows how the cost reduction via prevention many times leads to lower labor costs and could help increase overall benefits and the fact that lower labor might be able to produce high quality products is also highlighted. The author [134] also fails to highlight the reasons behind why cheap labor cannot produce high quality products or services. Quite often, plants had been built in areas where lower labor costs were assumed to translate into significantly higher profit margins but the real costs of designing systems that can safeguard product costs in regions with varying organizations and labor force skill levels [25]. It is realized that, this is a global problem wherever cheap labor forms the major portion of the workforce.

**c) Reducing the overall costs is the goal:**

Improvement programs will show baseline savings that companies crave for while avoiding the possibilities of failure due to budget reduction associated with quality. These drawbacks possibly will comprise reductions of creation or service excellence, enlarged purchaser displeasure, additional rephrase costs, or unpretentious changes of costs that may affect the overall quality from one area to another [37]. The later a problem is found, the more it costs to fix. The central theme behind COQ is that the largest costs occur after product has shipped or a service has been achieved; that is, in the grouping of external failure costs [64]. By selecting proper budgets in the order of job undertaking, executives will emphasize the developments or failures on issues at the earliest possible point in the workflow. This needs to be done so that the quality based checkpoints of the implementation process would help in identifying any failed business logic [53]. A COQ system shows the payoff of improvement activities that helps in finding the correct procedure to obtain a correct trade-off between cost and quality. If the organization reached the point where added improvement activity consumes more resources than it returns in benefits, an ongoing COQ program will answer that by showing the pace of improvement and cost significance [146].

**d) Cost-benefit advantages:**

Different nations differ in both their wealth per capita and product requirements. This not only reduces the import threat to both, but also provides considerable opportunities for the mass-produced goods of one continent to be sold as the specialties of the other continent [1]. This is mainly due to the difference in markets and also the quality based activities that are more focused on the products that region specializes in. The greatest economies of scale are obtained

in the mass-market products in each country and not in the end of line products. If labor is expensive, the best quality value of a product is found at higher levels of material and equipment cost than if labor is cheap [1]. The comparison of how the tariffs affect in different geographical locations is shown. This highlights how COQ implementation affects the factors or processes in two different regions even though the end result is the same for both.

According to Kiani, B., et al [87], despite the complications encountered during its execution COQ reporting has a major role to play in attaining the eventual goal of every organization, to capture and enhance customer gratification level [87]. This notion is supported by earlier findings that COQ reporting enables a identification of potential areas for enhancements in cost-benefits which will lead to operational quality programs and ultimately improve overall organizational routine [88, 143,113 and 83]. Meanwhile, Ramudhin et al, [113] state that COQ recording reduced the maneuvers and overall cost to the least possible value while Williams et al, [143] noted that COQ reporting heightened organizations' affordability through higher quality and lower costs. Roden and Dale [119] outlined the cost-benefit advantages of COQ enactment. They stand:

- Quality statistics are further willingly acknowledged since they are congregated and analyzed with the accounting department in a team situation [12].
- The COQ scheme aids in the evaluation of capital venture options [74].
- The COQ system helps justify and pilot investments in deterrence activities, which lower quality costs. It also helps justify and steer other quality improvement efforts and investments [89].

- The COQ organization pointers to the expansion of an additional progressive performance measure in the areas of customer gratification, construction and enterprise [16].

The solution that can be provided to this study is to explore the difficulties encountered throughout the implementation of COQ. The distribution of the problem faced by industrial establishments in a particular geographical location must also be studied [162]. The above 4 mentioned points form the most significant uses of COQ and how their use can help the organization reach its goal. Several authors feel that there are other significant benefits also associated with COQ that may not be as astounding as the 4 mentioned factors, but these factors are also critical to the business as they help the organization obtain the needed verifications before jumping into the implementation phase. These factors are explained as follows:

**a) Result orientation:** The base of all organizations include sale revenues, manufacturing expenses, purchasing material, training, direct/indirect labor, and production costs. Implementing quality cost program can assist a business in setting up a proper quality costs system in the manufacturing industry [57]. Based on the findings and review of literature, the study found the primary four significant factors and three categories of measures that aid in the success of a quality costs program. According to Rodchua [57] Figure 3, shows a model of factors and measures that aid a successful quality costs program in the manufacturing industry.

Figure 3 presents the relation of four factors (upper management support, understanding concepts of Cost of Quality, effective system & application, and cooperation from accounting and finance departments) and three categories of measures (percentage bases, volume of outputs, and qualitative measures) to quality cost program implementation. The majority of respondents

stated that management support is one of the most significant factors affecting the COQ programs achievement [76]. Dr. Deming and other quality gurus agreed in the main principles of Total Quality Management that top management must provide the leadership for quality. Management support can help in making decisions, creating a positive company environment, and providing appropriate tools and resources [76]. These factors interact with each other and can be explained in greater details.

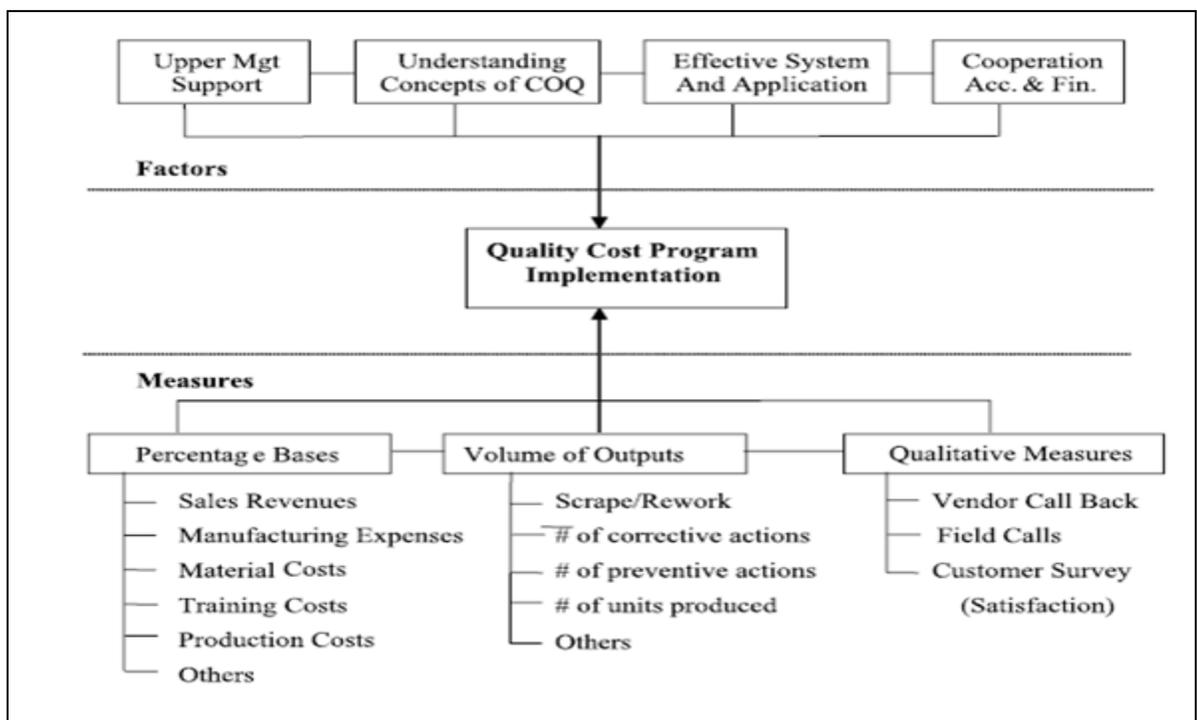


Figure 3: Factors and measures of quality costs program implementation

**b) Management support and commitment:** Upper management and executives must strive for cost saving and understand the impact of quality costs implementation [57]. The roles of top managers are to establish an organizational culture that favors prevention over correction, organize quality cost steering committees, meet monthly or quarterly to discuss the work

progress of the quality costs program, and provide opportunity for training and learning the costs of quality for involved departmental managers and supervisors [57].

c) **Effective systems and application**: The tools used in data collection and analysis are very important in order to obtain accurate and complete information. Each organization has a different structure; hence, quality professionals must set up the quality cost system and methodology that fit their own needs and work well with the financial and accounting systems [16]. An effective system should be user friendly and integrated with cost drivers and collect costs related to unknown (hidden) costs. Commercial software and training for quality cost programs from the Juran Institute and the American Society for Quality are available in today's industry [17].

d) **Understanding concepts of Cost of Quality**: A group of respondents indicated that lack of knowledge of Cost of Quality caused unsuccessful quality cost implementation. It is important for everyone involved with the programs to understand the concept and elements of quality costs [57]. There are a number of current quality cost techniques used in today's manufacturing industries, such as the quality cost, the Activity Based Costs (ABC) model [57], Taguchi Loss Function, Total Cost Management, and others. These techniques might have different methods, but they all focus on the foundations of learning and training.

e) **Cooperation from other departments**: Most respondents discussed the importance of cooperation from the financial and accounting departments to the quality cost program [87]. Department managers should understand and accept the value of looking at information and acting with positive steps toward improvement. Moreover, employee involvement is also a vital issue. If workers have high job satisfaction and value preventive actions, the products will meet customers' demand as well as decrease IFC and EFC [114, 58 and 47].

The various factors and reasons mentioned here are the most important factors in terms of advantages with regards to COQ. This also adds to the intriguing question as to why do organizations still not want to implement COQ even though there are so many notable advantages associated with the technique. But as ever for every technique there are both pros and cons associated with it. Hence the next section would be concentrating on the disadvantages and negativities associated with COQ.

### **2.2.2 Disadvantages of using COQ:**

The most frequent reason given for not tracking Cost of Quality was a lack of management support or absence of management interest in pursuing such costs [138]. Specific clarifications relating to this deficiency of maintenance, encompassed lack of concern for how much and in what way quality does compensate. Administration viewpoint and establishment ethos that are not supportive of quality costing leads to the perception that quality costing is nothing more than excess paper work that the management would not have any value for. Several times executives believe that there is zero significance in any efforts to fully measure costs of quality [76]. Some authors suggest that:

- The most common response indicated is that, the company's economic conditions or status contribute to the lack of Cost of Quality tracing. These are the most habitually cited circumstances if the companies were being a newly started company, a developing company [140] or the company is too small.
- Lack of knowledge of how to track the Cost of Quality and the benefits of a COQ program were the common reasons cited for not tracking [140 and 134]. Explanations included not knowing what elements to include in the Cost of Quality. Lack of

knowledge of quality principles and lack of knowledgeable manpower to accomplish the task [140 and 134] is also quoted as another difficulty.

- Another common reason given was the lack of adequate accounting and computer systems necessary to track Cost of Quality [140 and 134]. The usual complain amongst organizations is that the tools to collect, organize, filter, and report quality costs are usually sub-standard. The accounting systems and resources not being adequate to perform standard COQ calculations common in the industry [140] is also one of the reasons.

Lack of data or complications in collecting data, lack of collaboration from top management and lack of empathy towards COQ principles are communal difficulties identified during the implementation of COQ [116, 56 and 133]. According to the authors [2], because of **poor design** or **poor implementation** of COQ methodologies, it often suffers from one or more of the ensuing problems. COQ data gathering is watered-down [3], or has superficial applications that quickly become tedious exercises with little or no assistance. However, the author [102] also lists some of the reasons as to why many quality cost programs fail:

- Using COQ statistics as a scorekeeping tool rather than as a driver for continual improvement;
- Obsession with faultlessness in influencing the COQ figures; and
- At times the magnitude of the problem makes it an obligation for the need of a prerequisite of having a prevention mechanism in place before setting up COQ.
- Stable culture and employee arrogances towards COQ system are not favorable.

Based on other similar studies [162, 50 and 90] there are a few observations that highlight the problems associated with COQ and how the implementation would affect the overall quality of the work. The following are some of the other points that show the problematic features with respect to quality costs:

- Exertions are directed at where it is easy to amass data, or easy to contrivance changes, instead of converging on the COQ priorities [50].
- The COQ input data are often imperfect. The COQ descriptions are often un-clear, or not fully implicit, resulting in varying construal and implementation over time [29]. This inconsistency tends to add significant noise to the COQ data, clouding the clarification and hiding noteworthy trends for protracted epochs of time. [22].
- Administration does not actively use the COQ data in an operative manner. Conclusions are often made without neither comprehending nor considering the influence on COQ, thereby castrating the COQ system to irrelevancy [106].

### **2.2.3 Summary:**

The first section of the chapter gives a clear idea on the fact that COQ has been in existence for a long time. Even though it has not been termed the same way, the actions oriented with it are similar to that of what is being presented as the COQ techniques in modern times. The authors also specify several instances as to how the COQ system has evolved from just being a cost effective system to a procedure that can help define the overall functioning of an organization. They also finally conclude that COQ cannot be considered as a single body entity and just using the technique does not mean guaranteed success nor does it mean an organization

not using will fail. The reasons as to why they felt this way would be explained in the successive sections.

The second section of this chapter gives a clear understanding on the various concepts of COQ that have been used by various organizations to get the optimal financial results that they have been craving for. The authors also help us understand that the concept of COQ is termed and worked differently at different parts of the world. They also specify that each of the mentioned techniques can have a particular type of reaction on a type of industry. The various models present in the business world are also briefly described to show their similarities and scrutinize the technique COQ. The whole idea is to find out common points or factors that can help us understand the system and its behavior in a more elaborate way. There are also several authors that help highlight different models that are considered to be close to that of the COQ model and also some models that are not very significant but can shed some light on the working of the COQ technique. Finally, this section also gives an idea on what OCQ is composed of other than the general factors that many authors use to describe COQ.

The final section of this chapter is composed on identifying the Cost of Quality perspective which gives the reader an idea on how COQ is being understood and how the various factors present in the general work environment affect the outcome of the process. There are several authors who understand that the need behind the usage of Cost of Quality is extremely important, as it shows how COQ can be used and for what purposes it is being used. It also pinpoints at the probable solutions that are usually overlooked when COQ is not being implemented. Some authors also voice out their opinion on how the COQ system is at times associated with several negative aspects that cause some difficulties during the implementation

of COQ system which are otherwise not a problem. They also specify that the difficulties encountered eventually transform into a flawless process that helps the process implementation transition into an advantage. Finally, it can be concluded that the COQ ideology has many advantages and is one of the main reasons as to why COQ is used and also core values of Cost of Quality which form the key advantages are highlighted with the help of several studies.

### **2.3 Implementation of COQ:**

Once an organization has recognized and defined its cost groupings, it must identify the cost fundamentals necessary to implement COQ. Quality cost elements are the detailed tasks, activities, functions and expenses that make up the quality [47]. Quality cost elements differ substantially in varied settings hence the implementation is dependent on these factors. Organizations may place the same fundamentals in different cost categories, and define elements. Otherwise this makes implementation of quality aspects across the organization difficult [48]. It is best for the organization to implement COQ using a standard structure where the organization knows the internal links between the cost elements. Crosby [48] endorses that quality cost program executives begin the quality-costing implementation by directing input/output analysis of the process. When an organization identifies the inputs to a process, then they can all be measured. Regardless of whether the association is examining production, service, industrial, or research and improvement activities the implementation should be generic enough to tackle all the issues using one common setup. The input/output implementation methodology sanctions an organization to classify the authentic process elements and to identify those which are not part of the required process [47]. Subsequent to this are parts of the input/output analysis, decision-making approaches that may be used by administrations to complete the implementation setup.

Some of the implementation ideas based on previous works [118], [90], [49] and [28] show that there are several evidences on how COQ is perceived and how it is implemented to work as per their needs. It can be understood that COQ implementation is a cooperative responsibility of the various employees and professionals in an organization. The technique such as COQ can be used for accumulating quality cost data. Implementation of COQ using pre-existing accounting or estimation system may need variation and extra efforts for quality to be incorporated. The use of the quality costing systems in an organization is prevalent in quality cost [103] and the use of a matrix form of accounting system has also been recommended in the literature [109] as one of the most significant ways to implement quality based costing techniques.

Furthermore, in a large organization the fiscal structure can be useful in collecting, measuring and estimating quality statistics on the cost elements that help notify the organization on the information regarding implementation and this procedure helps in associating quality cost implementation statistics with other costs [103]. Some of the studies broadly discuss the prime advantages of implementing quality cost data for:

- Pursuing management courtesy for quality improvement [109];
- Performance measurement of accomplishment of quality enhancement;
- Determining the expanses where collective schedules will be most lucrative [103 and 109].

Some studies were developed to assess both quality system maturity and how implementation of quality costs affects the overall outcome of an organization [32]. Data analysis and interpretation helps to compare the quality cost categories and the implementation

setup as proposed by the author [123]. And based on the studies the following results were obtained:

Forecasting the failure costs are the major expenses for the implementation in large organizations. On average, failure costs were about 70 to 80 percent of TQCs, while prevention costs were 10 to 11 percent and appraisal costs were 9 to 17 percent [36].

- Implementation of COQ could only account to a high percentage of internal failure costs and large organizations had the high percentage of external failure costs which could not be found out even after implementing. Recall costs, warranty claims, and lost sales are external failure costs that become excessive for large organizations [40]. Using sales revenue or manufacturing costs as a base in quality cost calculation may have a difference in reporting. SMEs had lower TQCs than large organizations when using sales revenues as a calculation base. On the other hand, using manufacturing costs, SMEs had higher TQCs than large organizations [38].
- It was surprising that even after implementing COQ, organizations' reports had prevention costs and appraisal costs together at 27 percent, which was a crucial part of the failure costs. Large organizations tend to reduce their failure costs by adding more activities into prevention and appraisal sections which only add up to the additional overhead costs during implementation [25]. These activities may include marketing research, design development, supplier quality planning, process validation, receiving or incoming inspections, field performance evaluations, and so on [54].

It is worth noting that the methods of implementing, categorizing and measuring quality costs may vary between organizations [108]. A company's structure, product life cycle, and

ongoing quality improvement programs (Six Sigma, Lean Systems, ISO, and other quality certifications) may have an impact on implementing and collecting quality costs.

In the past decade, studies have shown high but varied percentages of positive changes due to implementation based on sales revenues and manufacturing costs (this highlights the fact that quality cost elements are associated with the implementation as conveyed by several authors). There are several forms by which the organizations decision on implementing COQ or not is obtained based on the cost elements for their business. Some authors [15, 28 and 66] feel that the implementation is usually based on several other factors such as how the organization is affected by the various geographical locations. When the organization needs to make special considerations to the implementation process the overall effect due to COQ implementation is affected. The organizations implement it solely based on the organizations needs such as the language, or cultural difference that is present in the organizations location. Also, the employee's attitudes vary largely when the effect of the location forms a major part on the outcome of the implementation [16]. Based on the survey findings and the literature reviews, there are difficulties that companies might experience in implementing a quality cost program [86]. **These causes can be divided into four main issues: measurement, people, process and information.** These form the fundamental drawbacks in implementing COQ as a process based system in an organization.

There are also some of the success stories based on previous studies about how COQ was implemented perfectly and the end results were higher than expected. Gryna [70] wrote in his article that for most companies, quality costs ran in the range of 10-30% of sales or 25-40% of operating expenses after the implementation of COQ for a process. David R et al, [56] conducted

a study within 46 companies in the manufacturing industry and found that the average total quality costs can range from 2.5 to 5% of manufacturing disposition revenues and 7-10% of manufacturing expenses; and the internal and external failure costs are about 70-80% of total quality costs [13] which was a great difference to the earlier obtained costs before implementing COQ. This study's results as shown in figure 4 indicates the difference between the organizations savings before the implementation of COQ is completely different from that of the same organization after implementing COQ .

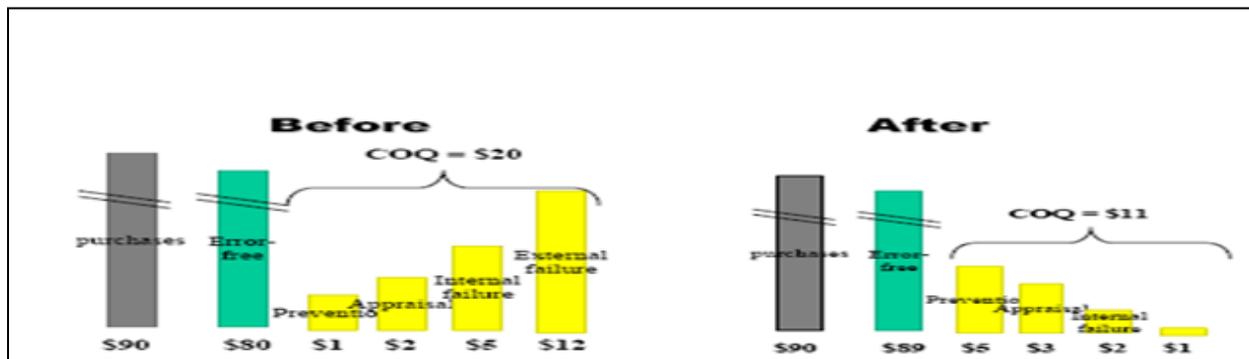


Figure 4: Getting efficient with conformance related COQ

Kumar and Brittain [90] also feel that when implementing COQ program not only reduces costs but also could assist to improve the reliability of quality. Another success story on the implementation of COQ is based on the conditions that currently prevail in British manufacturing industry with relatively low labor rates and a generally high level of awareness of quality provides significant opportunities to showcase the usefulness of implementing COQ [112]. It is seen that the total quality initiatives is being adopted by many companies and the introduction of formal quality management systems certified to ISO 9000 has started to bear fruit in the form of higher levels of awareness of quality issues and this also helps in easing the efforts associated with the implementation phase of the COQ technique (refer to figure 4). To support

the necessary implementation skills required, it is considered that formal training in COQ techniques is vital at all levels [110]. To augment these universal training bodies and governing enterprises, initiatives are taken in order to place them in prime position to promote COQ awareness and its benefits. Using the British manufacturing industry's processes as a case study other industries now have a golden opportunity to reduce business costs and to enhance the reliability of its products using the same implementation exercise.

### **2.3.1 Summary:**

This section gives an idea on how COQ was being used in the past and the various studies based on COQ. The whole idea of this section is to highlight the various areas or sections where the authors in past did concentrate on implementation factors that affect the COQ technique. There is also a brief study on the analytical review on the concept of how COQ implementation affects a certain organization and based on this study a comparative analysis on the factors that affect the system is provided. This helps in obtaining the reasons as to why COQ is such an important quality process in the market today. The other significant points in this section are the provision of the success stories which serves as an encouragement for other industries and also serves as a motivation as to why COQ needs to be studied more.

### **Chapter3: Identification of research gaps**

This chapter is used to discuss the various authors whose works are mostly related to the topic of this thesis in order to highlight the state of the art and the latest developments in this area. This chapter will also highlight the motivations behind this research and also the missing links between the other similar researches carried out in the past. This section will show the differences between the existing papers and also show a general idea on what are the contributions that would be provided at the end of thesis.

The first most important research paper that formed the background to this thesis is based on the work of Rodchua [57, 116 and 118]. The researches carried out by Dr.Rodchua highlights the reasons that an organization can lose a lot of money by not implementing the technique correctly. The author also provides insight on the various reasons and advantages on using COQ in one specific industry (i.e.) the manufacturing sector. The author also suggests that the contribution of the paper is the formation of an empirical study on the quality cost facts that affect the overall outcome on results oriented with respect to financial gains for an organization. The methodology used in this research is to conduct a survey only in a specific organization and within a limited number of survey respondents (63 respondents). According to the Rodchua quality cost categories are based on sales revenue and manufacturing expenses. Forty-six respondents provided their quality costs based on sale revenues. Results of the calculation are shown as follows. The 28 SMEs had responded with respect to TQC that 2.64 percent included prevention costs, appraisal costs (0.45 percent), internal failure costs (1.23 percent), and external failure costs (0.68 percent) [118] as a part of results with respect to COQ. Large organizations with 18 respondents had TQCs of 3-4 percent, including prevention costs (0.45 percent),

appraisal costs (0.35 percent), internal failure costs (1.51 percent), and external failure costs (1.63 percent) for their results based on COQ.

Even though these results are highly conclusive, **there have been several shortcomings in this study. It was not addressed how COQ helps in identifying the areas of focus and also what are the key positions that need to be identified and highlighted for making improvements.** Another shortcoming is that only 63 respondents were chosen, which raises a question whether this low sample can produce conclusive results.

The next paper under scrutiny is the research based on the works of Murugan Ramasamie and Kanagi Kanapathy. The research conducted by the authors was very similar to that of the previous authors [175 and 162], the main difference being the geographic location, which was Malaysia in this case. The organizational composition [162] for the thesis is given in table 3. The authors performed a simple exploratory survey among the manufacturing companies in Malaysia and investigated the difficulties and advantages associated with the COQ implementation. The findings of the study revealed that, only 33 organizations (or 39.3%) out of 84 organizations had implemented COQ reporting system.

*Table 3: Organizational composition and Interviews*

Data Collected from Questionnaire	Information	Data Collected from Interviews	Information
Preparation time	<b>2 months</b>	Interview Period	<b>5 months</b>
Tools used	<b>Google Survey and Kwik Survey</b>	Interview duration	<b>15 – 35minutes (per person)</b>
Purpose	<b>Data collection and Methodology</b>	Technique used	<b>Structured + Semi Structured Interview</b>

Database used	<b>Google</b>	Purpose	<b>Data retention + Cross verification + Methodology verification</b>
Respondents	<b>639</b>	Respondents	<b>21</b>
Fully completed questionnaires	<b>429</b>	Job positions types	<b>8</b>
Needed Sample size (Czaja and Blair, 2005)	<b>384</b>	Industrial categorization	<b>7</b>

Out of 84 respondents, 82 respondents were all involved with quality based management in one way or another. The responses from these organizations were analyzed, to ascertain the difficulties encountered and benefits gained through the implementation of COQ reporting system. 33 organizations during the implementation of COQ highlighted the fact that lack of cooperation amongst the employees was one of the major difficulties. The other most significant problem was the hardships the organization faced in order to obtain the data that is needed for analysis. It is a known fact that every system has both pros and cons. The authors of this research also agree with this theory of having benefits by improving an existing processing terms of the quality of product or the quality of the service. The other important fact was that on implementation of COQ the overall costs due to failure was reduced to a very large extent.

The idea behind this study was to explore the difficulties and advantages encountered throughout the implementation of COQ in manufacturing sector in Malaysia. The research shortcomings that can be highlighted on this research are **whether all manufacturing**

**organizations face the same results. Whether this theory holds good for all sizes of manufacturing organizations and finally is this trend noticed in all geographic locations is an unanswered question.** Since these answers are not very clearly explained in this research there is a need for more in depth analysis, which also serves as a motivation for this thesis.

The final two papers that are being explained are the works of authors Maria Arvaiova and Elaine M. Aspinwall [96] and P.A. Cauchick Miguel and Silmar Pontel [37]. The approach provided by Arvaiova, Aspinwall, Miguel and Pontel were very similar as they all concentrated on the relationships between cost factors and quality factors, under the assumption that COQ was already implemented. The authors claim that the use of COQ affects the usage of TQM principles in an organization. This is also followed by another result which is the sustainability of organizational competitiveness which was never a part of the organizations important factors before the use of COQ. The other authors [112, 140, and 143] even though they followed a similar approach, the use of COQ was generally used to make conclusions on the organization based processes such as defect calculations and how the number of defects reduced with the implementation of COQ. The authors [96 and 37] also conclude on how the warranty costs for the organization reduced with time and how the **failure costs also were reduced with the usage of COQ**. The authors conclude that a **COQ program can lessen the actual cost** and also help in improving the reliability of quality. Henceforth it can be concluded that there is strong relation between the COQ methods that are being considered here and the other techniques that are being used by other authors for different purposes.

There have been several studies [162, 96, 175, 57, 116, 90 and 81] based on previous works done on the basis of Cost of quality. The most significant works have been produced by

the authors [57, 96, 37, 175 and 162] and they followed similar approaches of using the survey technique. There have been several other authors who have other techniques which have not resulted in a similar result as that Rodchua, Arvaiova and Aspinwall [57 and 96], but the reasons identified by the above four authors [Arvaiova, Aspinwall, Miguel and Pontel] are much more contributing as they specify on each segment of their work how they link COQ with cost based analysis and why COQ is being used as cost control method. They also discuss how COQ can enhance the activities in improving the quality of a process. There have been research gaps in the past on how COQ helps in identifying the areas of focus and also what are the key positions that need to be identified and highlighted for making improvements [162].

Along with these gaps present in the existing researches, this thesis will **provide an extensive analysis using a survey based on the various types of industries, different organizational revenues, different employee experiences, job positions and different geographical locations**. This allows forming a comparative analysis on how implementation of COQ affects the different types of environments. This thesis also helps in understanding how the various factors (that affect the implementation of COQ) are inter-related amongst themselves. This thesis allows us to fill the research gaps that are based on the implementation of COQ and the factors affecting the implementation of COQ. Based on the earlier studies performed by Warrendale [58], implementing effective quality cost program has made most companies reduce scraps/rework and costs of poor quality. It also has led to the development of a strategic quality improvement plan consistent with overall organizational goals. Quality cost information is rarely exchanged among businesses [27]. Quality professionals are still trying to determine the main factors and measures aiding in the successful quality cost programs and what problems can be incurred in the quality cost program implementation [166]. The purpose of this study was to

identify main factors and measures that aid successful implementation of the COQ technique.

The three research questions formed on the basis of the above mentioned research gaps are:

**Research question 1:** What are the positive effects due to the implementation of COQ in an organization?

**Research question 2:** What are the problems experienced in implementation of the COQ program?

**Research question 3:** Does the implementation of COQ have variable effects on different factors?

This section is very helpful as it would provide the bridge necessary to close the gaps that exist in the past literatures and also provide the needed motivation behind this thesis and gives an idea on what would be the expected discussions based on the research questions.

## Chapter 4: Research Methodology

There are several research methods that can be used for analyzing questionnaires. The two chief types that should be acknowledged for their experimental value are the **exploratory research** and the **irrefutable research (Using an irrefutable research method is not possible because when using it the research questionnaire cannot give answers in terms of negative issues (i.e.)the person responding cannot give no as an answer. )**. The exploratory variable obtained from the exploratory research can be manipulated by the researcher and then can be validated. This is one of the major reasons behind using this technique in this thesis. What can be observed is that whether the hypothesized dependent variable (in this case the implementation of COQ) is affected by the factors that are present in the questionnaire or not. The experiment (in this case the experiment refers to the questionnaire) possesses a statements or questions that can highlight a particular problem that is to be solved using this technique. The reasons behind why exploratory research can be used for my thesis and is considered better than irrefutable research are highlighted below [79]:

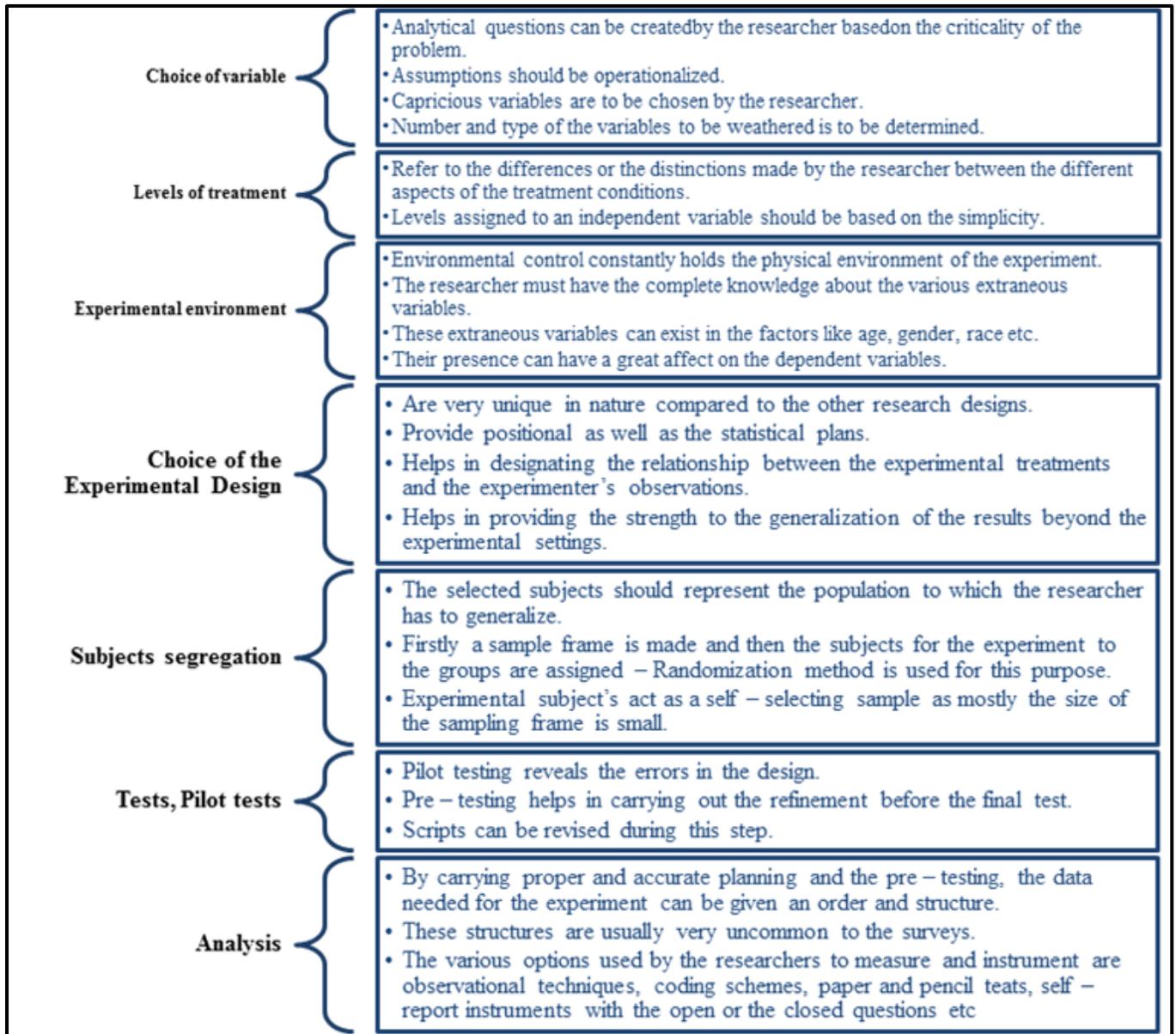
- a) It is approved and validated to be carried out in the real – world environment
- b) The results obtained are bias free.
- c) Is it inexpensive compared to the other experiments.
- d) It is not very time consuming.
- e) It has highly simplified working nature.

Another important reason behind using this technique in the thesis is that while designing an experiment using the exploratory research, the design helps in pointing out the view to ascertain what the experiment is trying to prove (in this case the effects due to the

implementation of COQ) to bring out the needed precise results [81 and 79]. By experimentation using the irrefutable research the complexities are not only growing exponentially with respect to time for preparation of the questionnaire but also the formulation of the questionnaire keeps changing for every few weeks due to lack of consistency [87].

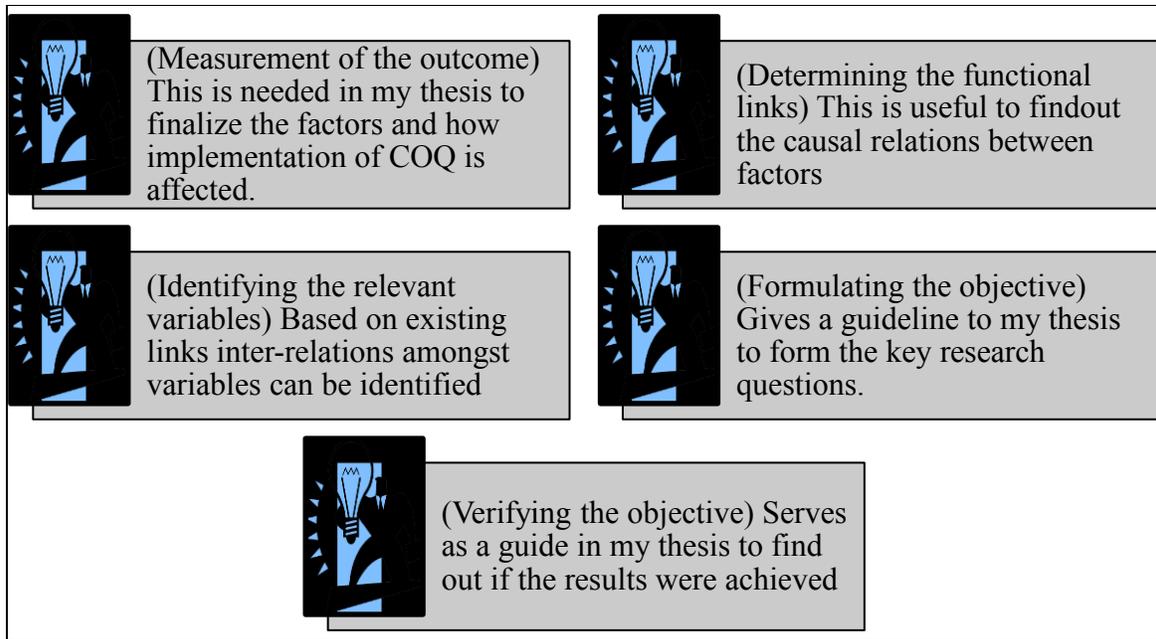
#### **4.1 Steps involved in carrying out an experimental exploratory questionnaire:**

A questionnaire contains of a diversity of the queries printed or typed in an unambiguous order on a form in order to obtain results from the respondents. The participant has to respond to these questions on his own which is helpful in this thesis to avoid bias. The main purpose or the intention of the questionnaire is to amass data from the respondents, who are by and large dispersed in a vast diverse area. This is an important factor for this type of research as we aim to concentrate on a global view. This technique also helps in the gathering of resolute and trustworthy data; hence validation for this thesis is very simple, structured and reliable. Based on the ideas provided by the authors [79, 165 and 172], the basic steps in creating a qualitative questionnaire are specified below presented using figure 5:



*Figure 5: Steps involved in carrying out an experimental questionnaire*

Since this thesis contains exploratory experiments using questionnaires it serves as a best practice to know the objectives of an exploratory questionnaire. Knowing the objective is important in this thesis as the questionnaire would serve as guideline to know the depth unto which questions are needed for analysis; this is shown in figure 6.



*Figure 6: Objectives of questionnaire*

The advantages of knowing the objectives while using an exploratory questionnaire is that [79]; It facilitates in carrying out the handling of the autonomous variables [this is important in my thesis because it helps understand the factors that are primarily affected due to implementation of COQ]. It also provides better effectual control for the spreading amongst the frequently varying variables in the questionnaire [This property allows the questionnaire to explore on the effects due to implementation of COQ]. Another advantage is that it helps in better modification of the variables [in this case the factors that affect the implementation of COQ]. Finally the most effective part is that the experiments conducted can be recurring [Since the questionnaire is generic in nature and needs to be sent to many types of industries it has to have a recurring property]. From the objectives a clear understanding on why we use a specific type of questionnaire for a given problem can be shown [79 and 145]:

Hence from the objectives of a questionnaire we would need to decide on what type to use on the basis of what is the expected result. The structured questionnaire is a series of questions asked to individuals to obtain statistically useful information about a given topic. This is mainly used when working on a social or qualitative research. It is useful in this thesis because I am working on a qualitative problem which has statistical information to be obtained .Hence the **structured questionnaire is the most suitable for the intended research as it** [78] allows the questionnaire to have explicit and tangible questions. The questionnaire is so systematic and is equipped well in advance that the structured format allows the author of the questionnaire to find the number of samples needed to verify the questionnaire. The questionnaire also appends and confirms the data, previously amassed. Finally the questionnaire can be employed in learning the economics and the commercial difficulties that are not found out using the other types of questionnaires such as non-disguised questionnaire or the non-Structured disguised questionnaire (Unstructured Questionnaires are usually formulated around open questions. This is not suitable, as respondents can say what is important to them and express it in their own words and hence has a high level of bias). This technique acts as a great source or a facility for the compilation of the data from the varied and speckled group of people.

#### **4.2 The survey method:**

The major categories of questionnaires used in exploratory research-methodology are made up of “**Specific Survey**” (A survey that usually concentrates only on one particular type of target audience) and “**Sample Survey**” (A survey techniques that has a predefined set or number of respondents to validate the questionnaire). The permutation of these two methodologies form a “**Mixed survey Questionnaire**” that appears as the nucleus of an open ended and close ended

types of questions, and this is used as a tool for investigation in this thesis as we need both types of questions to gather the needed data. According to Kent and Leibesman [86 and 92], mixed survey is a, comparative undertaking which applies systematic method to the study the handling of the related problems and the surroundings. Mixed survey is suitable for this research because it has no definite geographic limit, plus such a spreading of facts, conclusions and recommendations will allows us to craft the common answer that can satisfy most theories and their corresponding actions. Hence a logical investigation using **exploratory questionnaires** is the best choice for the thesis because [92]:

- It allows to create categories while creating a questionnaire (advantage, disadvantage and practicality),
- The approach used to collect the data, is very universally used (Hence can be globally published).
- It is useful in scrutinizing events, people, behavior and conditions while answering the questionnaire.
- The interviews and questionnaire can be considered to produce similar results, since a direct link can be created between the researcher and the respondent.
- It is helpful in assessing the different sectors or types of people, as my questionnaire is sent globally the result set can be considered as unified.

This survey method is a very indispensable for my research as it helps to gather the verification related to the various problems and advantages with respect COQ. The main advantages of using the mixed survey in my thesis instead of specific and sample surveys is because [79]:

- Formulation and assumptions on implementation of COQ can also be considered globally, since data collection is done globally.
- This is useful in my thesis as it can be used to study smaller group sizes (each sector based on demographic data is considered a small group).
- It is very helpful in my thesis as it can bring all the respondents replies to one common database for analysis.
- Mixed surveys help in studying individual problem causing factors, since studying important factors with respect to COQ is a part of the thesis.
- The mixed survey provides a more accurate validation of the data obtained when both questionnaires and interviews are used simultaneously.
- And Finally, Mixed survey is useful in my thesis as it helps keep the questionnaire under control and the bias is highly reduced.

Based on the three types of questionnaire designing it is very helpful to decide on which of the three types is more suitable in the case of this thesis. **Thus we can safely assume that since the problem is a time based questionnaire and it has a very large population as the target audience and the results obtained from the questionnaire help us analyze the problem in hand with the option of choosing interviews if needed makes mixed surveys the best option amongst all 3 choices.**

There are some disadvantages in the usage of mixed survey in this thesis, specifically in the terms of it being exceedingly knowledge intensive [80]. Sometimes delicate unfairness may create variable results and these are associated with an incidence of the non-comeback errors. Since the number of advantages overpowers the disadvantages it is the best technique to be used

in this thesis. Thus the following factors serve as an argument as to why to use the mixed survey with a proper structure as opposed to the others.

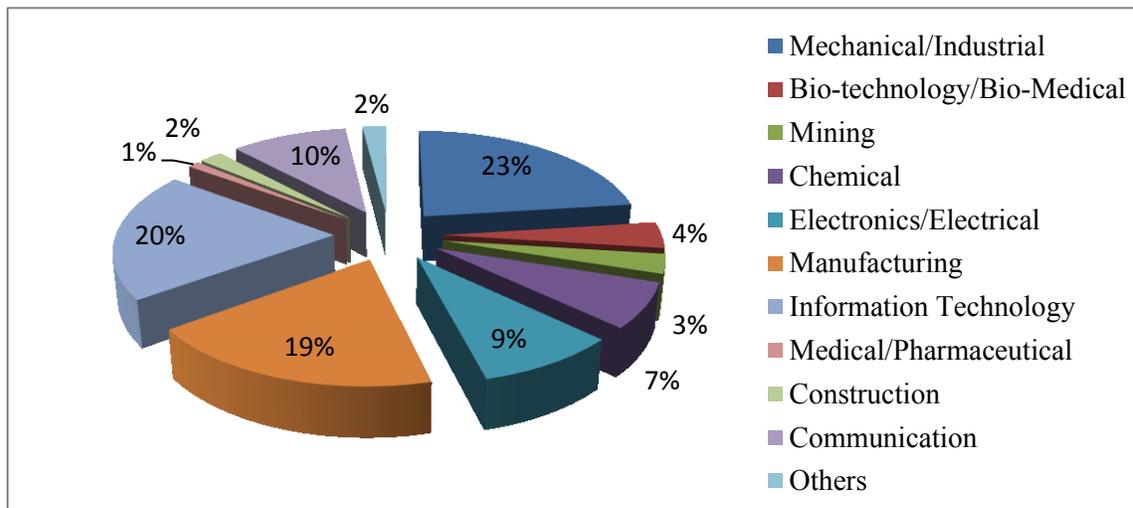
### **4.3 Questionnaire structure and its development:**

The questionnaire created for this thesis was divided into five sections. The first was designed to gather general information (e.g. number of employees, annual turnover, business area) about the participating companies. The second part of the questionnaire investigated whether the respondent companies were certified to use COQ [18] or to any other management system. It also ascertained whether or not they measured quality costs. If not, they were asked to indicate the reasons and were then directed to omit section three. This third section was devoted to the COQ program implemented investigating the reasons for its design, the models being used, the difficulties encountered, the expected and achieved benefits and finally the perceived disadvantages (e.g. increased documentation, duplicities in the costing system) associated with the program.

This section was intended to provide a valuable insight into an organization's COQ program; however, bearing in mind the sensitivity of the area, no confidential data were sought. The fourth section was concerned with the company's general costing system and whether or not it provided sufficient information to support the managers' decision-making processes. Considering the fact that COQ [17] is strongly process-oriented, a further question was added to investigate whether process costing was covered by their system. In the last (fifth) section companies were asked whether they would wish to receive a copy of the survey results, additionally they were offered an opportunity to take part in the further stage of the research. These analyses are usually based on the advantages, disadvantages and practicalities. The whole

scope of this thesis is split based on the ideologies provided by three principal areas of interest as shown in figure 7:

- Advantages related to COQ implementation.
- Dis-advantages related to COQ implementation.
- Practicalities related to COQ implementation.



*Figure 7: Respondent categorization for questionnaire*

#### **4.4 Preparing the questionnaire:**

The preparation of the questionnaire was conducted in 6 logical and orderly phases:

##### **1) Questionnaire design:**

This was the initial phase where the understanding on what was the need for a survey was discovered along with the possible answers of receiving the research questions or objectives with respect to the implementation of COQ in any organization. This period took 4 months of preparation and creation was initially done on paper and then uploaded online using the Kwiksurvey™ online survey system, it was online for about 3 weeks before which the site was

brought down due some uncertain and uncontrollable reasons the site was brought down and this ended up needing to uploading the survey into Google® survey system and some amounts of HTML coding to get the full effect of the questionnaire, the design was unbiased and also the respondents were based on the background that was identified using the demographic data section in the survey.

## **2) Questionnaire dry run:**

The period of dry consisted of exactly 2 weeks and 3 days' worth testing and around 50 respondents of random fields. The results gathered were used to analyze if:

- The size of the questionnaire was acceptable.
- If the questionnaire took more than 15 minutes to complete.
- If the response rate was good enough within a fixed range.
- Cohesiveness of the questionnaire.
- Impact analysis of the questionnaire.

These functions helped understand how the questionnaire was being used if the design was correct and if there was an acceptable range of work behind each of the given needed questions that would led to data analysis.

## **3) Questionnaire analysis:**

From the obtained raw data given by the questionnaire the various values were calculated and the final results were obtained. The demographic data played the most important role in categorizing the questions and respondents. The analysis was based on cross verification of the questionnaire for 2 months using the Pareto principle and the dichotomous questionnaire principle. And eventually the main data was obtained, from which analysis was helpful in increasing the clarity of the major factors that help show the importance of COQ.

#### **4) Questionnaire launch or release:**

The Google® surveys was used to initially send the questionnaire out on an online survey basis and this was most significant as the database was simple and straight forward to use. This corresponding phase was a major part in the methodology of finding the needed data on the long run. This phase was a total of 4 weeks in creation for the online version and making it perfect. There were other tools that were available such as SurveyMonkey© and KwikSurveys™, but the limitations were so high that it couldn't be used on the long run and it had to scrapped from use.

#### **5) Result obtaining and analysis:**

The actual values that were obtained from the data are used in an extensive analysis using statistical principles with respect to the questions and the weighted values obtained from each of the sections. This is then used in a cyclic way to get all the needed results and the values are imported to a table that shows the values for each of the given systems. This is finally converted to data that is workable and can help in finding the primary reasons that would help in obtaining the results based on the research questions.

#### **6) Result estimation on the basis of demographical categories:**

The results obtained can be used to get a more detailed analysis where the respondent's values are correlated to the three research questions and this is made or fed as the raw data for the graphical representation. The graphical representations are used to show the data from the questionnaire and helps obtain a schematic view of how the factors affect the overall output for a given specific set of values. The analysis is based on the weighted factors obtained from the questionnaire.

Based on the above 6 points the idea behind how the questionnaire can be used and how the survey's results can be used to obtain the needed data in order to analyze the research

problem. The following section above helps us understand how the questionnaires must be created to get the needed result.

#### **4.4.1 Data collection using questionnaire:**

The data from the questionnaire is collected in a periodic way, the questionnaire has 3 sections as discussed earlier and this was split into two main forms of questions, the selection between liking and disliking the choices using a simple yes or no format also known as the “**Polar question scale**”. The other type being the gradation form between 5 choices of agreeing and disagreeing also known as the “**Likert Scale**” forms of questions. This forming the basis of the whole questionnaire can be used to find out from all the 64 questions that were used to create the questionnaire, the answers obtained were given a scale of 1 to 5 points for the answers, Strongly Agree carried 5 points and Strongly disagree holds 1 point.

Based on how the respondents replied to each of the questions on the given scale an additive value is given to the whole collection of the questions for each of the respondents. Based on the replies obtained from each, the actual understanding for each of the reasons as to why the implementation of COQ for a given type of respondent works and why it needs certain factors to be present for it to work. The demographic questions present in the first section of the questionnaire are categorized to find the following details that can be used to identify the type of respondent. Also to find out how the cross connections between existing points of focus and also the newly formed ones due to interconnections with respondents form a newer relation amongst those that already exist.

*Table 4: Demographic data categorization*

• The respondent's geographic location.
• Number of employees in the respondent's organization.
• Number of years of experience in the organization for the respondent.
• Number of years of experience in the particular job title for the respondent.
• The respondents Job Position.
• The respondents department in the organization.
• The amount of revenue generated by the respondent's organization.

Before the respondents were allowed to answer the questionnaire they are expected to answer the questions as to whether their organization uses COQ and implements the various methods based on COQ or not as shown in table 4. Based on the reply given by them for this first question the sequence of questions would be altered. The cross checking mechanism implemented in order to get the verification of the answers provided by the respondents and to get the right answers from the respondent in order to get the right analysis for the research questions to be answered.

There is also a provision for the respondent to give his or her own comments in with respect to the organizations way of working with a particular problem and this also helps in finding out the research interest. On obtaining the needed respondents in this case since the scale of respondents is world-wide scale the usage of the Pareto principle can be done to split the total data into two workable halves and the results obtained in one half or the 80% of the data is compared to the results obtained from the 20% of the results. This on comparison if it yields the same answer then the analysis has been given a fruitful result and the final analysis is properly satisfying the needs.

The obtained data from the survey is used to find out the needed results and based on this result the actual data can be used to calculate the identified values for the survey results. This is used making the real observation on the values of the data obtained. This is also verified with the interviews taken from several employees from various organizations and types of industries and also with the experience they have in several organizational exponents such as departments and job titles.

The survey results were gathered from 639 respondents from the several environments and organizations and an additional 32 employees were interviewed from different backgrounds and types [48]. Of the 639 respondents only 27 respondents did not complete the questionnaire and these were neglected completely making the critical value for selected response as 94% and the cumulative response rate is 64% of the total questionnaires sent through the various mediums of social and normal networking possibilities (i.e.) personal interviews. This also shows that the results obtained that the 644 respondents inclusive of the interviewed respondents, using the distribution principle produced by Czaja and Blair [49] when the population presented for the sampling theorem in use the needed sample size in the proportion is around 312 and of which the remaining may be used to check if the results obtained are presenting the same results as those of the 412 respondents as shown in table 4. The ratio of respondents based on the demographic information can have a similar ratio of the available number of remaining respondents and this ratio is similar to that of the 80% of the respondents that were initially analyzed [63].

#### **4.5 Interviewing methodology:**

The process of collecting data using the questionnaires was followed by the interview methodologies. The interviewing technique is one of the best ways to gather data and is highly

accurate and reliable and in this case used as a technique to verify the data obtained by questionnaires. The interviews that were conducted were on a head to head basis and the questions asked were on the same scale as that of the questionnaire. The interviewees were all in all 21 in total and each of the demographic positions were covered and as reliability check the same type of interviewee with a similar job position. This was done simply to cross verify if the person who replied really made sense or was just not giving out the right information. This also served as a practical way to verify the results obtained from the questionnaire that was initially being tested for verification using the Pareto principle.

The interviews were held for a period of 5 months in total, and there were people of various categories and backgrounds who helped in verifying the values that were obtained from previous results. The interviews categorized based on table 5 were primarily based on the questionnaire and followed a very similar pattern of questioning and hence hold the same weightage as that of the respondents who replied to the questionnaire. This helps in maintaining a validation of the existing questionnaires and this also has a needful understanding of which part of the questionnaire has a direct link to the respondent in the corresponding job position for a verifiable sequence in the interviews and the questionnaire. This is thus highlighted using the interviews. Most of the interviews that were held were between 15 to 35 minutes on an average scale and was also done face to face hence the proof of validation and the weighted average for each of the factors is also endowed in the process below. This is as thus is useful to make the correct decisions for any specific needs in the highlighted implementation factors in the field of COQ.

#### **4.5.1 Data collection using interviews:**

The anthology of the momentous data, that is able to work as information at a firm stage of research methodology is inevitability in today's advertising slanting cutthroat world. For this purpose large numeral of methods or techniques is obtainable but verbal method is used very frequently for the compilation of the data is the interview method [78]. According to Vivien Palmar, "The interview constitutes a social situation between the two persons, the psychological process involved requiring both the individuals mutually respond through the social research". The purpose of an interview calls for a varied response from the two parties concerned [78]. This routine acts as a very imperative tool for the collection of the statistics in the social explore as it is all about the direct systematic tête-à-tête between an interviewer and the respondent. By this the interviewer is able to get germane information for a scrupulous research problem.

The primary objectives of an interview [79] are collecting the data – both comprehensively and intensively and exchanging the data and also the understanding. There also several **advantages to the usage of an interview method**. It is a very good technique for getting the information about the multifaceted, expressively laden subjects. The interviewer is able to be straightforwardly become accustomed to the ability of the person being interviewed. Interviews yield a good quality percentage of takings. The technique can yield an ideal sample of the universal inhabitants, and most importantly data composed by this technique is likely to be more correct evaluated to the other methods that are used for the statistical assortment.

**As expected there are some disadvantages to the interview method [79] as they are a** time based intense process which engrosses high expenditure and entails highly skilled interviewer. The interviewer requires additional liveliness adds up to the existing difficulties.

There are possible chances that the interview may every now and then involve methodical errors and as a result make the result more perplexing.

With the use of the obtained from the various employees of several organizations of very large scales and also at various positions that are suitable to verify the results yielded from the survey. This serves as a cross verification to verify the data obtained and conclusions made from them. This is how the verification can be made identical and also made correspondingly suitable for the needed conclusions.

#### **4.6 Using Pareto's principle for data validation:**

The entire idea behind the investigation done for acquiring the needed evidence about the dynamics affecting the realization of COQ in both positive and negative ways was determined by using a questionnaire. The results were cross verified using the **Pareto principle** [80:20 analysis methodology] to find significant impact caused by certain factors and this helped in finalizing the key areas of focus that needs to be highlighted to the organization in order to make the needed changes or control or tweaks in existing methodologies along with the order to obtain the right sequence of work needed to obtain the actual expected output on the long run [87] (refer to figure 8). The questionnaire used in this research is based on 3 main segments.

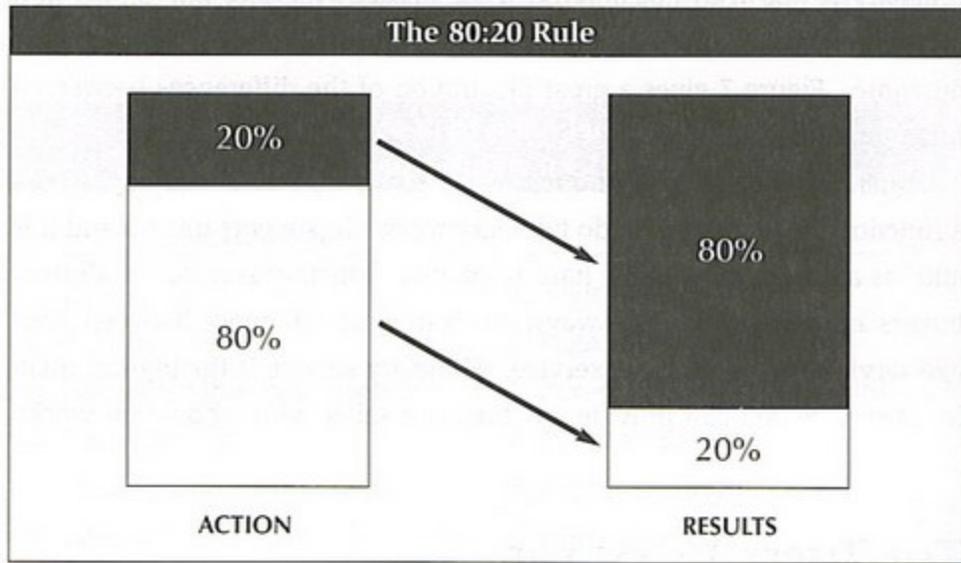


Figure 8: Pareto principle

**Sample Size Formula:**

$$SS = \frac{Z^2 * (p) * (1-p)}{c^2}$$

Where:

Z = Z value (e.g. 1.96 for 95% confidence level)  
 p = percentage picking a choice, expressed as decimal  
 (.5 used for sample size needed)

c = confidence interval, expressed as decimal  
 (e.g., .05 = ±5%)

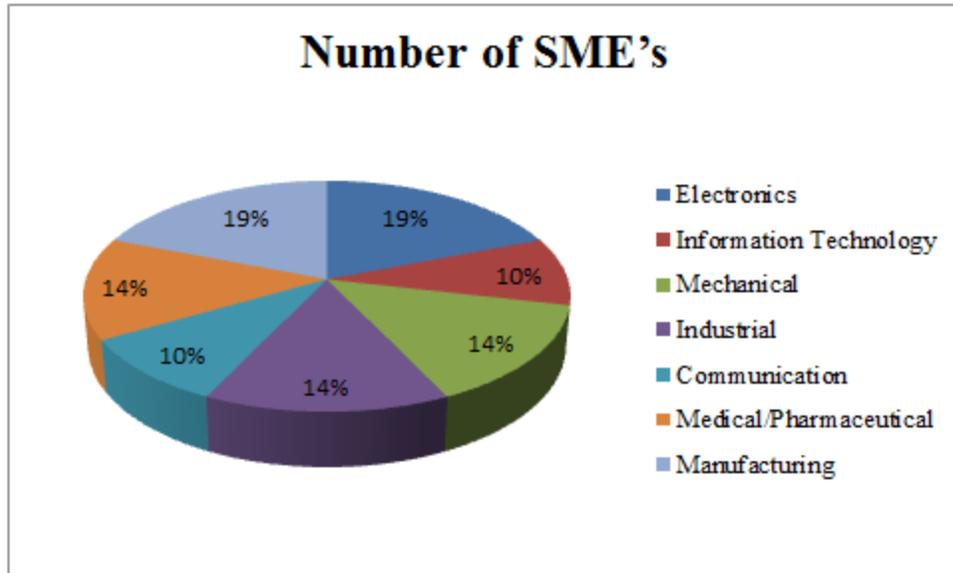
$$SS = \frac{(1.96)^2(0.5) * (1-0.5)}{0.05^2} = 384.16 \text{ (400 responses approximately)}$$

The Confidence interval used is the standard value of ±5% and percentage of accuracy to cover maximum deviation that may occur is chosen at 50% because when determining the sample size needed for any given level of accuracy we must use the worst case percentage (50%)

[49]. The advantage of using the Pareto principle over the other techniques available is that since the questionnaire is split into 3 parts, where the advantage and disadvantage would be exact opposites with respect to factors affecting an organization, the chances of finding 20% of the problems can help us obtain the 80% reasons for the problem. This helps us find out the major causes for the problem and alongside that we can also verify if the 80:20 rule can be cross verified as 20:80 rule. Since the values are exact opposites this kind of analysis would be very helpful in finding out the factors affecting the implementation of COQ [87]. This is true based on the validation ideas provided by a statistical expert who confirmed that using such a technique is valid and correct.

#### **4.7 Procedure to make raw data to fine data:**

The data obtained from the questionnaires is first calculated using the Likert scale values or scores and the added values give the total score for each of the respondents and the total score is found out using the cumulative values for the entire section, which is then added to the final third portion of the values. The values are then tabulated in an excel sheet based on the values obtained. Then the graphical representation of the given values is obtained and the graph is drawn to obtain the peak and pits of the various important points of focus as shown in figure 10. The values for each of the important factors are given appropriate weightage that they make more meaning when they are present with a particular combination of points of focus or critical reasons that change the working of the system. Hence it can be concluded process such as COQ is very capable of doing these changes and these changes lead to positive end results.



*Figure 9: Interview categorization.*

The data once obtained from the survey is placed in an excel sheet to form an order with respect to the various respondents who sent the questionnaires back this can be found out from the time-stamp available at the end of each questionnaire. The data is then arranged based on the demographic questions answered by the respondent and the first question of whether the respondents' organization uses COQ or not. The creation of the questionnaire based on the demographic idea can be seen clearly in figure 9.

Based on the above flow diagram the sectioning of the respondents is done and then the graph is obtained as to find out how many of the respondents with respect to their organizational criterion and this as a result gives a visual representation of finding out whether the respondents reply to the questions is following a similar trait as the rest of the respondents on the same kind of working environment. Below is an example of how the raw data would look like and how once transformed it would shape up into. This also shows how the breakdown can impact the

results for different types of organizations even-though they may be in favor of the implementation of COQ, and the end result may also be the same and at times they may share similar project services but the results actually vary when the need for a particular type of system orientation that manages to give a completely new dimension which form an important area of focus in this research.

#### **4.7.1 Data extraction methodology using the raw data:**

The figure 10 shows how the questionnaire is used to find out the critical factors that are and how the respondents in different departments answer for each question and the data obtained would constitute the raw data for the questionnaire. The raw data obtained is then made to go through other transformations to obtain the fine data that would allow in finding out more details about the factors affecting the implementation of COQ.

Your Department:	Your Current Position	Total years of related experience:	Years of Experience in Current Position:	Your Organization is located in:	Does your company implement COQ	COQ helps a great deal in cost reduction	There are other quality management techniques better than COQ.	Do you know any software for the management of quality?	Do your competitors use COQ techniques effectively?
Accounting	General Manager	1 to 3 years	7 to 10 years	Canada	1	4	5	3	5
Engineering	General Manager	4 to 6 years	1 to 3 years	Canada	5	3	5	4	2
Engineering	General Manager	4 to 6 years	4 to 6 years	Canada	4	1	4	1	3
Engineering	Manager	4 to 6 years	1 to 3 years	Canada	5	4	4	5	4
Engineering	Manager	4 to 6 years	1 to 3 years	Canada	1	3	5	4	5
Engineering, Marketing	Owner	1 to 3 years	7 to 10 years	Canada	1	1	1	3	1
Engineering	Manager	4 to 6 years	1 to 3 years	Canada	2	5	4	3	4
R&D	General Manager	1 to 3 years	7 to 10 years	Spain	3	1	4	3	3
Marketing	Manager	7 to 10 years	7 to 10 years	South Africa	2	1	3	2	1
Finance	General Manager	4 to 6 years	1 to 3 years	China	3	4	1	1	2

Engineering	Manager, Service Related Position	7 to 10 years	7 to 10 years	Korea	1	5	1	5	2
Engineering	Project Leader	11 years and above	4 to 6 years	Germany	4	2	5	1	1

Figure 10: Fine data analytics-Implementation of COQ

Based on the data obtained using the questionnaire the respondent would first have to decide on the first question of whether to choose yes or no as the response the question about whether the organization implements COQ. Figure 11 and 12 explain the discrete changes that exist between the decision of whether the organization has implemented COQ or not. This answer helps us obtain the various interesting factors that are not usually under contention when not considered as a part of the questionnaire. The results obtained from figure 11 and figure 13 are summed up and the cumulative values obtained and the cumulative percentage obtained along with is used to graphically represent the differences and commonalities in ideas between the organizations that implement COQ and those that do not.

Organization Unit:	Does your company implement COQ	COQ helps a great deal in cost reduction	There are other quality management techniques better than COQ.	Do you know any software for the management of quality?	Do your competitors use COQ techniques effectively ?	COQ implementation leads to a positive growth.	Implementing COQ helps create an edge over competitors.	COQ is useful for monitoring quality of the product.	Organizations use COQ technique results as benchmark against other companies.
Mechanical	Yes	2	2	No	2	2	1	1	1
Manufacturing	Yes	1	1	Yes	1	1	1	1	1
Manufacturing	Yes	2	2	Yes	2	2	2	2	2
Mechanical, Manufacturing	Yes	1	1	Yes	1	1	1	1	1
Manufacturing	Yes	1	1	No	1	1	1	1	1
Mechanical	Yes	1	1	No	1	1	1	1	1
Mechanical	Yes	1	1	No	1	1	1	1	1
Mechanical	Yes	1	1	No	1	1	1	1	1

Figure 11: Fine data analytics-Implementation of COQ- option yes

The raw data is presented above in a formatted way and the given raw data is converted using statistical mean transpositions to change them to the needed conversion states and the below set of statistics are obtained from which the following graph is obtained as shown in figure 12.

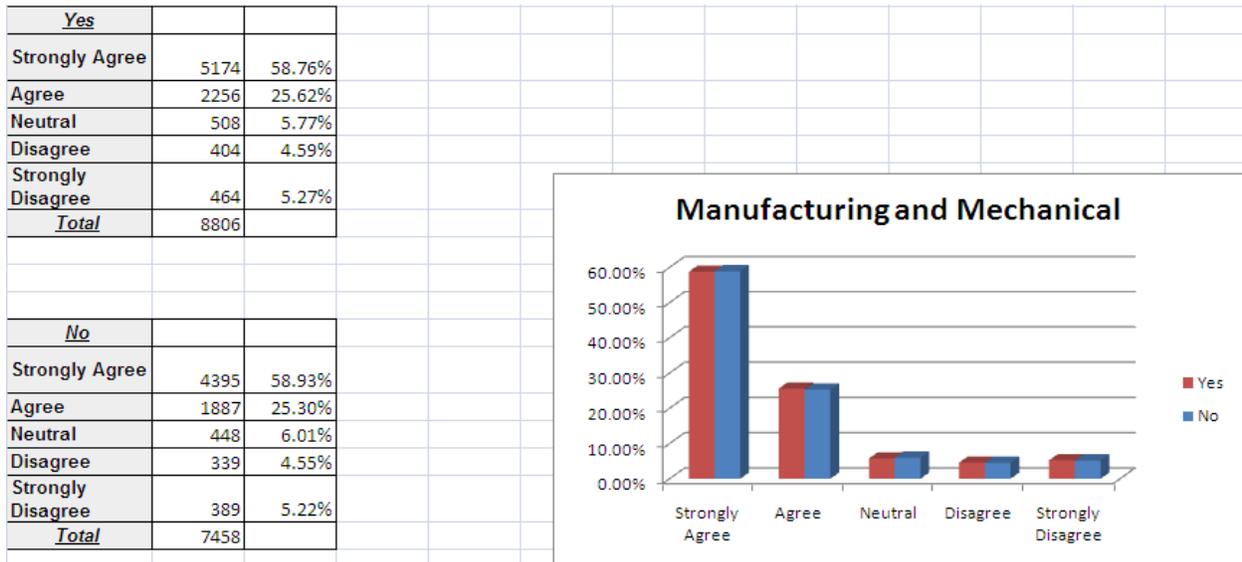


Figure 12: Fine data analytics-Conversion to fine data from raw data

Organization Unit:	Does your company implement COQ	COQ helps a great deal in cost reduction	There are other quality management techniques better than COQ.	Do you know any software for the management of quality?	Do your competitors use COQ techniques effectively?	COQ implementation leads to a positive growth.	Implementing COQ helps create an edge over competitors.	COQ is useful for monitoring quality of the product.	Organizations use COQ technique results as benchmark against other companies.
Electronics/Electrical	No	Strongly Agree	Strongly Agree	Yes	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree
Bio-technology/Bio-Medical	No	Agree	Agree	Yes	Agree	Agree	Agree	Agree	Agree
Bio-technology/Bio-Medical	No	Agree	Agree	Yes	Agree	Agree	Agree	Agree	Agree
Electronics/Electrical	No	Strongly Agree	Strongly Agree	Yes	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree
		Agree	Agree	Yes	Agree	Agree	Agree	Agree	Agree
Industrial	No	Strongly Agree	Strongly Agree	Yes	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree
Industrial	No	Agree	Agree	Yes	Agree	Agree	Agree	Agree	Agree
Industrial	No	Strongly Agree	Strongly Agree	Yes	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree

Electronics/Electrical	No	Strongly Agree	Strongly Agree	Yes	Strongly Agree				
Industrial	No	Agree	Agree	Yes	Agree	Agree	Agree	Agree	Agree
Bio-technology/Bio-Medical	No	Strongly Agree	Strongly Agree	Yes	Strongly Agree				
Bio-technology/Bio-Medical	No	Agree	Agree	Yes	Agree	Agree	Agree	Agree	Agree
Bio-technology/Bio-Medical	No	Strongly Agree	Strongly Agree	Yes	Strongly Agree				
Communication	No	Agree	Agree	Yes	Agree	Agree	Agree	Agree	Agree
Electronics/Electrical	No	Strongly Agree	Strongly Agree	Yes	Strongly Agree				

Figure 13: Fine data analytics-Implementation of COQ- option no

Finally the results obtained from each of the factors of the questionnaire show how each of the departments are affected at different areas. Figure 14 shows the graphical analysis for the various types of departments in an organization and its affinity to implement COQ.

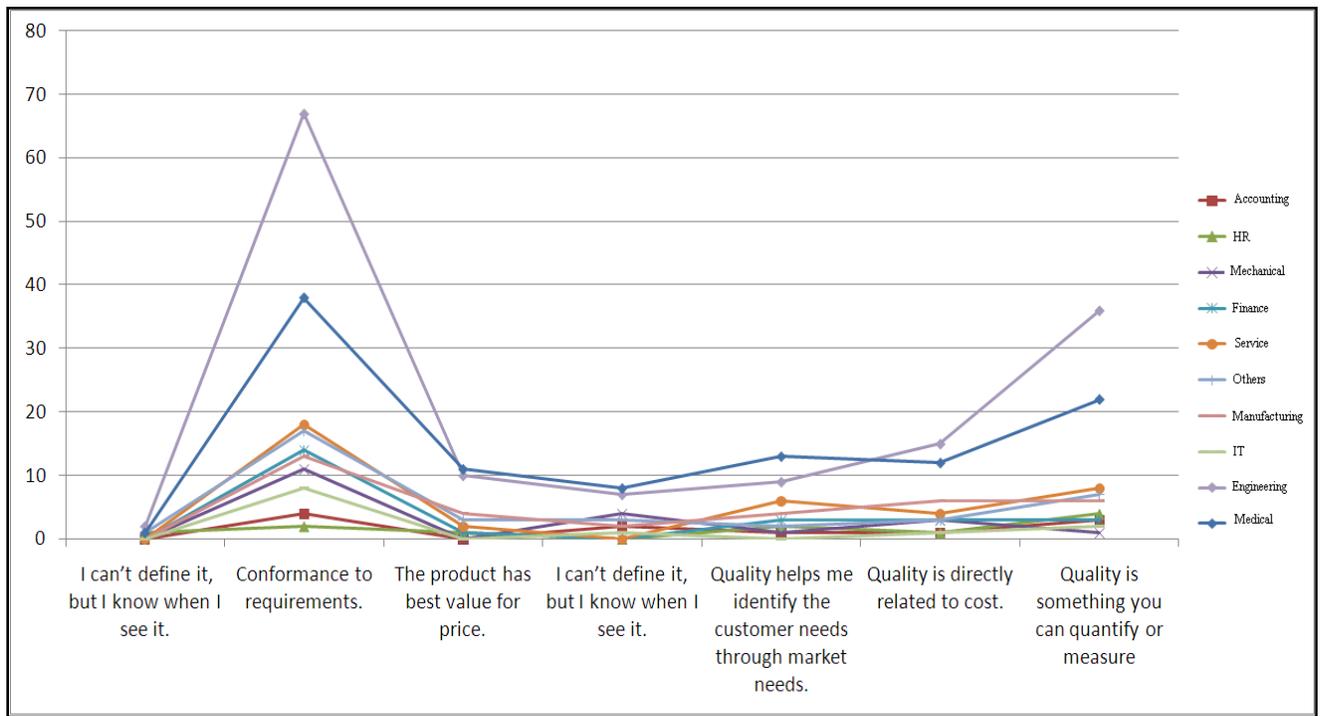


Figure 14: Graphical analysis for a type of organization and its affinity to implement COQ

The graph clearly shows the percentage of respondents of different departments who are for the implementation of COQ in a particular type of industry with the presence of a certain type of revenue and department of work and a corresponding geographical location. This shows how COQ would be treated in a general discussion.

#### **4.8 Vensim PLE representation:**

The data obtained from the previous questionnaire and the converted data obtained from the grouping done with the initial data obtained from the setup placed on the first question of whether the organization uses COQ or not. Along with the combination of interviews to cross verify whether the respondent makes real meaningful contribution to the research and based on all these results obtained from the sequence of results received over time a representation model for each of the different sections of this research-methodology. The Vensim PLE model allows the various factors that affect a particular type of process based model to show the variations that occur when changed under different sorts of possible and logical conditions.

##### **4.8.1 Causal diagram using Vensim PLE:**

The various relations used in the several sequences of possible logic in this situation where the respondent is considered to be from an engineering background and the organization of the respondent is also of the engineering focal points are used to show the basis behind the formation of a causal diagram for this particular segment. The rule of causality helps identify the need for a specific connection or interconnection to be present between two or more factors only to show that. When the business happens in real time there are more than one or several interconnected factors in the relational data obtained that make the reasons for causality even more important and this gives the organization and the respective teams a particular area of focus

to change the way COQ affects that specific area. Also this allows the respondent to concentrate on what is important and spend more on areas to improve the productivity and also achieve what was their initial plan when trying to implement the process of COQ in the initial stages.

The Vensim PLE modeling tool allows making critical changes on such points of focus, in this case when the COQ process is used to build the organizations revenue. There are disadvantages also attached to this reason, such as; the need for documentation of all the changes that are done when the process is implemented based on specific categories of the demographic data. Different levels of job hierarchy are involved in such situations, the overall condition for the organizations work load is increased and as an unwanted non beneficial reason the whole point of generating significant cost benefits is lost. The overall implementation of COQ as a revenue builder is lost and this serves as an important reason as to why the organization may have second thoughts for the implementation. Similarly the implementation of COQ acts a strategic plan builder for the organization and this helps the organization know the reasons behind the faltering on some particular basis. This is then used as a plan to help reduce the waste in the organization and the reasons behind the wastes that are generated in the organization. There are several causal relationships formed using the questionnaire and this is presented in Appendix B. The model is given a three tier spoke wheel model type, where there are 3 categories of factors that affect the outcome of the outcome, which are follows:

- **Factors that cause positive influence on implementation of COQ.**
- **Factors that cause negative influence on implementation of COQ.**
- **Factors that have an influence on the practicalities of COQ implementation.**

The three tier model is interconnected in accordance with the logical connections in the procedure. As explained earlier the Vensim PLE model used here is the wheel-barrow or spoke-wheel model Refer to Appendix A. The first tier are the factors that showcase the practicalities in the implementation of COQ, the next level consists of the negative impact causing factors that usually diminish the chances of the implementation of COQ. Finally the factors that cause a positive impact on the implementation of COQ are found. There are several levels of interconnections that occur within the three levels within these complex networks. This aids' in getting the right probability of logical operations that may occur for an organization and the respondents selection based their reply to the demographic information obtained initially.

This is then followed by the presence of a modulator that helps to vary between the maximum and minimum possible conditions but with the probable logic that make sense from a business perspective. This logic when applied gives the graphical and qualitative representation of the possible results that can be obtained when varying between maximum and minimum values of variation. The variations allowed in the model helps in showcasing the various changes that may occur in the field of study. The various logical options that occur in the procedure are shown in the table 6 below. On using table 6, it would show the various relational logical options that are present for one of the categories of the process in this case for a respondent working in the engineering department.

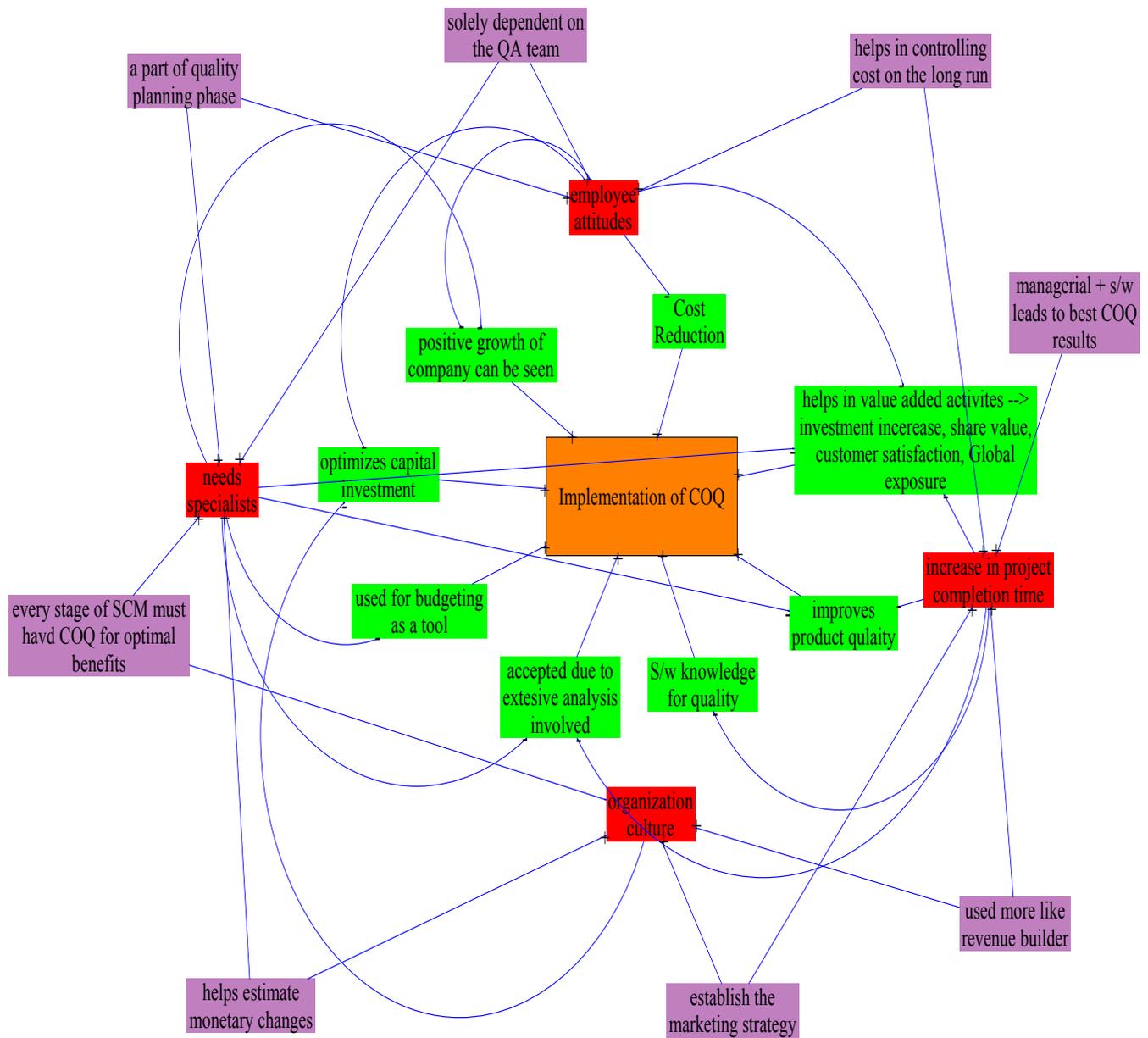


Figure 15: Causal representation using Vensim PLE

Thus we can see that using the spoke-wheel model as a background for the diagrams that are being created using the Vensim PLE tool, and this diagram is nothing but a visual representation of the Cost of quality across the Engineering department (refer to figure 15). The various advantages, disadvantages and practicalities are highlighted in the diagram as it shows the reasons of how implementations of COQ is being affected in an Engineering environment and also the diagram represents how the effect produces some of the most important reasons with

respect to how COQ implementation is affected and affects the Engineering department. This study helps in identifying and studying the gaps that were previously not identified in the works of the authors [116, 28 and 56] .Thus it can be seen from the values that for each factor the values may change and the end result leads in getting the needed value for a particular type of segment based on the demographic data [35]. The similar method is used to obtain the values for every one of the given models created on Vensim PLE modeling. Based on figure 15 the various factors that are placed in the table 6 are present along with other non-significant factors that help in understanding the behavior of the working of COQ in an engineering environment. These factors and their relations will be explained in detail in the following chapters, and as a gist to explain the table below; it simply highlights the various factors that affect the engineering environment based on the questionnaire and the Interviews conducted.

Table 6: Relational representation of engineering department using Vensim PLE

Advantages:	Disadvantages:	Practicalities:
Cost Reduction	lack of knowledge	solely dependent on the QA team
S/w knowledge for quality	employee attitudes	Helpful if a part of quality planning phase.
Competitors use COQ	organization culture	The reliability of the technique is very highly regarded.
positive growth of company can be seen	accounting difficulties increase as more complications add on as the systems are incompatible	company has their own techniques
used for budgeting as a tool	high costs of implementation	has to be done/reassessed/analyzed/tweaked every 4 months
monitoring quality	needs specialists	helps employees assess and know where to concentrate on to increase revenue

Advantages:	Disadvantages:	Practicalities:
Helps improve service quality	lack of knowledge high costs of implementation increase in project completion time	Establish the marketing strategy SCM upstream and downstream.
Helps improve VAS	employee attitudes accounting difficulties increase as more complications add on	More helpful if implemented on both personnel and facility.
Competitors use COQ	organization culture high costs of implementation	Used more like revenue builder helps estimate monetary changes.
Can be used a budgeting tool	lack of knowledge high costs of implementation increase in project completion time	It is a major part of quality planning phase.
Improves product quality	organization culture accounting difficulties increase as more complications add on	Company has their own techniques managerial + s/w leads to best COQ results.
Optimizes capital investment	employee attitudes accounting difficulties increase as more complications add on	Establish the marketing strategy managerial + s/w leads to best COQ results.

The above split amongst the various business based logic shows the various categorical possibilities for the respondent in a particular sequence of responses given by the user on the basis of the demographic information provided in the questionnaire at the beginning.

#### **4.9 Data analysis and Graphical measurements:**

From the obtained results of the causal diagram the Vensim PLE representation model is efficient enough to calculate the changes that may occur in the system. This is also used to highlight how the variations may occur in the graphical representation model, which may

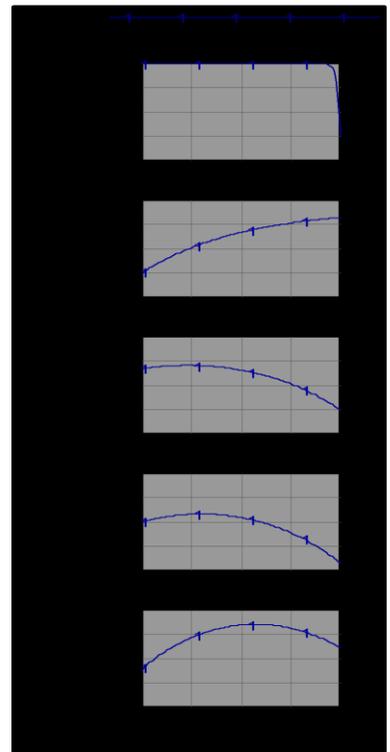
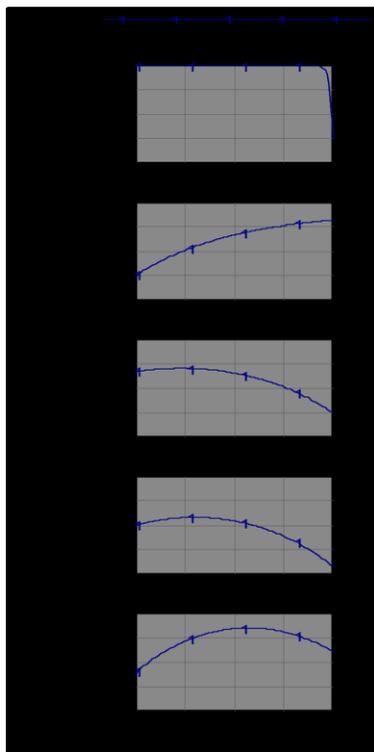
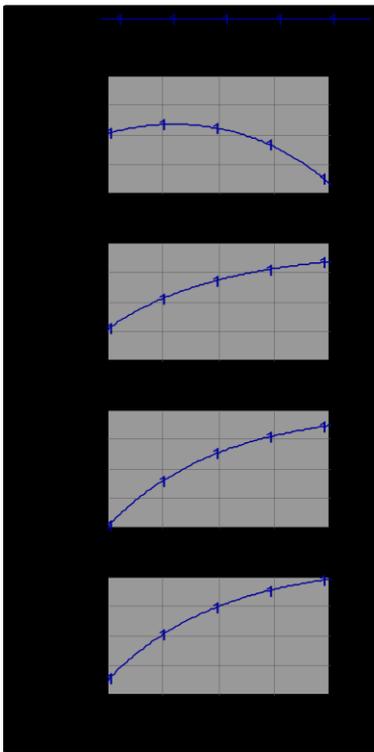
otherwise not be quoted or used as a point of focus that may affect the system while COQ is being implemented. A particular part of the process is very significant. This may lead on to having several forms or types of changes that occur only in that particular sequence of activities that are only responsible in that form or one certain role in an organization and certain type of departments in the organization.

Several analysis tools allow you to perform Causal Tracing. But choosing Vensim PLE for this purpose was very significant due to its advantages with respect to causality. Using Vensim PLE helped me create a causal analysis diagram which shows a selected variable and the variables that “cause” it to change (up to 3 connections distant -which is a limitation of Vensim PLE). Selecting a variable in this loop and using the Causal loop creation tool again creates a causal diagram/loop of that variable. In this way, you can trace the causes (or uses) of a variable throughout a model. A Causal Strip Graph displays behavior for the selected variable and all the variables *directly* connected to it so that you can see which variables contribute which types of behavior , this is a very important property as it allows me to track individual changes across the various sectors under study. Selecting one of these variables and clicking the Causes Strip Graph again traces the behavior for that variable and variables directly connected to it. Hence due to this advanced property I can continue to trace sources of behavior throughout the model. This is mainly why Vensim PLE is useful for discovering which feedback loops contribute certain types of behavior in a model (growth, decay, etc.) and no other tool can provide this analytical feature [176].

Using the graphical model created on Vensim PLE there are two possible options to verify the changes in the graph for the various factors that affect the outcome. In this case as explained

using figure 15 the two types of possible options to verify how the outcome changes when the factors are changed between the maximum and minimum values. The resulting possible behaviors when changed between two values (i.e.) maximum and minimum are as follows (refer to appendix A for diagrams):

- a) **At Maximum:** It is clear that the engineering department is the most prominent user of the COQ techniques as they need to make sure that the organization is doing what it is supposed to do. This also allows the organization to find out where to concentrate for obtaining the right results that are usually the prime concern for most organizations that spend a large amount of money on qualitative perspective of efficient service for the organization. This shows how the organization reacts to the maximum impact felt by the organization for the types of variations that occur in the organization due to the implementation of COQ.



*Figure 16: Graphical results of important factors for implementation of COQ*

- b) **At Minimum:** Similarly the variations that occur when the minimum values are taken into account for the engineering department is shown by the steep reduction in the mentality for the implementation of COQ. This also helps in obtaining the needed willingness towards the implementation of COQ in the organization. Also the current technique that is useful as it shows the various factors that change the idea for implementation of COQ and show the actual changes that would help to get the correct areas of focus of the organization.

The maximum and minimum values are used to obtain the graphs for the various causal diagrams and this is used to show the corresponding points of impact on the results.

#### **4.10 Procedure to obtain the output:**

There are several factors that cause different yet important changes in the model and these are obtained from the questionnaire. The consideration that many factors are placed in a logical connection affects the overall outcome. This also helps in finding out the behavioral response for a particular factor when taken into consideration. This is followed based on a logical and statistical explanation of how to validate and use the factors for getting the weighted scores for each factor in the relationship that exists. As mentioned above since the usage of Likert scale has a significant range and also the advantage of having a fixed range of 5 in the research questionnaire, there is an even value that can be taken for every factor in the process.

#### 4.10.1 Obtaining output using Likert scale analysis:

The general idea of working with the Likert scale is to add the values of the various selected options and create a final score for each respondent or each category of respondents. This score is used to represent a particular type of behavior. This is useful in evaluating the respondents reply as it shows the main ideas or factors that influence the replies from the questionnaire. The scores obtained can be used to create a graphical representation of the results across the population, and for further analysis the mean of the values is taken from the questionnaire can be used to identify the contributing factors. The meaning behind using the Likert scale is primarily because each item in the scale should be closely related to the similar to the topic of measurement so that the overall response is the same.

The idea of using the Likert scale could be used amongst the two types of scales the 5 point scale and the 7 point scale. The use of 5 point scale overpowers the usage of the 7 point scale in this thesis as the ordinal relation between the continuously linked factors simply makes it more complex for the respondents to use the neutral answer to any effect. The granularity of the questions is affected and this makes the overall system even more complex than is already is. According to the Colman and Norris [173], this approach encompasses multiplying each 5-point mark by the percentage  $7/5$  to scale it up to a corresponding 7-point score, or enlarging each 7-point score by  $5/7$  to scale it down to a comparable 5-point score. In every scaling method, the first step is to find out what is to be measured. The Likert scale is most prominently used when a question has two or more possible responses, (we consider this format as **dichotomous**). Surveys often use dichotomous questions that ask for a Yes/No, True/False or Agree/Disagree using the Likert scale of response. Because this is a one-dimensional scaling technique, it is understood that the data collected is also one-dimensional in nature. It is also possible to operationalize the

description of the difficulty as an instruction to the respondents who are going to form or produce the preliminary set of entrant items for the five point scale.

Even though the factors may have different effect, the grouping of the three types of factorial elements based on the author [157 and 158], they can form a fractional difference to the overall output and hence they form the following type of response outputs as shown in table 7 when being graphically represented. The reason being a questionnaire is dichotomous in nature, this forms the main reason as to why the linear relationship between the questions in the questionnaire and the factors affecting implementation of COQ can be evaluated using a mixed survey that is dichotomous in nature. With a conversion of the questions using the design weight system produced by the dichotomous system would lead to getting the questions to be transformed into close ended questions that have a 1 to 1 relationship.

This significance leads to understanding that each factor can have its own value and when added together with consideration of the number of respondents in that particular category, the actual impact is obtained. The design weight is based on the three types of questions (i.e.) the positive impact factors, the negative impact factors and optional factors that may have both positive and negative outcomes [49].

These three factors in correspondence with the number of respondents and having in mind that each respondent could choose one of the five possible options on the Likert scale gives the possible weighted design procedure more validity as shown in table 7 and 8. This in-turn gives the data a proper validation as to detect the reasons behind the factors that affect COQ implementation. This may be represented using the tables 7 and 8 as the factors each carry a certain value and they have weights that add to the overall value. The respondent size is then

multiplied with the respondent size and factor weight to get the absolute weight of each factor for the overall analysis of the questionnaire.

**a) Sample Calculation based on causal relationships based on departments:**

*Table 7: Design weight factor analysis*

Factors		Weighted Value		Respondent size		Affecting value at 100%
Positive impact factors	x	0,+1,+2,+3,+4,+5	x	No. of respondents in a particular category	=	Absolute weight for each factor
Negative impact factors	x	0,-1,-2,-3,-4,-5	x	No. of respondents in a particular category	=	Absolute weight for each factor
Practical positive or negative impact factors	x	0,+/- 1,+/-2,+/-3,+/-4,+/-5	x	No. of respondents in a particular category	=	Absolute weight for each factor

*Table 8: Design weight factor sample calculation*

Factors		Weighted Value		Respondent size		Affecting value at 100%	Percent value
Cost reduction.	x	$0*34 + 1*12 + 2*23 + 3*17 + 4*92 + 5*114$		1047		0.36	36.22%
Lack of knowledge.	x	$0*12 + 1*8 + 2*9 + 3*45 + 4*51 + 5*39$		-560		0.28	27.64%
Accounting difficulties increase as more complications add on.	x	$(0*1 + 1*18 + 2*21 + 3*18 + 4*26 + 5*41)$		-423		0.22	21.88%
Should be implemented on personnel and facilities.	x	$(0*3 + 1*9 + 2*17 + 3*8 + 4*82 + 5*47)$		630		0.14	14.26%



Then the second step is to collect data and transform it to useable format to make various discussions based on these factors. This step can also be used to find out how the factors affect the overall implementation of COQ using the 80:20 rule. The final section describes how to use the data obtained to create the graphical representations using the Vensim tool and how the tool can be used to pictorially represent the various issues while implementing COQ. The several advantages of using this technique and results based on using this technique are highlighted. The appendix contains a list of all the diagrams created.

The causal relationship between the various sectors is shown in this section and the inter-relationship amongst the several factors is significantly shown using the diagrams. This is helpful in making conclusive results that would be discussed in the next chapter. Hence this section serves guideline to understand the working knowledge about what happens to the organization that is trying to implement COQ and how it fares in terms of sustainable business.

## Chapter 5: Results and discussion

The results based on the data collected and the analysis made from them can be split into 7 different segments. It would be more appropriately set out as the study on the factors that affect the COQ implementation based on the following 7 critical areas of study, which are as follows:

- Various types of organizational **Departments**.
- Various types of organizational **Job Title**.
- Various types of organizational **Revenue**.
- Various **Workforce sizes**.
- Various **years of Experience**.
- Various types of **Industries**.
- Various **Countries**.

Based on the study done by previous authors and also the research gaps that are specified from their studies, the results in this section will throw some light on the factors that affect the implementation of COQ under various circumstances which are based on the demographic questions earlier posed in the questionnaire. All the analysis that has been performed based on the questionnaire prepared and the personal interviews taken with several important personnel within the organization. Also by taking into account the various comments received while data collection for the questionnaires the following were the conclusions obtained from the field of study and various areas of focus. The point to be noted here is unlike the fuzzy thoughts of

people and how they usually interpret COQ and its implementation to be, the actual results are far more complex than what they perceive.

Based on the first question in the questionnaire we can decide on the number of organizations that actually know or have implemented COQ in one way or another, the demographic question answers to the question “Whether your organization uses COQ or not”. Which has two possible answers and this comparison can be used to show the knowledge people have with respect to COQ. The table 9 gives a general idea on how implementation of COQ is split amongst the different types of industries.

*Table 9: Implementation of COQ amongst different types of industries*

<b>Type of industry</b>	<b>Yes%</b>	<b>No%</b>	<b>I don't know%</b>
<b>Mechanical</b>	<b>63</b>	<b>22</b>	<b>15</b>
<b>Industrial</b>	<b>69</b>	<b>20</b>	<b>11</b>
<b>Bio-technology/Bio-Medical</b>	<b>77</b>	<b>18</b>	<b>5</b>
<b>Chemical</b>	<b>54</b>	<b>31</b>	<b>15</b>
<b>Electronics/Electrical</b>	<b>62</b>	<b>21</b>	<b>17</b>
<b>Manufacturing</b>	<b>63</b>	<b>25</b>	<b>12</b>
<b>Information Technology</b>	<b>71</b>	<b>21</b>	<b>8</b>
<b>Construction</b>	<b>59</b>	<b>32</b>	<b>9</b>
<b>Communication</b>	<b>44</b>	<b>39</b>	<b>17</b>

This table is very useful as it shows a general idea on how vastly COQ is used and how many people within the same domain do not know about it or fail to recognize it. This can also be used to compare the work done by Dr.Rodchua [57] where she compares only the

manufacturing sector using 63 respondents and obtains 74% for the respondents who knew COQ and 26% who did not know COQ. Since the ratio of data obtained is very similar to that of the previous works, it can be considered that the data obtained is valid enough to obtain conclusions (refer to figure 17).

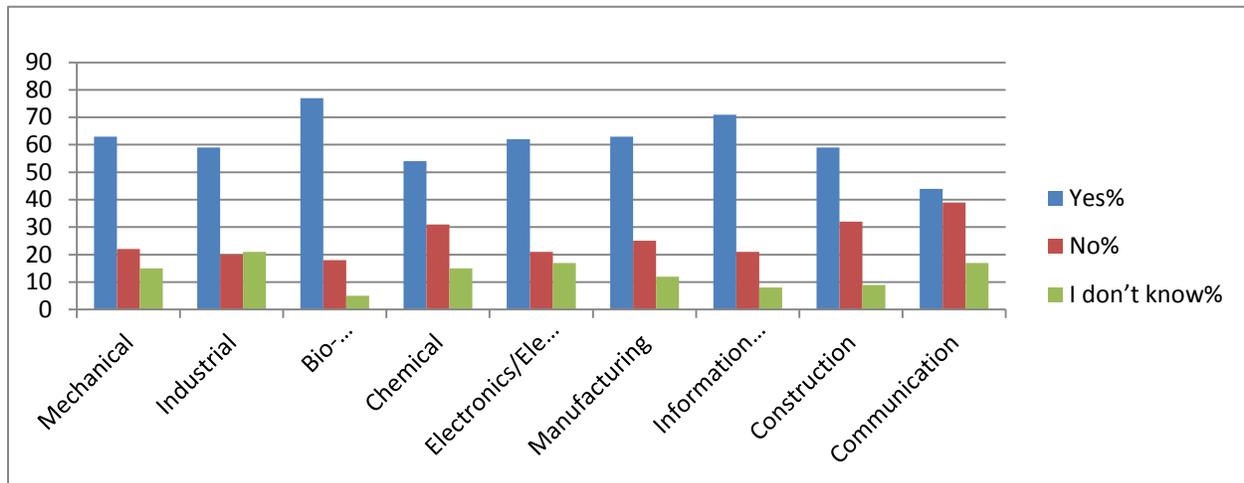


Figure 17: Graph for implementation of COQ amongst different types of industries

Table 10: Implementation of COQ amongst other categories

Department Type	Yes%	No%	I don't know%
Finance	69	22	9
Sales	82	12	6
Accounts	71	23	6
Engineering	91	4	5

Type of industry	Yes%	No%	I don't know%
Top Level Management	79	15	6
Bottom Level Management	68	27	5

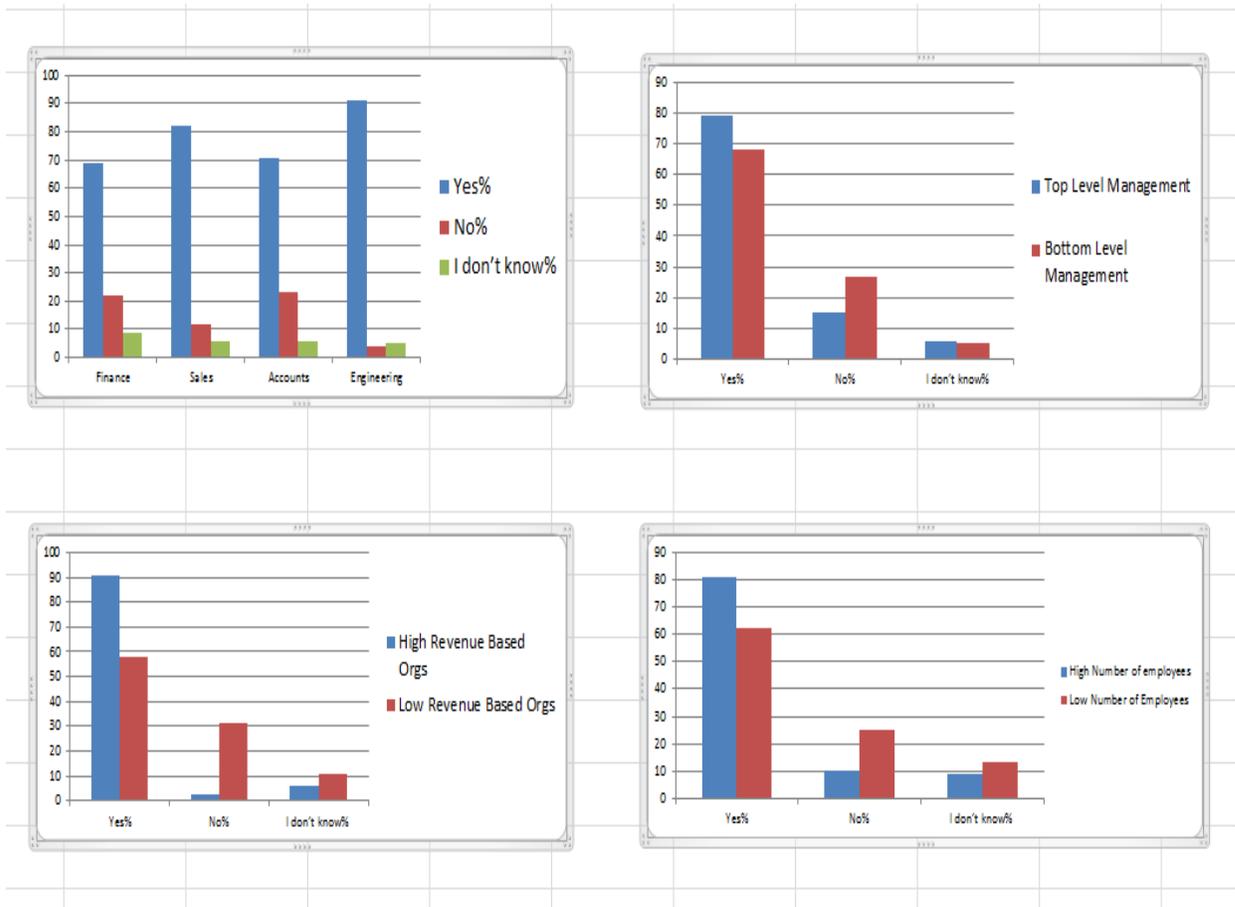
  

Type of industry	Yes%	No%	I don't know%
High Revenue Based Orgs	91	3	6
Low Revenue Based Orgs	58	31	11

Type of industry	Yes%	No%	I don't know%
High Number of employees	81	10	9
Low Number of Employees	62	25	13

Similarly the other factors such as department type, country, number of employees, job title and revenue also have a similar type of data representation on the knowledge of COQ (refer to table 10). It is represented using the tables and graphs below. They cannot be discussed as per the discussions conducted on types of industry as there are no existing researches based on this idea. Hence it forms an important part of my contributions (refer to figure 18).



*Figure 18: Graph for implementation of COQ amongst other categories*

Here in this research the various focal points are individually split and taken into consideration and individual analysis on points of high critical influence and the various negative aspects that usually end up creating hindrances to the implementation are taken into account for

the ignominious amounts of money. Based on an interview from a CEO of a major telecommunication company, time spent on finding out if there is a particular proved method which would aid in implementation of COQ in the best possible manner, which would satisfy all the amount of money spent on trying to improve quality is a completely misinterpreted concept. The following are the various points of impact that have to be noted and taken into consideration while implementation is taking place.

### **5.1 Impact on factors that affect the implementation of COQ with respect to organizational departments:**

**[Note: All the following conclusions and results are based on the Interviews and Questionnaire]**

From the Vensim PLE modeling tool we can discuss the following based on types of departments and the effect of COQ implementation on the various departments (Refer to Appendix: A figure 7). Based on the selection of the following departments on a broad scale, we can find the following reasons as to why certain departments are more inclined towards the implementation and why some are not. The following departments are: Accounting, Marketing, Research and Development, Engineering, Finance, Human Resource, Sales and Other departments.

1. According to an SME from a leading accounting and taxing firm, the Accounting department is not very inclined to the usage or implementation of COQ as the department. The employees feel that it falls as an extra amount of burden on them and has significant amount of expenditure in terms of time, which in turn is money for the organization (refer to figure 19). This leads to a conclusive feeling of why the Accounting department may not be very much drawn towards the usage of COQ even

though they hold the key reasons as to which are the significant areas to implement COQ and help the organization benefit from the whole process.

The other reasons as to why the Accounting department is not up to the task of implementation of COQ are the enormous amounts of documentation involved in every phase of the COQ implementation. Also the large amounts of data analysis and their respective documentation needs for each level of COQ implementation (Refer to Appendix: A figure 7 and Appendix: B 19). This ultimately leads to the key reasons as specified above the wastage of time and money even though COQ might lead to significant amounts of financial gains. This risk may not be worth it for the accounting department.

2. The Marketing departments representatives are the people who not only implement COQ but also see the various effects caused by it due to its presence and due to its absence (Refer to Appendix: A figure 7 and Appendix: B figure 20). They are able to portray the importance in terms of advertising capabilities and also help out in turning the efforts into monetary gains. This is why the Marketing department is very intrigued by the COQ implementation (refer to figure 19 and 20). Also the various needs for organizational commitment towards finding the needed resources and the efforts for any process (processes with regards to the quality of a product or service) is easier when, COQ has been implemented in the organization.

According to a marketing manager from a leading marketing company, the Marketing department also emphasizes on the fact that COQ implementation shows a level of quality or characteristic difference between the competitors. This simply helps

the organization to sufficiently benefit from the knowledge of people. Also we can conclude that the purpose of using COQ as a beneficial process is to reach the organizations financial goal. This gain must also include the expenses related to the quality process that has led to the implementation of COQ.

3. The Research and Development department are generally not responsible for the implementation of COQ or any other business intelligence based idea. In any company if the need arises as they have a technique tried and tested, it is usually the R&D department but techniques like COQ cannot be tested or proved to perfection as the conditions vary across the period of time and a project. It may be known exactly where to implement the technique and how to do it with least wastage and maximum gain in monetary significance (refer to figure 19 and 20) but there is no proof unless there is a real project that can execute it. The R&D department needs to know by experimental and risk based analysis of finding how the COQ technique would help the system grow.

According to a head hunter from a leading hiring firm, the R&D department also focuses on the fact that unless there are experts who actually know the facts of the COQ technique it is highly difficult to implement the technique (Refer to Appendix: A figure 7 and Appendix: B figure 21). Also the whole idea of where to implement it and how to implement is important, but it is important to make it significant and effective or gains are completely lost due to the overshadowing of the cost involved (with respect to implementation costs). The system as whole fails when given a test run. So the R&D departments play a vital role in this area.

4. The Engineering department is the most important department in the implementation of COQ they are generally affected by every other department as they are not stand alone (Refer to Appendix: A figure 7 and Appendix: B figure 22). All the factors for every department need to be seen and verified for the engineering department before taking decisions (refer to figure 19 and 20). According to an SME from a leading engineering firm, the implementation of COQ is primarily revolving around the facts as follows:

- a. Increase in difficulties as complex activities grow is a significant reason for the difficulties in implementation of COQ. This is the main reason as to why certain organizations opt to not use COQ, while some process oriented organizations use it. The point of using new techniques and increasing the complexity of a simple process by many folds even though the end result may not be the most effective one is an important reason for the engineering team to decide whether they need to use the technique or not. This is easily highlighted as the reason for the Engineering team to work and decide upon.
- b. Incompatibility of the existing system is always a problem for any system or any process the Engineering team needs to get the whole process redefined. Also understand how the process is affected if the difference between the existing and current process ends up accumulating on time and monetary expenditure in an exponential manner as it is evident that all changes will cost money. It is only the range or need for maximal or minimal needs that the engineering team needs to decide on for the fact of the process to go through or not.

The incompatibility usually leads to re-engineering processes which most organizations do not wish to implement as they feel that the process that are tried and

tested are simply being wasted. Experimenting with a new technique that may not be just as good as the existing one is a big risk. With the presence of this risk, the effort being invested on implementation as a result the top level management pressure may not be most fruitful at the end of the tenure(refer to figure 19 and 20). The engineering team needs to go around with high levels of brainstorming needs analysis and technical expertise advice to get the right balance between expenditure and savings.

- c. The engineering department uses the technique mainly to find the root cause and how to deal with certain technical problems. They also use it to find fixes for issues, and also how to get the optimal solution for finding the needs and the resources for any given system. But the engineering team must also go through the fact that COQ does not always reveal the root cause of the system. This is a reason as to why COQ implementation is often not taken into consideration as to how to find the problem in a system and how to curb them before they grow as the COQ may only highlight regions to focus on and not show the actual reason behind the problem. This is the reason as to why root-cause analysis does not hold good with COQ analysis and this in turn leads to more amounts of time and financial waste in a gradual incremental order.
- d. Increase in the need for a comprehensive quality system is a severely high profile problem in the Engineering department because the department must know how to analyze the problem. The process of seeing to that problem does not recur, the patching up of existing problems does not hold well with COQ methods. The quality system that is involved with it needs a complete refurbishing and also needs to be overhauled of its exiting issues. This usually leads to many folds of increase in the financial bonds and technical know-how of various quality experts are put to test here. This leads to the

understanding of how and why the quality system must be compatible and of the highest technical update in order to satisfy the needs of the customer.

This usually leads to the rise in expenditure and also in intricate relationships with the existing system that may lead to ample. The corresponding changes to existing systems this leads to the need for quality experts and that in turn leads to merging of new and old models of a working system. This makes the compatibility issue even more severe and more important than most of the other problems as it may lead to some of the biggest shortages on the short term and also lead to long run irreversible failures.

- e. Prioritizing actions is an issue that most teams face but the engineering team has this issue mostly due to the fact that when the changes happen in a simultaneous. In a continuous manner the priority is usually not the most important thing on the engineering front but with the implementation of COQ the priority of certain actions are more than just time based actions. It becomes more of a significant approach to find out what is to be done in an optimal manner and at what time to get the maximum benefits for the process as a whole.

Even though prioritizing is an important system defining process the problem that usually occurs is when there is a breakdown in routines. Automated processes are usually done with minimal human control and the COQ implementation in these processes is usually minimal as it is not worth the extra effort. On falling to a breakdown usually leads to re-engineering of the whole process and making that process top priority and as a result leads to temporary delays. More need for human resources in that particular period

for that particular quality-less process. This is usually tried and avoided by the engineering team on the long run once COQ is implemented.

- f. Cost efficiency has always been the major concern in any COQ process everything that is tried using COQ needs money and needs efficient spending of the whole technique as a complete process, rather than an individual process and it is understood that on the long run COQ may grow exponentially (refer to figure 19 and 20). This causes major amounts of expenditure which is the major concern for all top level managers and management personnel. This usually comes back falls on the quality planning and financial department due to negligence on the proper forecasting techniques that may have led to other better techniques.

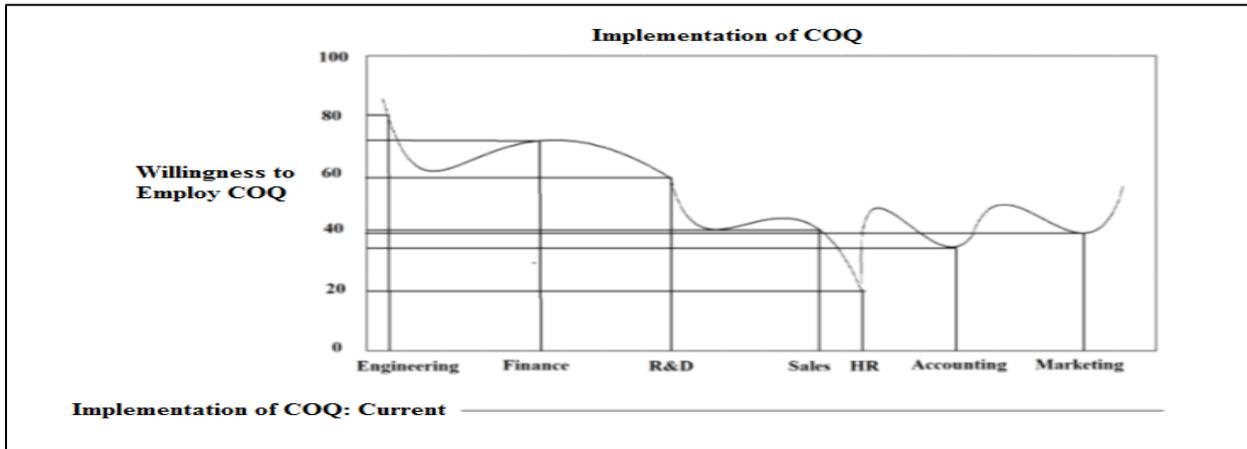


Figure 19: Graphical results representation of engineering department using Vensim

But there is ample proof that COQ is not a technique that leads to immediate success but needs it's time to grow into all the processes. This lets the organization as a whole understand where to concentrate the focus in terms of quality actions in order to get the COQ implantation the expected text book success. It can be understood that the

costs with respect to implementation of COQ grows exponentially, but at the same time there are possibilities to reduce the cost and improve the overall advantages with respect to COQ implementation.

Cost efficiency not only leads down to reduced spending and also the returns in man hours and in efforts by COQ personnel. Also it helps in understanding how and why the various systems may be affected with time as the complexity increases. This has to be calculated by the accounting and the financial/quality analysis team in order to get a close enough assumption on the expenses that may be incurred with time.

5. The Finance department forms one of the most important parts in the system and has a major influence on how the COQ system is actually implemented (Refer to Appendix: A figure 7 and Appendix: B figure 23). It is also the main reason finders for deciding on the implementation of COQ (refer to figure 18 and 19). There are two primary scenarios in the main scale, which are whether they wish to implement COQ or not. The final decision has always from various cases (based on interviews and literature review) been proved that the organization decides to implement COQ only if the amount of benefits is significantly higher than the efforts put in and is of immediate effect and not a long term goal. They usually want immediate results, which means that COQ would not be ideal for organizations that thrive on short term functioning and results.

This is how the most important scenarios are usually shown and decided upon as the financial department knows the areas to focus on. Based on an interview from a CEO of a banking firm, the implementation of COQ also allows the organization to have a genuinely sufficient time interval as to decide on when to implement a new technique like

COQ. The other reason being, a given system can be simply adjudicated on a common understanding rather than specific area defined expense, always leads to increase in cost for all the other areas that follow it and also lead to loss in employee functioning processes.

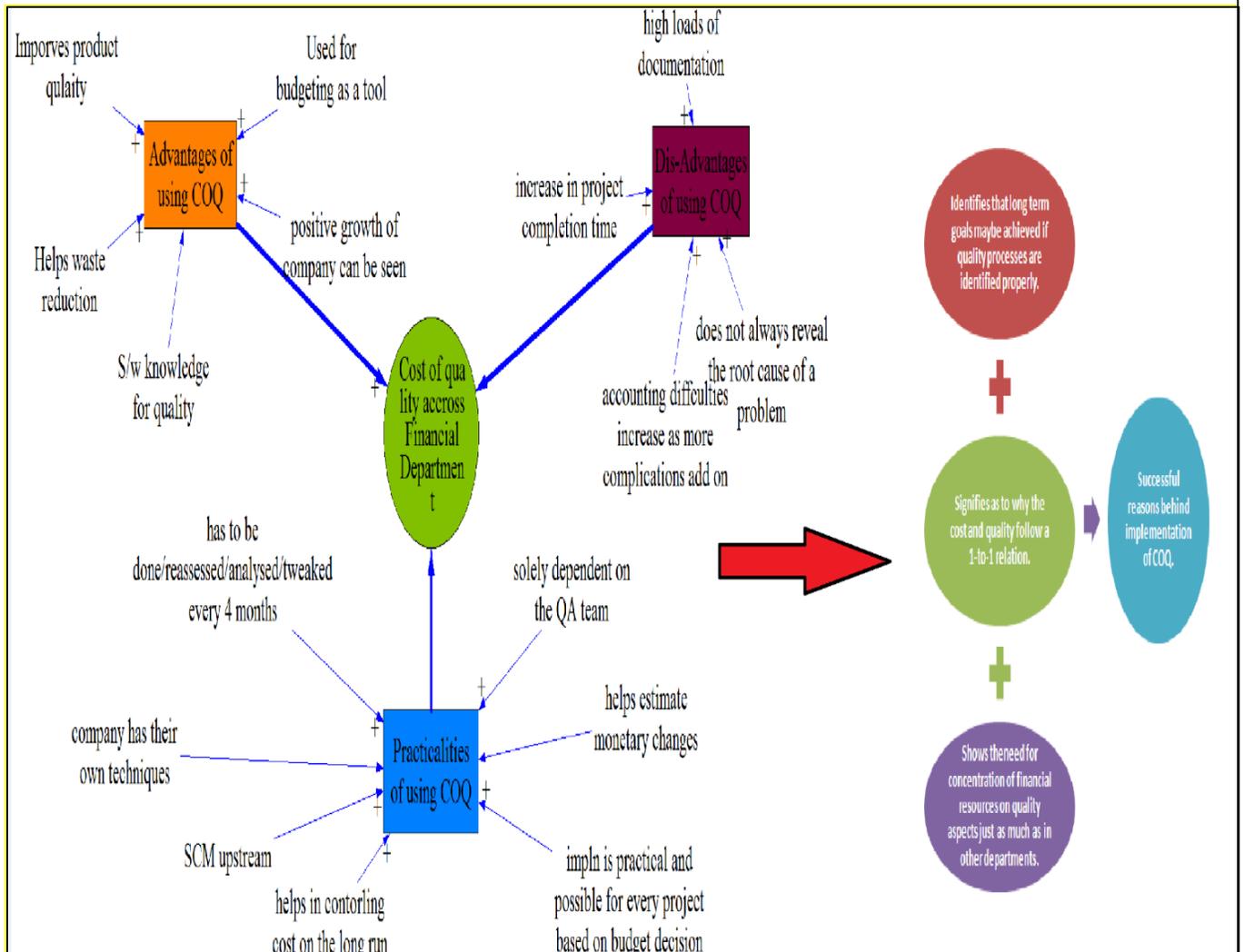


Figure 20: Causal representation for finance department

- The Sales team generally thrives on the fact that if COQ is implemented, they use this as a purpose to show the clients in the outside world why their product is much better than

other products (Refer to Appendix: A figure 7 and Appendix: B figure 25). The same works for service oriented organizations too. The predominant point to note in the sales team is the need for COQ to be at the best possible level (refer to figure 18 and 19). According to an SME of sales based organization, not just in basic or intermediate levels, as the competition is usually very high in some products and COQ plays a game winning role in portraying the product to be one of a kind and also a major contribution to the sales. They usually form a mixture of the client's environment and employee and organization work culture into a common blend that helps in finding out winning combinations that allow the organization to reap maximum benefits from implementing COQ on a regular scale (refer to figure 21).

Since COQ, unlike other processes is long term in nature; the improvement process always allows more space for further changes that occur in the process with respect to time. We can casually say that the sales team uses the COQ as a tool to showcase and highlight the entire system as an error free process. Cost effective work domain categorization helps in revenue building of the organization and helps in loyalty and customer relational augmentation.

7. Human Resource is by far one of the most complex departments to work on based on implementation of COQ (refer to figure 19 and 22). The basic workers mentality is usually to finish the work as fast as possible irrespective of how the outcome may turn out. According to an HR from a leading aerospace company, since the implementation of COQ has come out into the light, this has become less common as all the process now follow a standard procedure and must have a basic amount of work done

before it can be sent outside for production (Refer to Appendix: A figure 7 and Appendix: B figure 24). This in turn has led to greater amounts of documentation and longer work periods and this in turn has led to the workers' unhappiness due to overload of work. The upper management emphasizes on the COQ techniques due to:

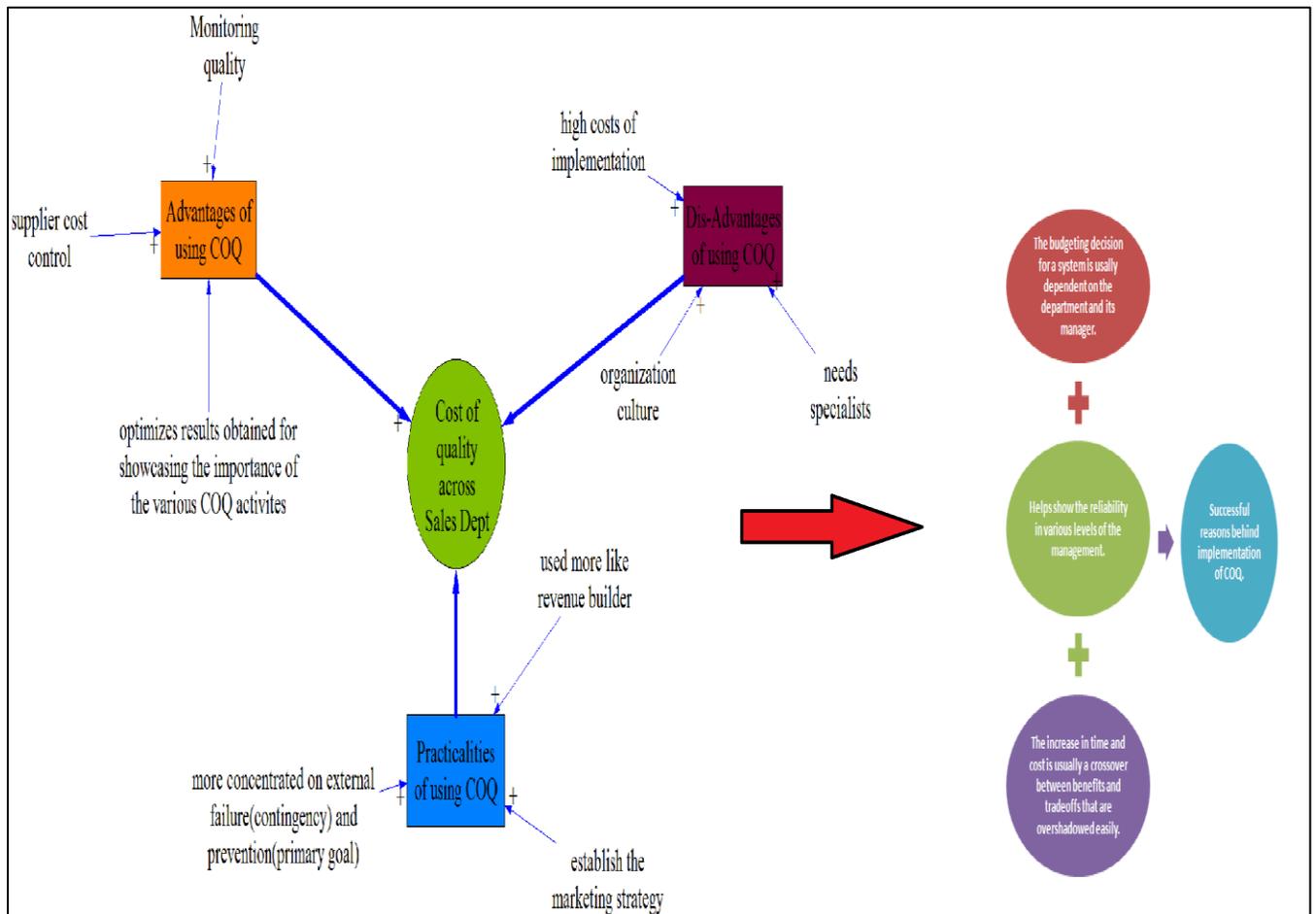


Figure 21: Causal representation of sales team

- a. Financial gains.
- b. Error free routines.
- c. Minimal recurrence of older problems.

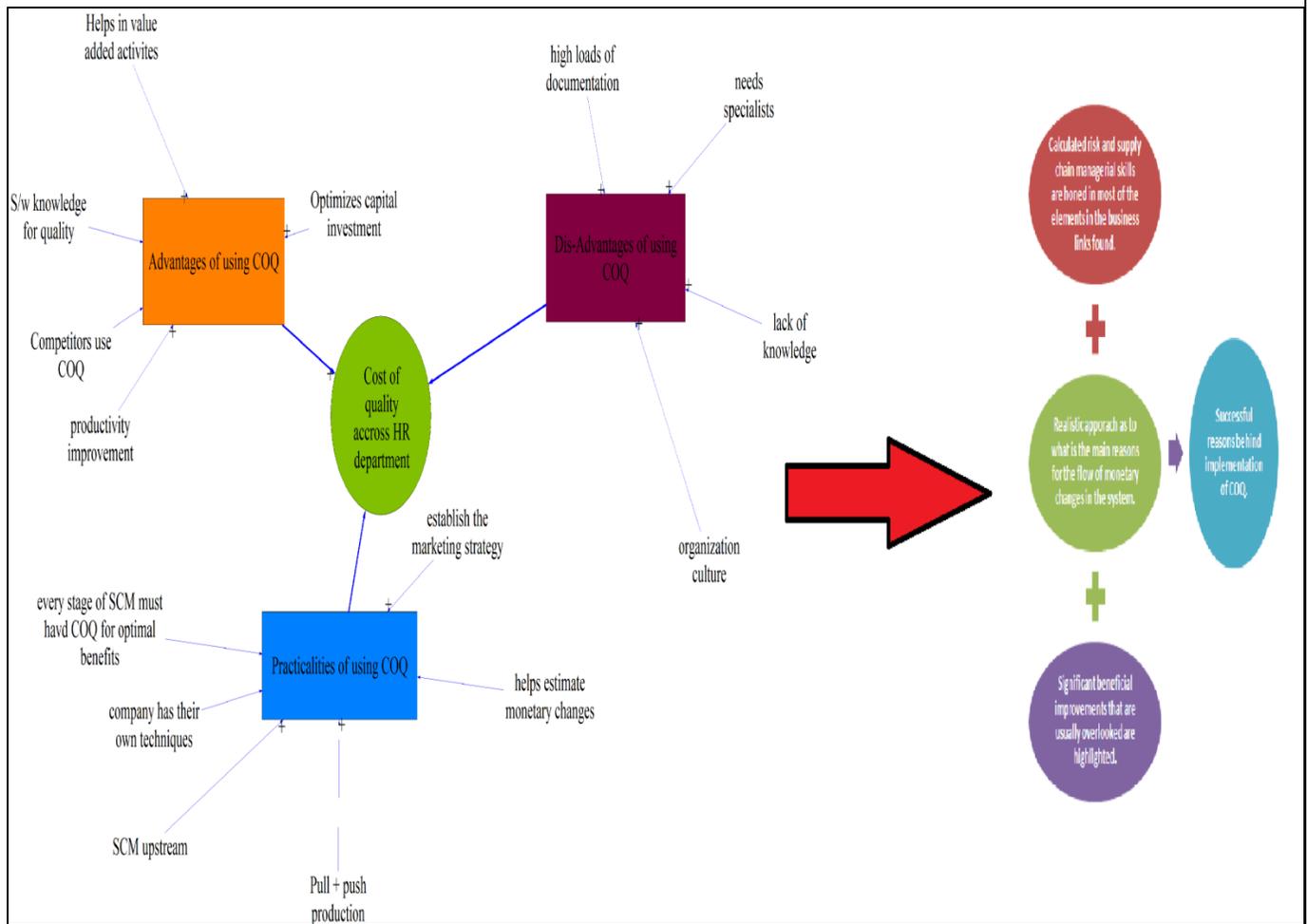


Figure 22: Causal representation of HR department

This as a result has caused the lower management and working level employees to have the problem of over working on simpler processes. Also, spending most of the time in understanding how to read older problems, which were easier to solve before are more complex with the new ways, and all this happens at the expense of twice the time. Even though with practice the level of work is getting higher and the speed also increases the result is on the long term. There is also a need for experts who can understand the process and make analysis of all the issues that may arise as the process goes further. This usually leads to employee attitudinal problems and also in several cases leads to employee performance which is below par. This is one major reason as to

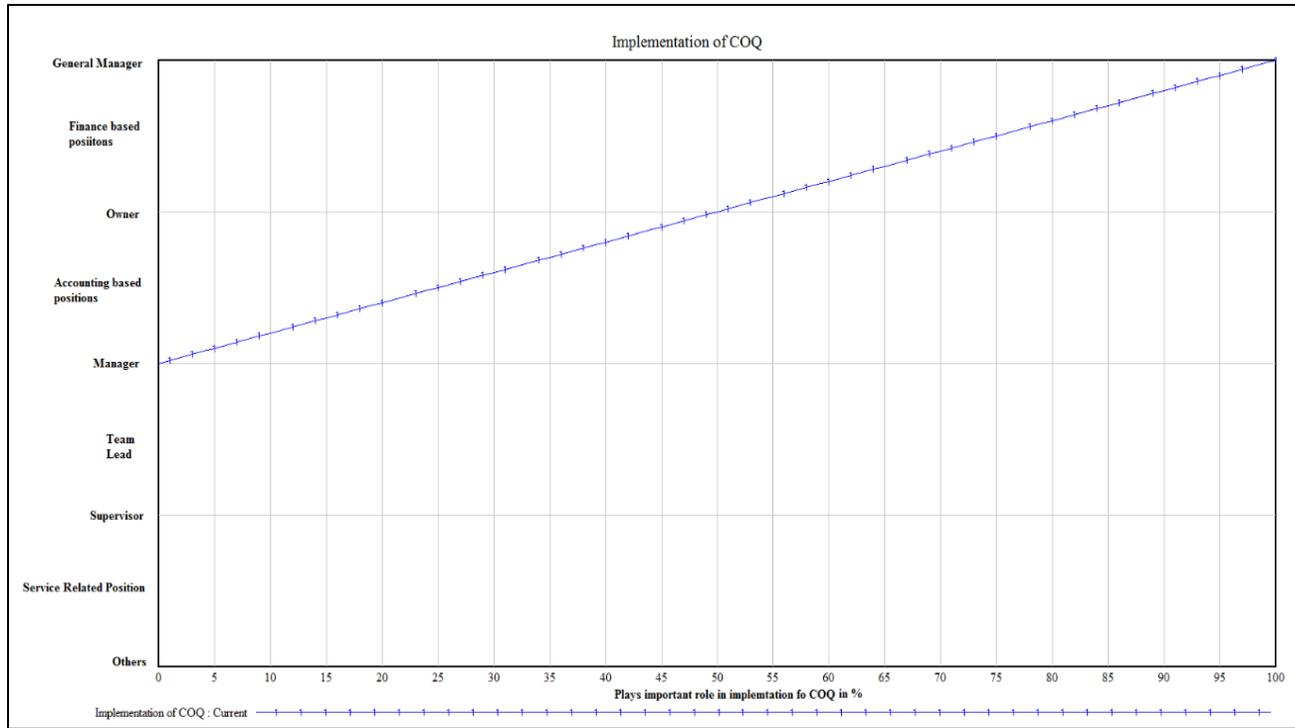
why the HR teams need to reevaluate the processes with regards to time. Need for more employees is a big problem as this leads to more expenses and this expense may not tally with the overall expense of COQ implementation.

Organizations have started using the technique of evaluation of employees using COQ techniques to see how productive one was during the usage of COQ and without the usage of it and also how the organization performs with and without COQ. The HR teams these days must also evaluate the tolerance levels of several employees before actually putting them in a process such as COQ. This usually allows the organization to know how the overall performance of COQ has affected the organization.

## **5.2 Impact on factors that affect the implementation of COQ with respect to job titles:**

**[Note: All the following conclusions and results are based on the Interviews and Questionnaire]**

The main work for employees when the organization has decided to use COQ is usually boiled down to the following base that usually helps identify the needs and the overall aim of the organization. They must also be able to select one legislative unit of the corporation to serve as a preliminary site. They must be able to discuss the intentions of the study with the strategic people in the association (refer to figure 23). There should be a possibility of amassing whatever cost data are expediently available from the accounting system. The suggestion should deliver for a task force of all apprehensive parties such that circulation of a draft of the groupings should outline the Cost of Quality.



*Figure 23: Graph for implementation of COQ based on Job Title*

Broughton [171] clearly felt the COQ implementation sequence must be tailored for each organization. These ideas and working schemes are based on actual events obtained via interviews from various organizations. Their employees in the various job positions show how and why the organization needs to work and how to focus on the implementation in order to get the right results [1].

- a. **General Manager:** The general manager is usually the one who decides on whether the technique such as COQ has to be implemented or not (Refer to Appendix: A figure 5 and Appendix: B figure 27). They are usually the people responsible for the decisions that are taken at the top level of any system and this is the reason an organization decides whether to go for the implementation or not (refer to figure 23 and 24). According to a GM of

from a leading automobile company, the General Manager is the one who identifies the opportunity when the process or techniques analysis and implementation helps understand the ease with which the technique maybe used. A process may be analyzed and also how the collection of data for the analysis of the data may usually get the process to be implemented in the system.

The General Manager is the one who knows if a particular process may lead to the optimization of a particular system. Also if the system leads to the possible obtaining of the higher capital investments that are usually not obtained from the techniques that affect the overall revenue. Outcome of the process also leads to the reasons behind how the technique maybe used to portray the reasons that cause the waste reduction to be analyzed. This job position is a major reason that helps in identifying the estimation of monetary changes. They also have more influence on how the employees assess and know where to concentrate on to increase the revenue of the organization itself.

The service quality helps identify if the technique or process implemented is a success and this is usually decided based on the decision of the General Manager. The decision also helps in obtaining accurate results. Also the expected strategic decisions lead to obtain the various business aspects that help asses and keep competitors at bay without losing on the business front.

- b. **Manager and Project manager:** The manager is the person who is responsible for a particular team and how their decisions affect the overall working of a team and the processes associated with it. (Refer to Appendix: A figure 5 and Appendix: B figure 28). The manager also needs to decide when to add or remove a particular technique or

process and where to concentrate the resources to. The manager has the knowledge on how the spread of overall funds/time amongst the team members (refer to figure 23 and 24) affects the outcome on the implementation of a technique such as COQ. The manager has a key role to play in the implementation of COQ throughout the team and is associated with the actions that correspond to the implementation of a process within an organization. According to a project manager from a leading IT organization, the key roles played and decisions made have to match with the organizations long term plans. The SME also explains the other following points with respect to factors to focus on:

- The usual understanding amongst the people in the business world is that no technique can be fully served as a completely working system. COQ is considered as a system that needs no monitoring. The Manager is usually responsible for the actions and activities that the process produces throughout the life-cycle of the process. The Manager also needs to have the knowledge of the process and also know to provide the technical solutions. This highlights at the fact that software skills along with the managerial skills integrated as one is an important necessity for a manager of an organization (while implementing a technique such as COQ). They help in working out on a long term solution that can be used across the board for any team in the same enterprise.
- The next reason that pinpoints the importance of the manager is the dependency on other teams. The manager is the person who needs to bring two or more teams together and gets the final decision to be implemented. COQ is mostly the work of the quality team, this can be only be done if the teams have a proper understanding amongst themselves as to how the decisions are taken and why they are taken in due course of time of the process. This is also now considered by taking into account of how the managers of the

two teams take the quality based decisions and result in what must be done in order to keep the productivity high.

- c. **Supervisor and Team leader:** As the name suggests the supervisor and team leader are the group heads who decide on how the team operates, on a lower level they are usually responsible for the solutions that are usually technical in nature (Refer to Appendix: A figure 5 and Appendix B: figure 31). The rest of the managerial needs are taken by the higher level hierarchy. The supervisor is usually responsible for the decisions as to know which part of the organization is more important to have the quality based focus on and whether the need for any purpose or technique needs to be implemented on personnel or facilities or both (refer to figure 23). They help in identifying how to manage and obtain the needed result at a reduced cost price. A supervisor from an automobile company highlights the whole roles and responsibilities of the supervisor and the team leader while implementing a process like COQ:
- The team leader is the one who provides a blue print of the work or task that needs to be achieved by the team member in order to obtain a particular result set that is acceptable and also can be used for further needs in other processes and procedures. Since the team leaders are the ones who are mostly in the complete regards of how the project works and how the results are going to look like, since they are in close vicinity of the results they are able to assess and find out which are the key reasons that have to be concentrated upon, in order to get the ideal reasons and points as to where to concentrate on in order to increase the revenue for the project.

- Another reason is that the implementation of COQ usually need more than a few months of testing in order to get a credible result for the process and success; hence it is up to the team leaders. The supervisors know this best and re-assess the system and as it is known that the analysis and the tweaking of the system needs to be assessed once every 4 months as they are closely involved with all the changes that go through a project during and after the implementation of COQ (refer to figure 22 and 23). If the implementation is found out to have errors in the system then a decision has to be made on whether the system needs to be removed or repaired so that it can perform what is supposed to do.
- Since COQ is a good reason to obtain the strategic quality planning and budgeting of a given system the supervisors and team leaders need to make an impact on those actions to get the ideal result. This is also an added value added service to the overall process and at times needs to be validated to obtain the result of the expected work plan that is being implemented at the current moment.

These are the reasons as to why the supervisor and the team leaders form an integral part of the system. They also have their own roles and responsibilities that lead to the possible chances of obtaining the expected results at the end of the implementation process.

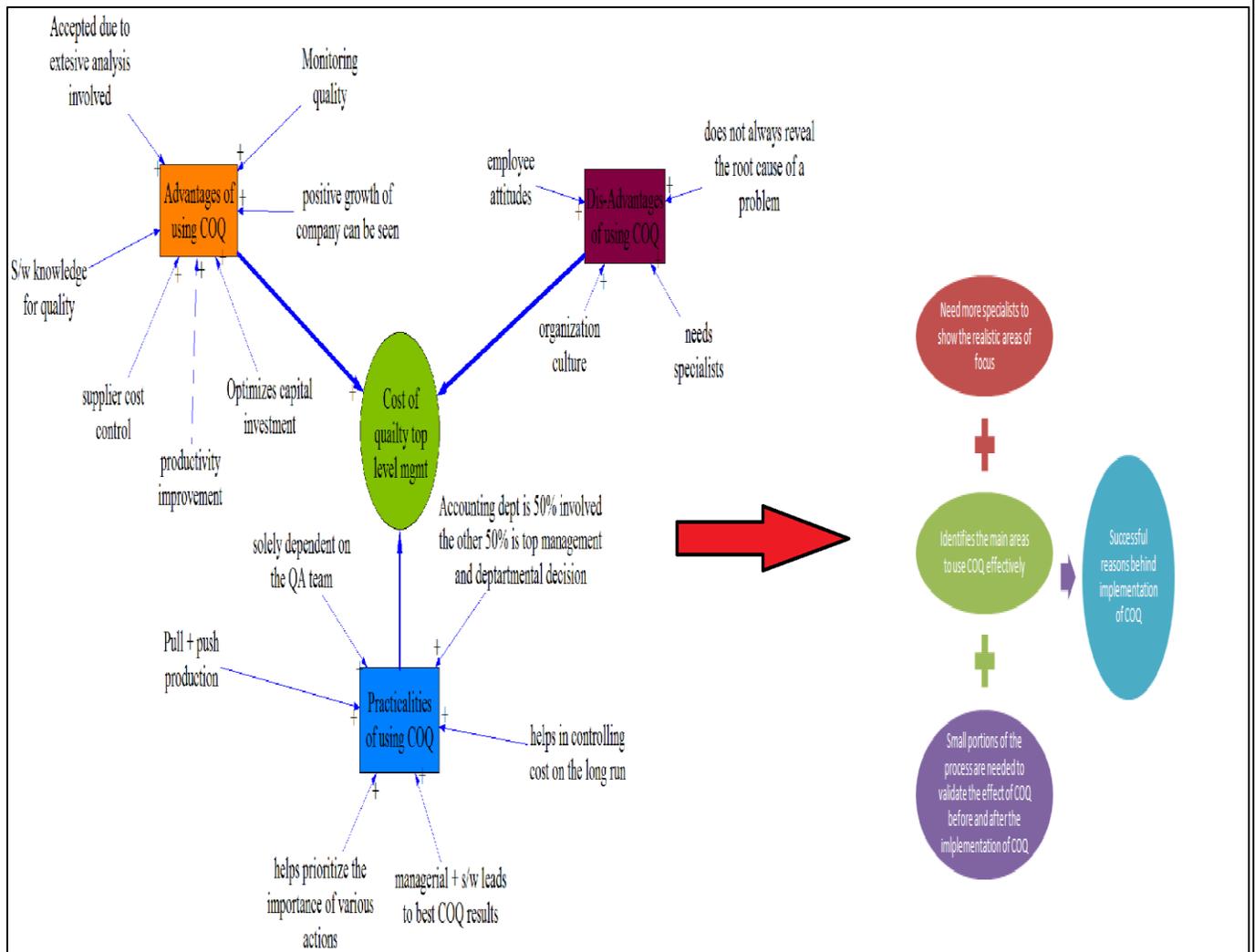


Figure 24: COQ implementation amongst top level management

- d. **Owner:** The owner is the person who is usually acting as a CEO or a General Manager for a company that is not large or is eligible enough to be considered to be the top level management for the whole organization (Refer to Appendix: A figure 5 and Appendix: B figure 29). Based on an interview from the owner of a medium sized IT organization, the work of the owner though similar to that of the CEO of an organization there are several large differences between the work span of the two, they are presented as follows:

- There may be several techniques in the market for a specific type of job. This may or may not lead to the actual benefits that the organization is in search for. This is usually up to the owner who is the ideal person to decide on this and provide a solution to the enterprise (refer to figure 23 and 24). To the employees as they are the sole revenue providers to the organization. They decide whether a company's existing techniques and processes are either used the same way as expected or they are needed to be overhauled and changed to obtain a new and improved version of the existing system for getting a more significant impact on the overall results.
- The next important reason is the project completion time analysis, they are usually shown and calculated based on what the project requirements are. The owner also knows what is needed to complete a project as they are the ones who decide on the expected profit margin. Hence if implementing a technique such as COQ is helping them obtain the results much faster than normal; then it emphasizes the usefulness of the implementation. Thus it is under the owner's discretion to decide on implementing a process or not.
- The final reason is the financial growth of the organization, when the technique or process leads the organization to get the actual output in a more specific manner than the actual result itself it makes the organization as a whole to contemplate on the reason as to whether it is good or bad to implement such a technique for the organization. This is up to the owner to decide what they want and the amount of risk they are willing to take in order to get the right results for the organization.

These are the prime points of impact that owners play with regards to implementing COQ and also the important reasons to play a major role in the organization and in the business front.

- e. **Service related position:** The service related position for an organization is usually based on the following factors and explained as follows. The organization needs to understand that when there is a service that brings in revenue for the organization then there must be an equal amount of analysis put into that method in order to get the most benefits out of the system (Refer to Appendix: A figure 5 and Appendix: B figure 30). The employees in this job role are in the position to get significant results that portray a given service as a technically sound one. This also proves that the implementation of the service based process such as the COQ is good for the overall business of the organization. According to an SME from a leading service based organization, the service related position holding employees are usually in direct relation with the outside world. These are in direct contact with the customers in the market and hence they are needed to understand how the system works in order to make the best out of the limited resources they have (refer to figure 23 and 24). This is then shown by the marketing strategy team that the organization builds the decision of whether to implement the based on the results obtained from the analysis of the services team or other factors that may be more conclusive.

The service based people also have the key role in deciding the needs of the customers and also play a strategic role in deciding how to prioritize the key roles in deciding which action is foremost in importance and has to be completed in order to

obtain the rewards for using the COQ process and also by strategically placing the most important actions of a system for a long term benefit. All this is solely based on the decision only if the feasibility exists and implementation is practical and possible only if the budget decision for the organization is well within the reach of what they had initially expected.

The final reason that has to be put-forth for the service based system is that there is always an extra need for a comprehensive quality system that, leads to easier and less frequent monitoring that significantly show how to get the quality planning phase imbibed in all the roles of the organization. Once the system is wholly understood and completed then this ultimately shows, what the key needs for obtaining a contingency plan are and when the vice-verso portion of the plan is needed.

- f. **Accounting related position:** The employees forming a part of the accounting based position, are a team that mainly coordinate all the financial activities to the upper level management (Refer to Appendix: A). This characteristic lets the lower level management such as supervisor and team leader obtain an idea on how to get the exact amount of results for the money that is being put in for the process such as the implementation of COQ (refer to figure 23 and 24). This also allows the team to forecast any such monetary based systems as this is usually what the organization expects to happen on the long term. This makes it an ideal habitat for the accounts team to work and make the system work for any given procedural standard of work.

With respect to an interview and the questionnaire filled by the chief accountant of an IT firm, it is clearly shown from the questionnaire that more than fifty percent of all the

decisions made by the lower level management on the go (Refer to Appendix: A figure 5 and Appendix: B 32). The accounting teams forecast is generally used by the upper level management's decision, as they decide if a particular system or process such as the COQ helps in obtaining what the organization wants. This also shows what can be more efficient if there are two or more processes in contention and can be used to obtain the needed output.

These are the above outcomes of how the various relative positions of the organization help in achieving the goal of the organization. The above obtained results help obtain the main reasons for forgoing with the implementation of a process such as COQ and how the various job positions affect the overall implementation of that process.

### **5.3 Impact on factors that affect the implementation of COQ with respect to organizational revenue:**

**[Note: All the following conclusions and results are based on the Interviews and Questionnaire]**

The revenue is usually based on the fiscal amounts of monetary changes that occur in the organizations revenues in an annual cycle (Refer to Appendix: A figure 3). This description of creating sectors amongst the organizational revenue is based on the 3 types of sectors in order to categorize the types of organizations [116] (i.e.) most sectors and:

- **High Revenue organizations [\$250 Million to \$500 Million]**
- **Medium Revenue organizations [\$51 Million to \$249 Million]**
- **Low Revenue organizations [\$1 Million to \$50 Million]**

#### **a) High revenue organizations:**

These are the organizations that have very high amounts of revenue turnovers each year and have a very intense amount of planning. Based on the response given by an SME of an automobile giant, High revenue organizations need special process oriented applications that help decide whether a given procedure is suitable for the current amount spent on COQ or not (Refer to Appendix: A figure 3 and Appendix: B figure 18). In high revenue organizations the most important factor that affects the decision that is taken is the revenue based on the complexities that are multiplied due to more number of employees, more complications due the fact that there is many levels of approvals needed before the implementation of COQ (refer to figure 24). The documentation level in the implementation process and the procedural time is amplified by several folds that the organization needs to spend so much more on recording the work done. Sometimes performing the documentation takes more time than the actual work itself. The productivity for the organization is affected positively or negatively based on how the organization reacts to the process. This is mostly considered as a big challenge for the organizations of this large size and this affects the overall outcome.

These organizations have very good logistics and highly precise forecasting methodologies (refer to figure 26). According to an SME of a very large manufacturing industry; having good logistics gives the organization an advantage on supply chain logistical implementation with respect to quality. This is very big advantage because the organization knows which part of the components need to be focused on more and where the revenue needs to be more for COQ based activities. This advantage also allows the organization to decide whether if COQ based activities spent on one portion of the supply chain stream is good enough or there is room for improvement in the given part of the system. Thus the overall progress of the organization is at times hindered by certain critical problems such as these and is handled

appropriately. This is how the organization with high amounts revenue works and gets the work done any new processes such as COQ or any other technique.

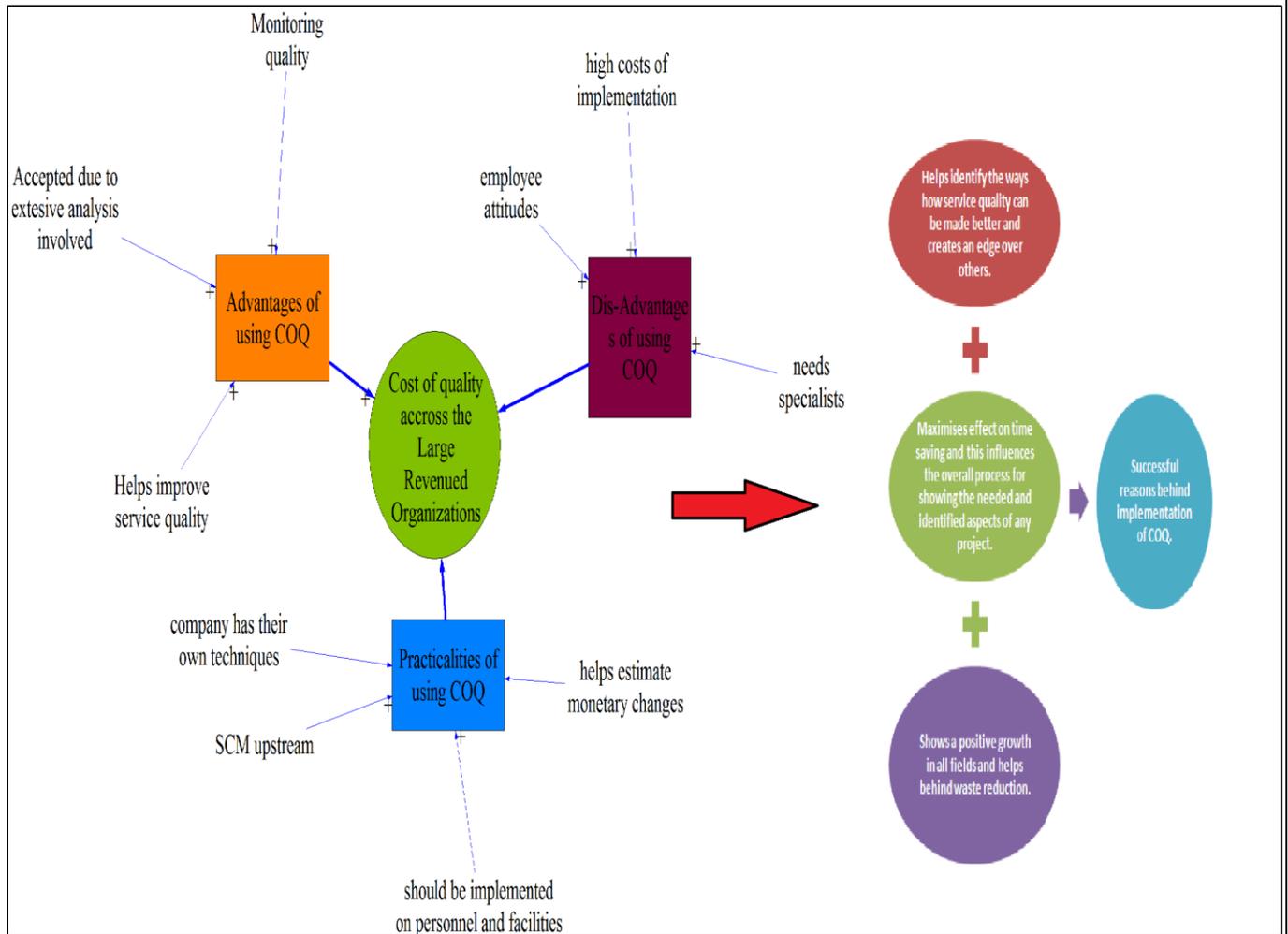
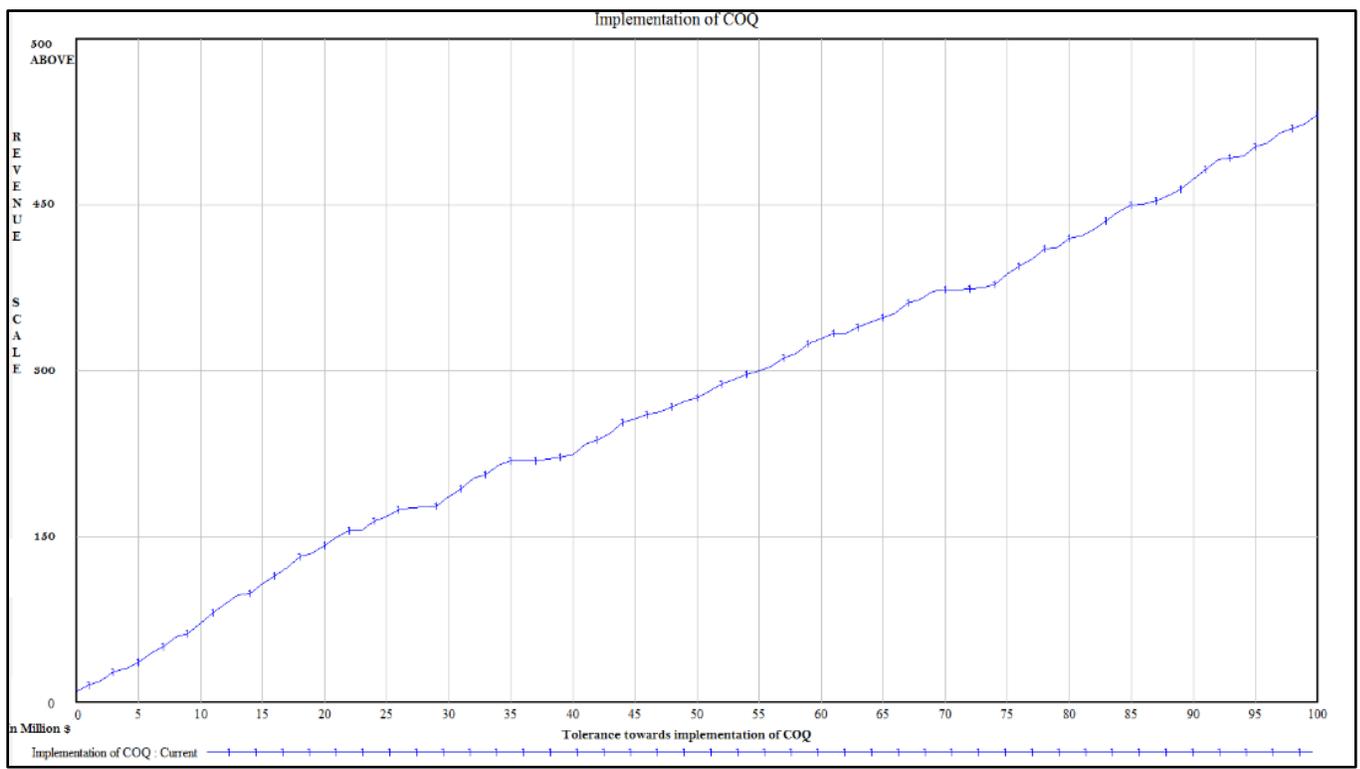


Figure 25: Causal representation of large revenue organization

**b) Medium revenue organizations:**

These types of organizations usually have lower levels of monetary advantage and cannot experiment too much on newer techniques and processes. This is because most of the money that is involved in an organization is usually spent to the business itself and the results orientation is

directly associated to the money that is put in towards the business (Refer to Appendix: A figure 3 and Appendix B: figure 16 and figure 17). This as a result makes the organization think from the outside perspective where they will have to use already tested methods and hire only personnel that have the prior knowledge of the technique (refer to figure 25 and 26), then use it to go about with changes in their business and this as a result causes the organization to change the way it looks at certain techniques and processes that alter the organizations way of working.



*Figure 26: Graph for implementation of COQ based on types Organization Revenue*

The next important area of focus in medium level organizations is the requirement of specialists. This is unlike bigger organization that can have its own team to teach and get licenses of its own to make something work or have the power of financial benefits to create their own work based techniques (refer to figure 25 and 26). This is not possible, firstly they pay heavily to invest in a

new technique such as COQ then they have to hire personnel and pay more to get the benefits of these members who have an extra skill set and get the other members of the organization to learn from them. Based on the insights provided by an SME of an IT firm, Medium sized organizations need to acquire the knowledge to get the cross platform consistency and plan it right from the start. They need this knowledge to be able to maintain a lower cost for human resources. There is always a risk that the organization would be wasting a large amount of money on training the personnel on a subject that may not exactly be up-to the task.

There are evidences of positive impact for the mid-level organizations as they have the possible chances of getting a collaborative approach with the larger organizations that have the process implemented. Based on the knowledge shared by several interviews, success stories serve as proof to this fact that, organizations need to use a very low amount of the actual cost to get the work started and may as well use their expertise to test or communicate any problems that may arise during the initial phase of the procedures. This is how the mid-level organization with relatively lower revenue power works with the implantation of techniques such as COQ.

**c) Low revenue organizations:**

The lower revenue organization that forms the third tier on the basis of revenue alone are usually the non-experimental and the non-expenditure based organizations (Refer to Appendix: A figure 3 and Appendix B: figure 12 to figure 15). They have very low tolerance towards the lack of accuracy and possible risks that may occur in the projects due to the implementation of new unknown techniques. This is a valid state of working conditions as they are not willing to fore-go whatever they have earned just to find out a technique that may be able to solve the problem easily but there is no proof to go by it (refer to figure 26). At the same time they lack the

financial advantage in order to make collaborative approaches with other bigger organizations as they cannot support the technical infrastructure on their own.

The next big challenge is the employee size. As they have lower revenue they usually do not hire a large amount of people. This is due to the fact that if the man power exceeds the outcome of monetary returns then there is a great possible chance that the organization may not be able to concentrate on working of their own internal processes. This as a reason forces the organization to not concentrate on the real problem itself. These reasons cause several possible critical errors and are a reason for which the organization would be forced to leave out real problem creating issues. According to an SME from a leading accounting and taxing firm the above mentioned complexities add up and the factors related to crating problems in an organization are no longer just one problem but instead a sequence of problems that cumulate to the overall error (refer to figure 25 and 26). Thus implementation of COQ is point-blankly denied by most small organizations as they feel it is a complete gamble to the financial gains. Low revenue organization don't have the independence to re-evaluate the progress of the organization to get the project back to normal working conditions, an insight provided by the CFO of an medium sized organization.

Thus we can see how the organizations differ from each other due to various changes in the organization revenues. How the impact of implementing COQ causes large differences in the organization when the revenue varies largely amongst them.

#### **5.4 Impact on factors that affect the implementation of COQ with respect to workforce**

##### **size:**

**[Note: All the following conclusions and results are based on the Interviews and Questionnaire]**

It is an understanding provided by the SME of major Engineering organization that whenever an organization is of larger size, the aspects on quality are usually more concentrated towards the implementing of a technique such as COQ for obtaining a better result (Refer to Appendix: A figure 4). This is very easily understandable as the bigger organizations have more money to spend on the process and experiment on testing the process to see if the given technique is a successful one or not and this also allows the customer satisfaction quotient to be more tact (refer to figure 27). Based on the specification provided by the SME one can understand that the results produced (with respect to impacts due to implementation of COQ) allows the organization to assess, the needs for the remainder of the tenure for the process or technique.

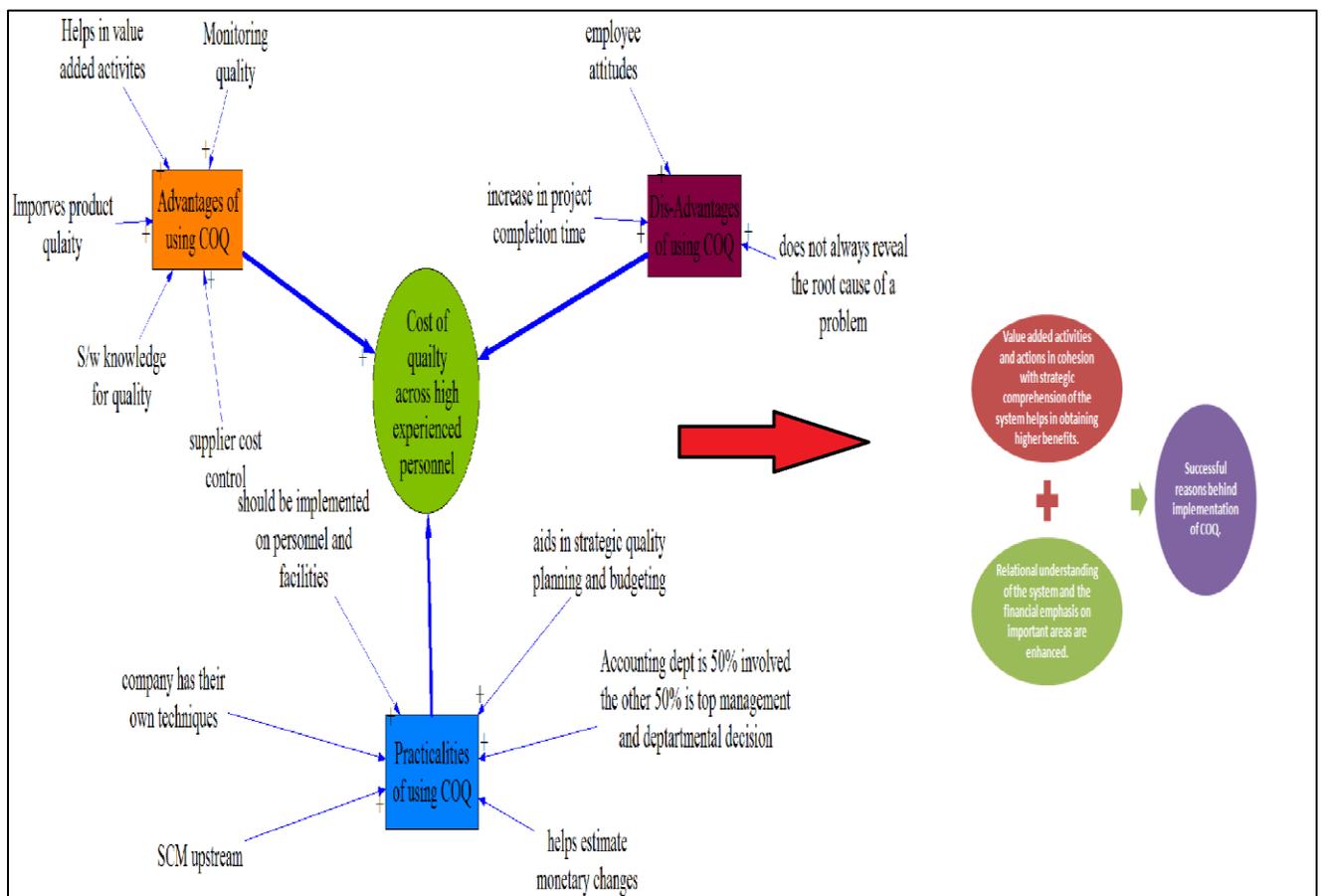


Figure 27: Causal representation of highly experienced personnel

There are some important points to be understood when considering the size of the organization; such as larger the organization the more the effect on the employees attitudes. The organization culture and the employees' attitudinal changes can be easily managed and observed in smaller organizations and this also helps them to find out the reasons that affect the changes in any environment. This is usually much more complex when the organizations size increases and this is the reason that needs to be accounted for. Hence when the changes affect the outcome so heavily there is a need for the analysis in more phases of the process or system than normal. This also leads to higher levels of complication in the quality planning phase (Refer to Appendix: A figure 4 and Appendix B: figure 45 to figure 48). The accounting difficulties also increase as more complications add up, increase in the size of the organization augments the complications and this leads to high levels of increase in money spent for accounting purposes. This leads the organization as a whole to need the overall understanding of why the particular technique causes a change in procedure of work and also leads to the overall reduction in cost for the process.

The other important factor is the time factor, the more the number of employees in an organization the more the time it would need for a given system or process to complete. As specified by the SME of a communications company this is a very significant need for the organization as the time incessantly increases it also leads on increasing the cost of the process (refer to figure 26). This leads to creating unnecessary time increments for the overall processes; hence we can see that accounting difficulties increase with the increase in the work force number in any organization.

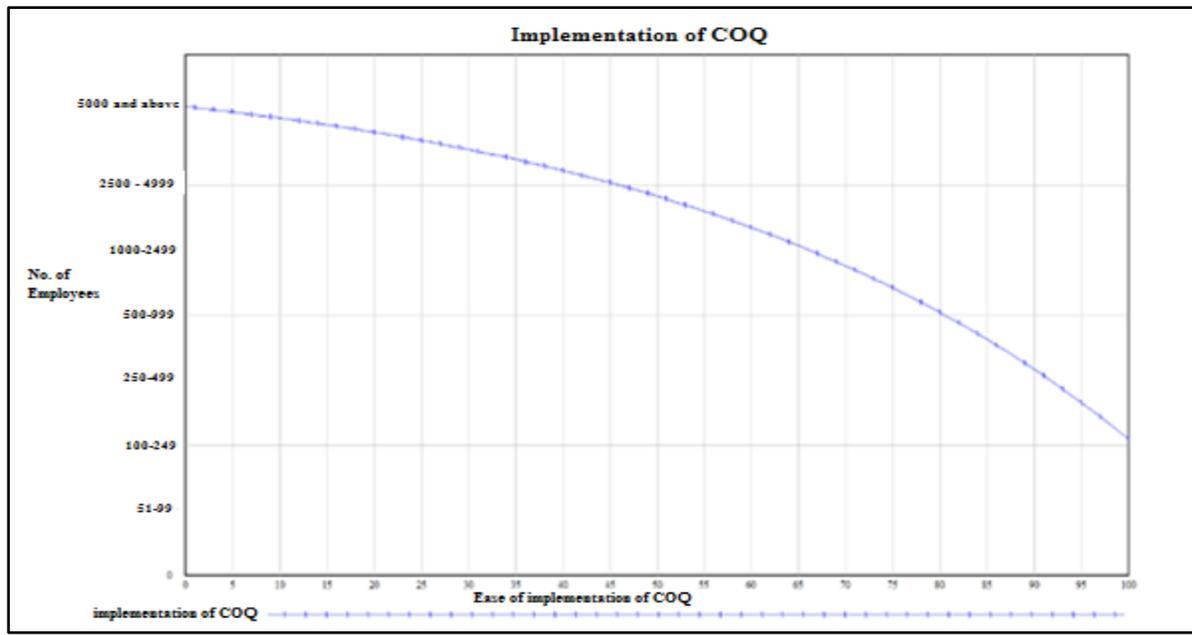


Figure 28: Graph for implementation of COQ based on Number of employees

The problem with inducing a change in an organization is that, when a new process is added to the roster of existing systems there must be a check conducted to see if compatibility exists. There must also be a check to see if the workforce is compatible to the change as a whole and if there is a need for the change. There also needs for specialists who are present in the organization who can help in the implementation in a much more significant manner (Refer to Appendix: A figure 4 and Appendix B: figure 49 to figure 52). There is a need for hiring externally which leads to increase in man power and also the cost of the system, and then finally the need for training of the employees in the organization costs a lot of overhead. As mentioned by the team leader of a service based company, these are the main reasons behind the need for having a good understanding of the work force and for finding out how the actions taken on individuals affect the overall balance of the work force. Based on the information provided by a manager of a major commercial enterprise, the critical business changing decisions that affect the

workforce size must be taken into account as they affect the outcome of a project. The organization must also check how the cost and time trade-offs occur in the system. When the changes in workforce size are put into effect, it must be tested to find an optimal result. This is also a very important point to be noted as it affects the overall business structure and vital decisions that could make or break the organization as a whole (refer to Figure 27, 28 and 29).

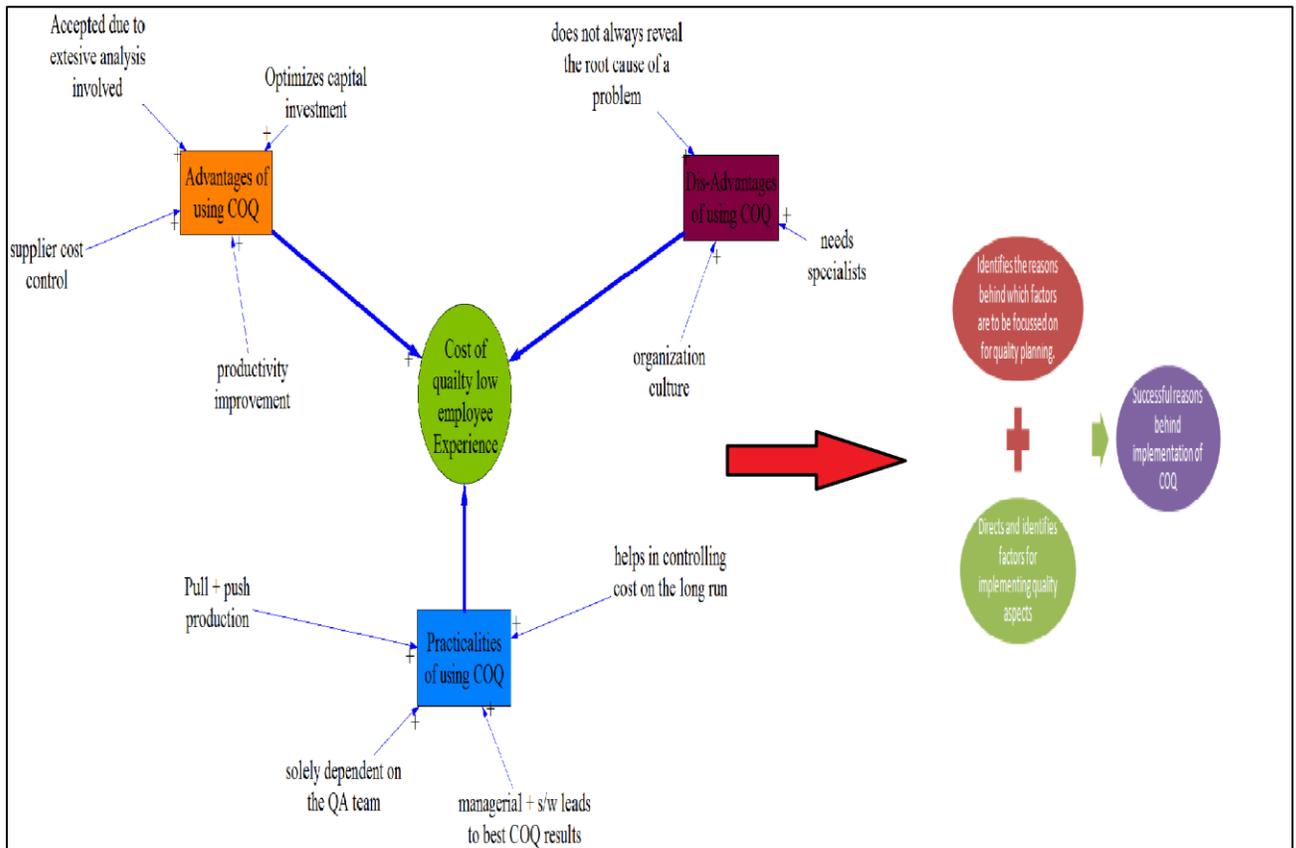


Figure 29: Causal representation of low experienced employees

**5.5 Impact on factors that affect the implementation of COQ with respect to employee experience:**

**[Note: All the following conclusions and results are based on the Interviews and Questionnaire]**

The experience of a person usually affects how the results turn up for a particular process in a organization (Refer to Appendix: A figure 2 and Appendix B: figure 7 to figure 9). This is typical of the organization since they usually do have the ideal methodology to obtain the needed financial outputs and using the employees experience for the methodology makes the process more valid. This also is evident when the organization makes new venture on new processes as the possibility of closing it down due to lack of guidance (which is due to in-experienced employees) is high. Techniques that make procedural changes to the entire organization as a whole are validated throughout the result sets obtained through experimental analysis, this is usually validated by the employees with high experience and they know how the process must respond. According to an SME from an industrial company, highly experienced employees know the business so well that, the organization knows where they stand and how they must focus on certain key aspects. This is fundamentally understood in how the organization is usually enticed into probing the need for new techniques. Based on the idea provided by the General manager of a leading manufacturing company, With the increase in experience amongst the employees, the vision towards finding newer more techniques that give a more profound result is usually the way by which most organizations work on in most cases; this is further more explained in a more precise predicament (refer to figure 30).

It is usually understood that when an organization is composed of several tiers of employees of different years of experience and each one has their own work flow and principle job functions to perform. Hence it is understood that with higher experience the job functions with respect to implementation also increases. The usual ploy in most cases is that the top level management gives the reasons and the lower level take the orders and perform the duties needed

to get the process or the work done (refer to figure 31). The next point of focus is that there is a decision making role for the employees with high experience that changes the whole organizations outcome on the monetary basis. The revenue of the organization plays a vital role in how to manage that particular situation because the organization with a large number of highly experienced employees is usually the one that takes more risks and has higher profit percentage returns. This is because they have teams that analyze the whole system and get the expected results in a realistic manner which shows that, higher the experience with regards to implementation, lower the chances of making losses. This is due to the fact that the experience they have allows the organization to take calculated risks and they can forecast the changes more accurately than those with low experience.

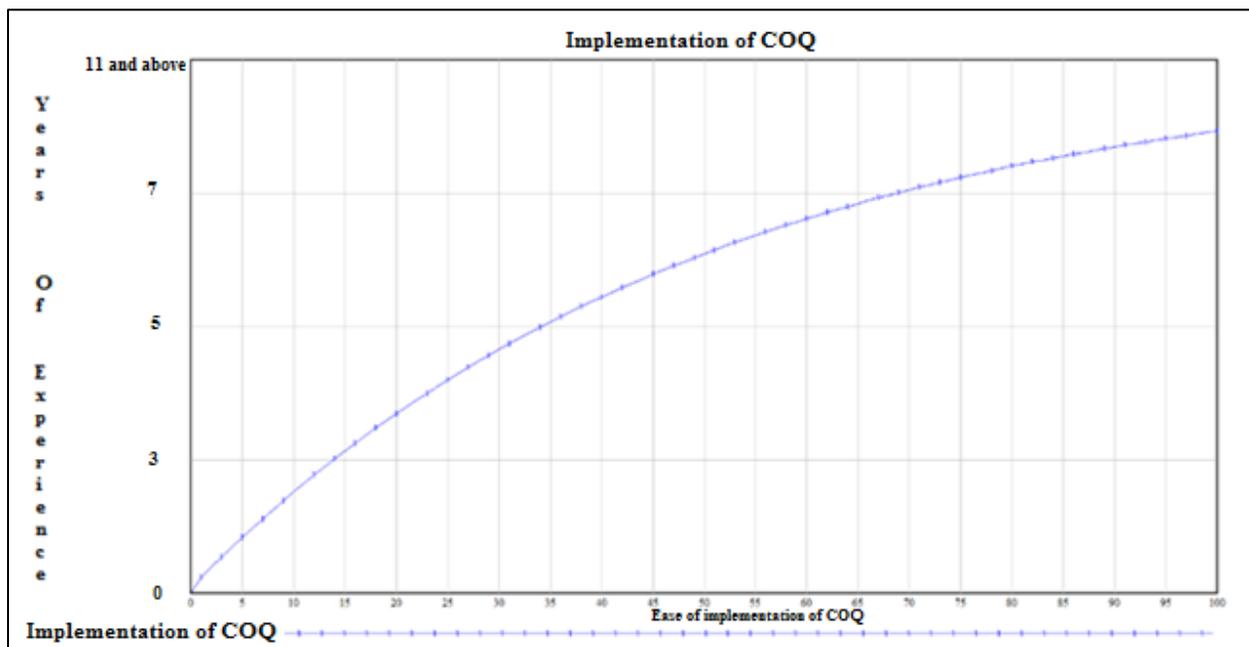


Figure 30: Graph for implementation of COQ based on years of experience

Whereas the organizations with employees of lower experience, they don't have enough knowledge to actually benefit from newer techniques or older ones. This also leads in problems

in finding the right mix of getting the right personnel for the job and to find the right results to overcome the amount of money spent on training the employees with less experience (Refer to Appendix: A figure 2). If the new technique is a success it usually shows by the monetary gains and also this allows the customer to gain more recognition to the current brand and acts more like a marketing push (Refer to Appendix: A figure 2 and Appendix B: figure 10 and figure 11). But this can be only identified through experience and also through results analysis which takes time, says an SME from a leading pharmaceutical company. COQ implementation serves more on the push strategy than the actual pull strategy in the production limits (refer to figure 30 and 31) and this can be identified only by the employees with higher experience as the trends can be easily seen by them.

The SME also feels that, whenever a mistake occurs in an organization that has large number of highly experienced employees there are easier recovery cycles than in those of the ones with lower experienced employees. This shows that the possible reassessment plans for the organizations is dependent on the employees who have previous experience with such conditions and can make a difference if something does go wrong. This shows that the industries are usually only dependent on the cost and benefits than the probable expected results that are obtained from the particular technique such as COQ in our case. This comparison of experience with workforce size is a one to one relationship as there is direct correlation. This can show the others within the same organization or outside the organization how to handle such situations and serve as a benchmark to others of the same organizational size.

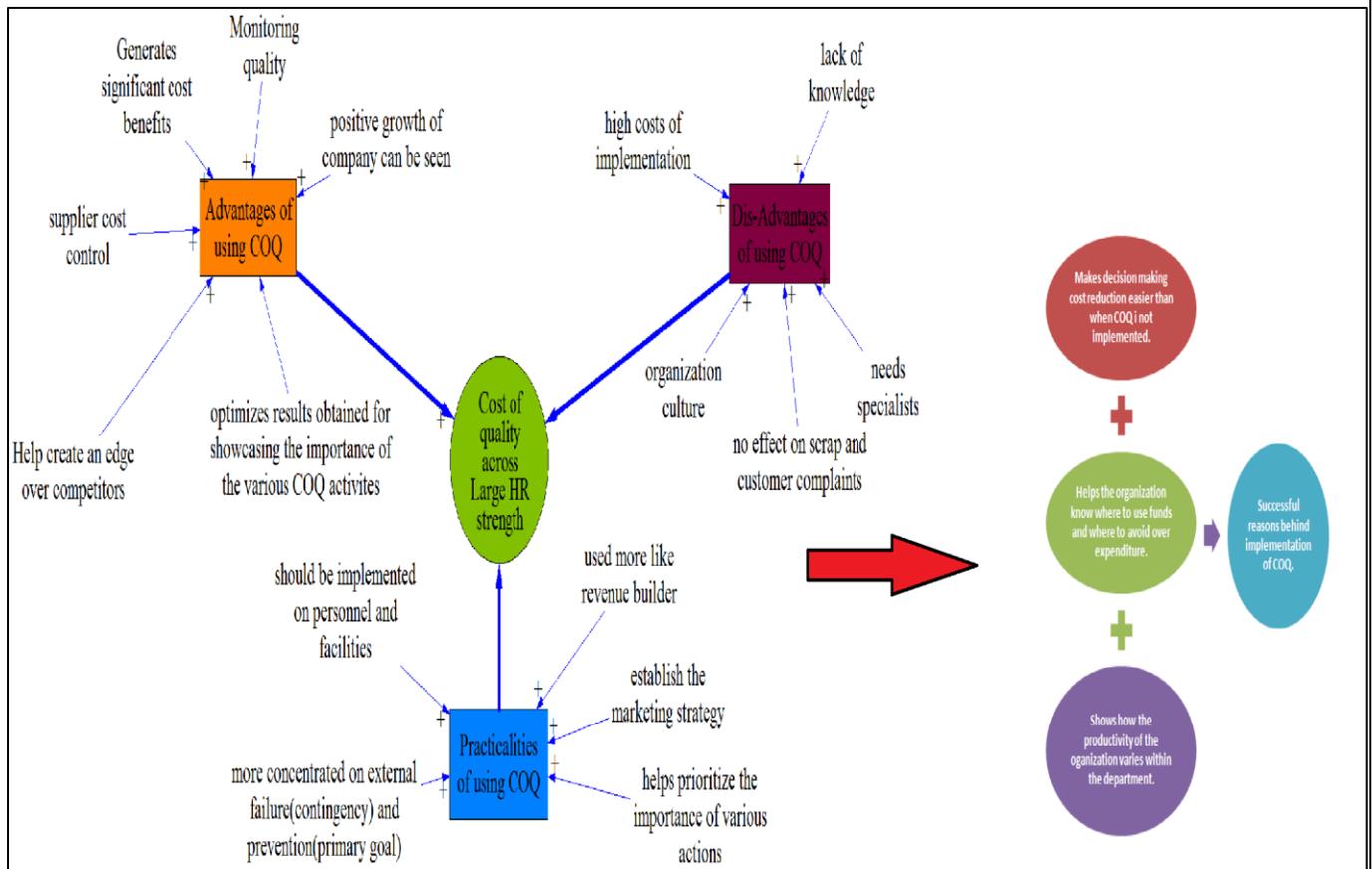


Figure 31: Causal representation of organizations with large human resources

## 5.6 Impact on factors that affect the implementation of COQ with respect to industries:

**[Note: All the following conclusions and results are based on the Interviews and Questionnaire]**

The implementation of COQ in industries of different type is usually different as most of the non-industrial business specters would usually assume to have the same end of obtaining high profits at relatively low costs. The industries are classified based on what products they produce and this also claims the probability of specifying the categorical industrial segment they belong to. The unique form of categories shows that majority of the organizations falling within a category usually behave in a similar manner. Hence the following categorical split of organizations is as follows as shown in table 9:

Table 11: Industrial categorization

• Bio-Tech	• Industrial
• Chemical	• <b>Information Technology</b>
• Communication	• <b>Medical</b>
• Construction	• <b>Mining</b>
• Electronics	

- **Bio-Tech and Medical industries:** These are considered to be of a similar category and as an industry they are usually associated with very high levels of accuracy and very high quality in the work they do. Moreover, since the fact that as it is high-tech industry that needs high precision in the working conditions they have great influence on quality aspects (refer to figure 32). These organizations do not have tolerance towards the losses due to low quality that are usually associated with lower tech organizations where precision is not the most important aspect. According to an SME from a leading Bio-medical company, the company has more intense payments in the quality department as they pay to learn in order getting higher results based on technologies, instead of achieving the results through the failure methods and through trial and error methods.

Simultaneously the presence of a technique such as COQ also aids the organization in obtaining the rightful and needed amounts of precision in the products. This also allows the organization to capitalize on the outcome as they are of high quality and this helps in serving as a marketing strategy for the people (Refer to Appendix: A figure 6 and Appendix B: figure 35 and figure 42). The organization can benefit from this, as the price for quality is reimbursed to the organization in terms of marketing help (It allows them sell more due to high quality). Also this helps the organization get monetary benefits of the sort that helps them maintain the productivity (refer to figure 34). This is an important and relatively

straightforward understanding of the advantages of using COQ in an organization that belongs to the biotechnology background.

There are some practical reasons as to why the organization follows this practice of getting new techniques such as COQ in action for gaining better results. The organization firstly has to deal with the needs and demands and as the quality goes up so does the organizations relative time for the job completion. Based on the results provided by an SME in the Bio-medical engineering company, even-though implementation of COQ seems like a monetary expenditure there is actually a good chance that they can find out where to put more focus on to reduce the overall costs. Also the time needed to obtain the results may have also amplified by a few instances but the ultimate result of getting the needed outcome in a profound manner is usually based on the work that is being done regionally. The manageable system efficiency has led to the need for implementation of COQ as a more essential and practical form of quality implementation in the organization.

- **Chemical:** industries are usually high risk industries due to the fact that there is a need for high amounts of process based accuracy tests in the products produced such as chemicals. In this case COQ aids in giving the edge to the organization in providing solutions and products at such high levels of quality. A manager of highly regarded chemical company specifies that all the costs spent on the COQ activities is reversible and the cost spent is reduced on the long term as the organization gets used to the COQ process (refer to figure 32). The other advantage is that when there is an issue in the organization such as a failure in composition of the formula of the chemical or the end product error or a break in the production line of the system or process or even at times in detection of the change in production of a product

with the change in time all this can be easily handled when dealt with in the right way such as by using COQ (Refer to Appendix: A figure 6 and Appendix B: figure 36). This also aids the organization as a proper root cause identifier and helps in obtaining the results needed by the organization.

The usage of COQ also allows the organization to find out the areas of improvement and this helps them know where to focus more on as all organizations try to maximize on the value added services that are provided by the organization to get actual needed results. This provides the organization a very easy way to control the cost and make sure the monetary changes do not go too overboard.

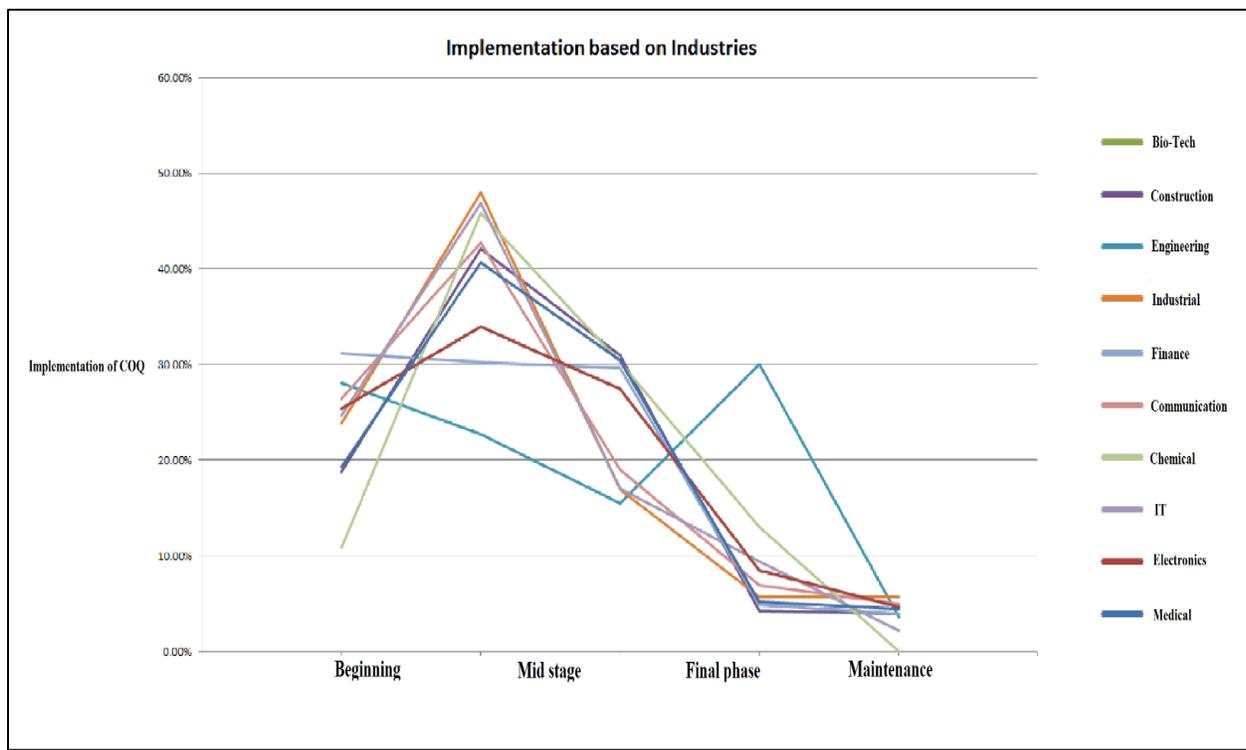


Figure 32: Graph for implementation of COQ based on types Industries

- **Communication based industries:** is another hi-tech organization that needs a lot of precision in the decisions made for the business and the service provided by them. Naturally this leads to heavy loads of complications in the work that is put in front of them and also the quality based results that usually affect the system is heavily affected by the overall productivity of the organization (refer to figure 32). The services provided by the organization are time consuming. Based on an interview with a communications expert, the communication systems need to have a lot of monitoring and may need frequent changes. If the process is followed by the use of a technique such COQ then the organization also has heavier loads on documentation that affects the overall time needed for the organization to complete the process in the expected time.

The usage of COQ has helped the organization keep track of the problems and the complaints that are created and issued during the course of the technique or process. This is why COQ is usually used in situations where there is no effect on scrap creation that the organization produces during the time-line of work for any given project. This implementation process causes great difficulties on the accounting instabilities or on the changes in the accounting needs for the organization. COQ also points out at the areas of where to focus with respect to increasing the revenues (Refer to Appendix: A figure 6 and Appendix B: figure 37). The implementation is practical and possible for every project based on budget decision.

As expected in most of the communication systems the need for a quality assurance team is of very high importance and also the work they do is also very department oriented. Based on the information provided by an SME in a telecommunication company, the QA team has a

very important role in making their dependency on showing the changes in the revenue and also the quality based analysis helps estimate monetary changes [112]. Thus the need for specialists is an important need in the organization. This at times leads to an increase in the time and cost needed. The whole productivity is adjusted and shows the need where to focus for getting the actual work in organization solved with lesser complications in the processes to be done.

- **Electronics:** is very large scale industry and there are many companies that are formulated on the same type of organizations that form the basis of electronics as the core industry that help the organization attain the needed level of clarity in implementing COQ (refer to figure 31). The electronics industries have a decision making process where each phase needs to undergo every test in the quality aspects before moving on to the next phase. The same happens each time as the organization has to check for a defect or a problem only once in a given procedure and once it is formulated as a routine, it simply is a time saving technique that does not save the organization loads of money in effective time management but also in reasonable areas of technological expenditure.

Based on the knowledge provided by an SME, Implementing COQ is probably one of the best marketing strategies any organization can use; this is simply because customers having a selective pricing range usually want to have a good amount of warranty or exchange possibilities in the product or service (Refer to Appendix: A figure 6 and Appendix B: figure 39). This is effective in the organization because when COQ is used in a manner that it forms the backbone of the sales of the product the customers believe that the product not only serves the purpose but also has longer life expectancy than the other products of similar type

(refer to figure 33). This is highlighted in the product by the effective revenue returns policy that is common in these types of organizations. A striking difference usually emerges when a hi-tech organization working in electronics finds the root cause due to the implementation of a technique such as COQ. It aids them to save on methods and processes and other experimental design based situations that lead to extremely large expenses and also the time needed to test such critical conditions leads to operational slowdowns. These are the reasons as to why the organization using electronics core to get the work done and showcase the implementation issues of COQ and the effects of the system.

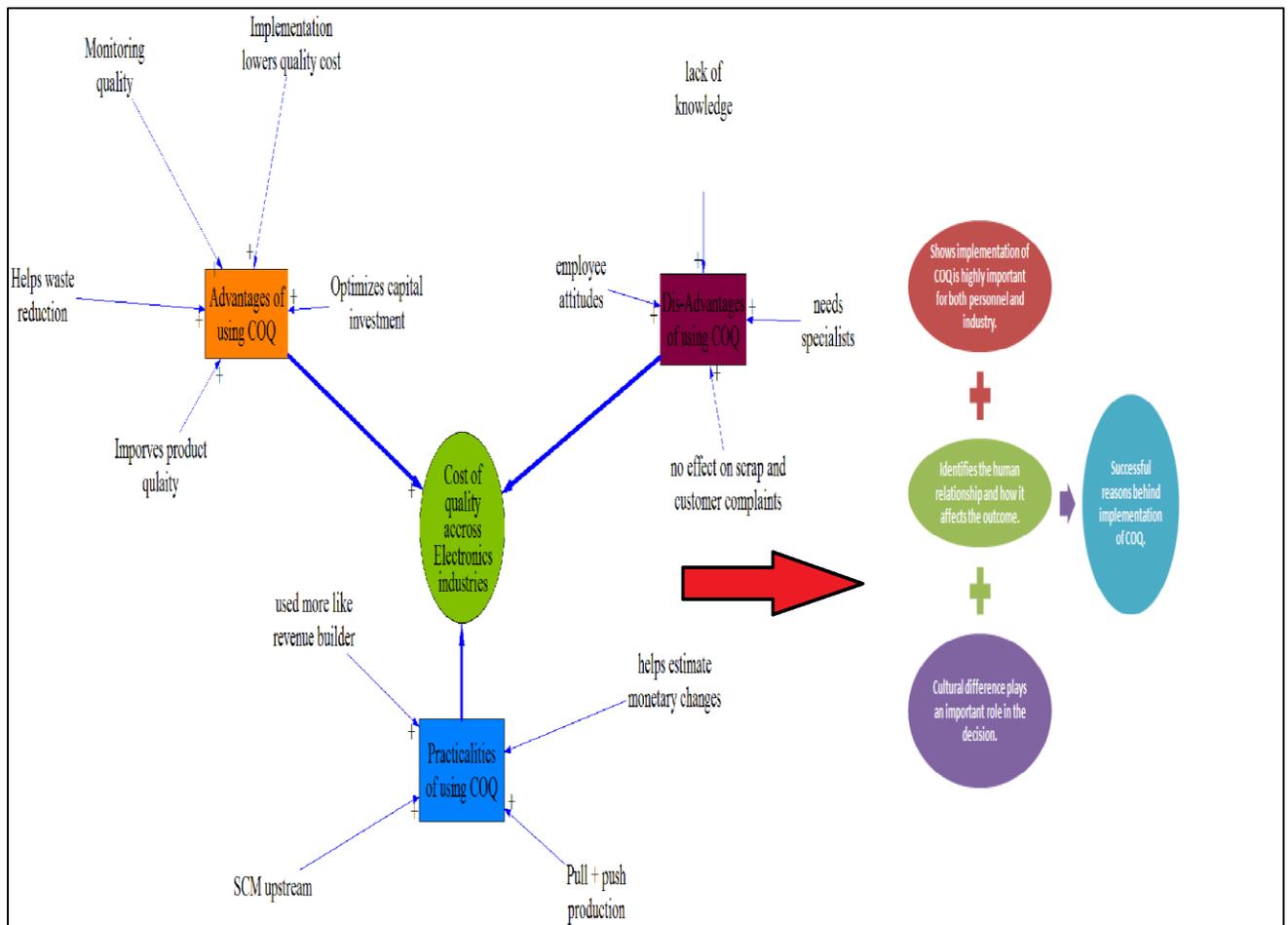


Figure 33: Causal representation of Electronics manufacturing organizations

- **Industrial [Manufacturing/Mechanical]:** organizations are one of the most complicated systems that work in unison as an organization. This is usually shown in per-capital income calculations that are available at the end of each fiscal year or quarter (refer to figure 34). This is complicated as there is more than one level or in fact a large hierarchy of people at different levels that has to be considered before any such decision with regards to implementation of COQ or anything related to the implementation is taken. This makes a very large difference in the working scale and the time scale for the project to be completed as expected (Refer to Appendix: A figure 6 and Appendix B: figure 40). This is very important as the cumulative monetary changes are most important for deciding if the progress of any given project is going as planned or going beyond the estimated value in time or cost.

According to an SME of a very large manufacturing organization, implementation of COQ has a profound effect on the capital investment of the project and the system itself as a whole. The organization when implementing such a process has to first consider the possible risks if the technique is a failure. If it does fail then the question of are there economic impacts for the system that implements the system (refer to figure 31). This also shows that the project may have to be scrutinized for the risk management techniques and analysis that may be carried out in the process in the beginning. This might only help them achieve the actual needed analysis of a completely working system even when the organization loses control of the procedure and leads to an earlier or emergency closure of the process.

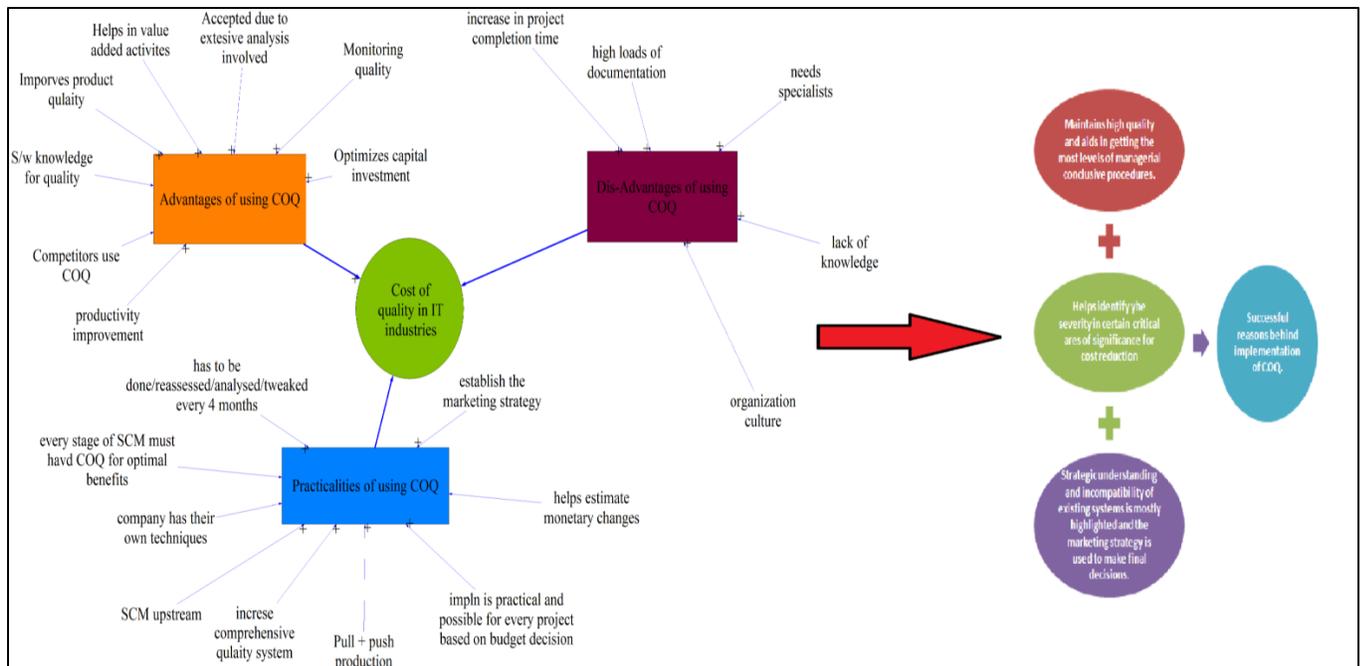
Another advantage is the lower cost that is acquired when COQ is implemented. This is because the organization has tried and tested the method. Once it is formed as a backbone of

the system the implementation becomes easier and so does the methodology itself because the employees by now know the way to work with it. Severe problems in the past are now resolved at greater pace and also with more experts working on the system the actual problems are much more easily handled. Easier to respond to when emergency situations arise, this always has led to higher and more excellent modes of quality control for the entire organization and also helps in giving the expected returns to the organization when invested upon.

The SME also feels that, there are several instances when the implementation of COQ can actually cause losses to the organization. The accounting difficulties are one of the major reasons that affect the organization. The fact is that most of the organizations have several forms and types of partnerships with other organizations or several departments in the same organization. This as a result causes the organization to have several levels of accounting tasks to be completed before the actual process of implementing the task is completed. This leads to very steep amounts of loss in time and cost. Since the addition of complications is so much more than the normal levels, the organization needs to have proper cross understanding of which departments are to collaborate. Based on an interview with a CEO of one the largest Industrial organizations, It is necessary to produce the exact calculations needed to get the actual account information. This is sometimes affected by the presence of specialists in the organization, because when the organization's department has several specialists in different departments it is possible to use the knowledge from various sources to a unified idea that works properly (figure 32 and 33). If they feel the outcome of the may affect the results of their department the changes due to COQ are even more scrutinized. The actual time needed is even more increasing than under normal situations.

There are some other points of focus the organizations in the industrial department have to look to control or make use of such as the cost of the process such COQ on the long run. The additive increments of a projects cost are usually something most organizations try to avoid and thus spend large amounts of money in trying to do so. This is not due one particular type of problem that the increase in costs occurs. It could be due to repetitive problems, newly created ones, problems due to existing incompatibilities in the system or other such problems. These are the reasons as to why the organization tries to avoid the inclusion of new techniques that might not always lead to positive increase in the organizations monetary gains and benefits. Another reason for implementing COQ is to see if the current market trends are good enough or organization might need to change its ideology in the future.

- **Information Technology:** is another hi-tech industry that depends on Cost of Quality methodologies, to a higher extent than most of the other types of organizations (refer to figure 34). As the software world is very highly dependent on the quality that the product is sent out into the market with, this is how the organization stands out as it serves as a difference between an organization that uses COQ and one that does not. This is how the organization makes a significant impact on the market needs (Refer to Appendix: A figure 6 and Appendix B: figure 41). The software knowledge on quality is so important that it helps in serving and obtaining the needed organizations marketing strategy and this helps in increasing the revenue building factors for the organization (refer to figure 34). This as a result helps in obtaining the needed service quality for the project and the implementation of the technique such as COQ helps in obtaining the organizations needed monetary estimates as planned.



*Figure 34: Causal representation of Information technology based organizations*

According to a manager of a leading IT firm, as any other industry, the IT field is highly dynamic and changes very dramatically in several dimensions. This makes the implementation of a technique such as COQ to be assessed and changed and analyzed once every quarter. Based on the insights provided by a manager of an IT giant; Sometimes, every fiscal year the project that uses the technique needs to be re-assessed to find if the actual output of the process has gone better or worse or if the organization needs to revoke to the older processes. Hence the tweaking needs to be more optimized and more up-to date instead of making changes and creating newer procedures to the organizations existing techniques (refer to figure 34). This also helps the organization decide if the implementation of the technique is useful and more likely to be used by them instead of changing the technique and spend more (cost and time) on finding a new suitable technique to replace the old one. This is how the various types of organizations work on the various techniques such as COQ and how

the implementation changes the organizations view. Thus the following processes show the real methodology behind the working of implementing a process such as COQ.

### **5.7 Impact on factors that affect the implementation of COQ with respect to countries :**

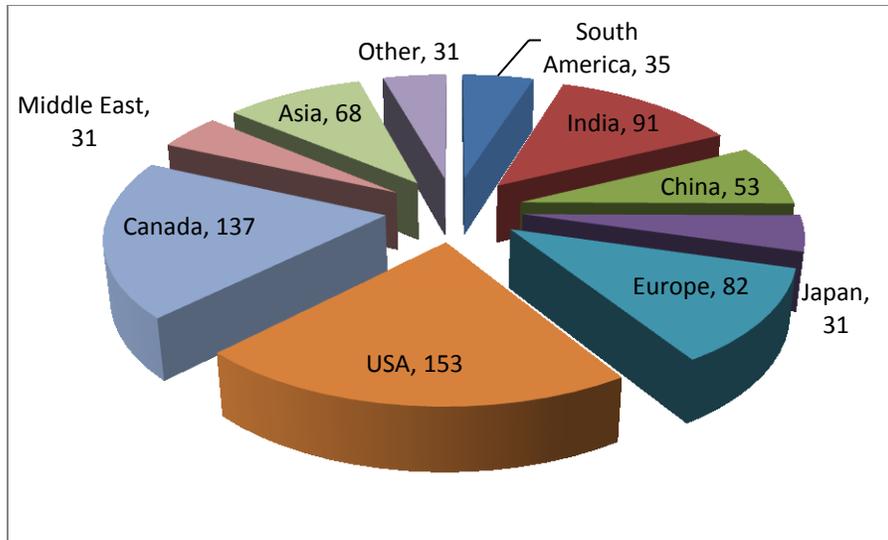
**[Note: All the following conclusions and results are based on the Interviews and Questionnaire]**

The effect for different methods and implementation for imbibing COQ and its techniques across the various countries is rarely discussed. The differences that usually are not shown actually have good impact as it can be used for comparing the various implementation methods across different countries. This section can highlight as to why certain reasons are more important in a particular geographic location and not of considerable need at other locations (Refer to Appendix: A figure 1 and Appendix B: figure 21). The following significance is due to business and cultural changes that cause the variations to occur even though the overall result is the implementation of COQ. The whole idea is to reduce cost and time needed in getting the work done for the organization in a faster and more significant method. This section is split into 5 regions due to the fact that sufficient amounts of data could be obtained only from these regions using the questionnaire.

- Implementation of COQ in **USA**.
- Implementation of COQ in **Canada**.
- Implementation of COQ in **India**.
- Implementation of COQ in **Europe**.
- Implementation of COQ in **Other Asian Countries**.

1) Implementation of COQ in United States of America is complex and considered state of the art. As noticed by most business organizations, the organizations in USA have their own way of calculating research capabilities and achieving organizational goals. Usually the implementation of COQ leads to systems or processes having to be considered for long term implementation. The intensity of all the types of cultural influences need to be considered before the implementation actually is done (refer to figure 35). The **three main reasons** to be considered in the implementation are explained as follows; **the employee's attitude and culture is of primary significance when trying to implement a new process such as COQ in the USA.** This is important because usually when a new process is being implemented the effect of how it works falls on the employees. As most organizations in the USA have a lot of employees this affects the work ethic of the people and also the implementation eventually suffers due to lack of understanding amongst the employees.

This attitude towards needing to be pioneers in any field and sustaining the name of having best quality products is the usual practice followed by the organizations in the USA. As the General Manager of one the leading communications company specified "Whenever a particular technique or process that was never used before and has helped in getting the needed results with that resulting in obtaining quality at low cost and high efficiency (Refer to Appendix: A figure 1 and Appendix B: figure 12). This acquisition when in expert hands has been proved by the American Standard of Quality or the ASQ, simply makes the process a standard that shows the process as a benchmark, and hence it serves the purpose. And the ASQ usually only promotes processes that have significant orientation to results."



*Figure 35: Number of respondents from each country*

The **second main reason as to the facts that affect the implementation of COQ in USA is the need for specialists the presence of ASQ and other leading ISO bodies has made the need for quality a very high necessity** and for organizations of really low impact such as plastics and mass manufacturing organizations like glass or lumber also need have more specific processes for implementing quality aspects in the organization. This usually helps in providing the organization with a certain possible standard to implement the quality structure they need to get the needed results within the range of financial decision they have made for a fiscal year. The impact of any process is usually considered to be made from the top level management that usually makes the decision of deciding as to when the company can make an impact using the implementation. There are also several conditions about when they don't have to use it. This is usually described in any of the organizations' high level document and also the periods as to when the organizations needs to implement COQ and when it can be removed.

The final reason for the implementation of COQ is affected by the supply chain processes that are integrated in the process itself and as the organizations decide as to which the most important level to implement COQ is in. Particular component deals with quality aspects more than other components and this cost is shared by the other components if they fall within the same type of company. There are also cases where the overall cost is compensated with the sales cost that includes the Cost of Quality being implemented in the process or the product. This usually has a pattern of the organization wanting to implement COQ in the upstream components than the ones below. This helps in showing or controlling the process in one particular region and helps in maintaining cost processes. Also in inhibiting from costs due to quality aspects from going out of hand as the organization knows where to concentrate and also where to stop the costs from existing system when there are failures that affect the overall results. These are usually calculated using the impact matrix and other area or domain specific impact calculators.

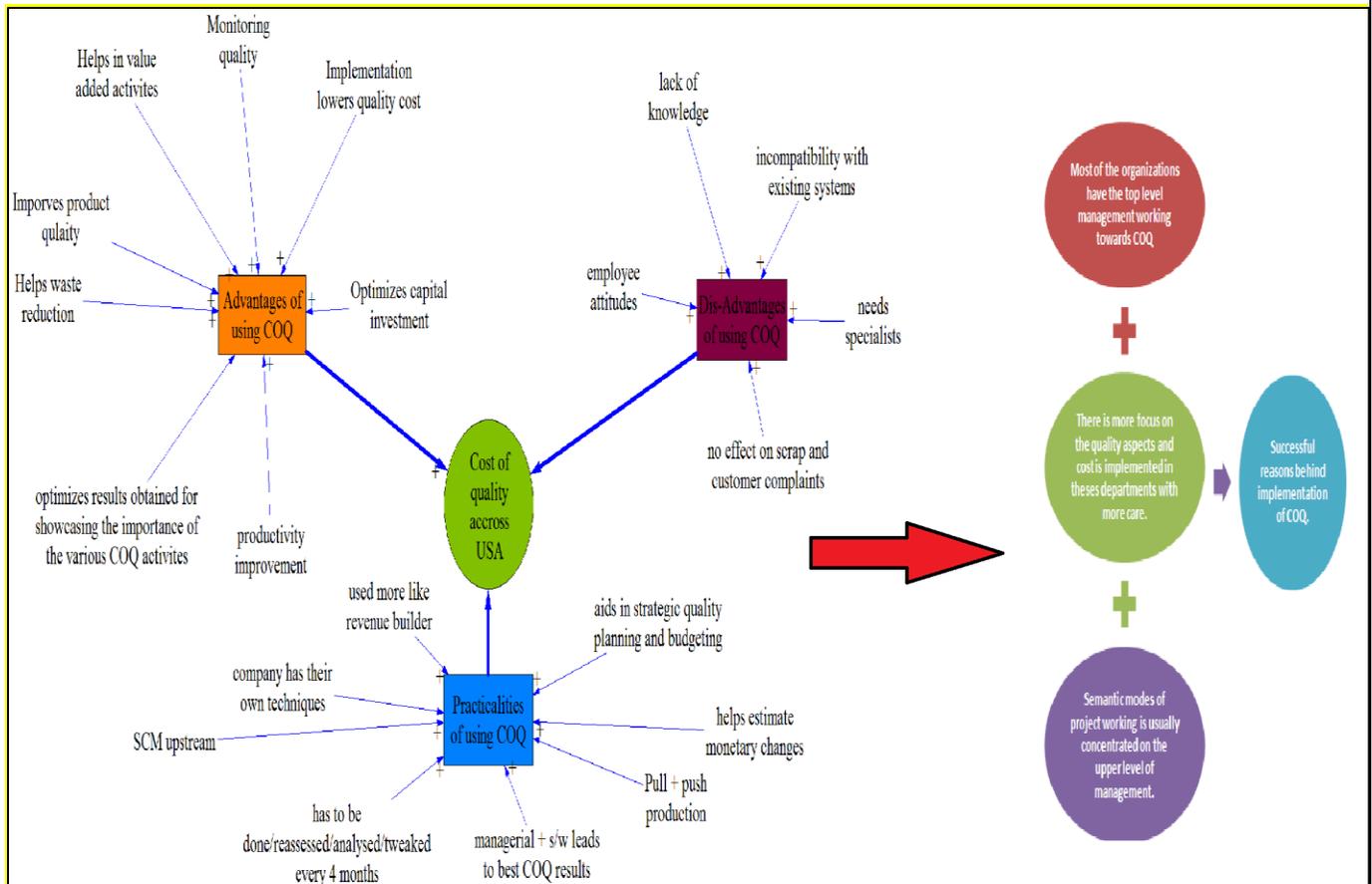


Figure 36: Causal representation of organizations across the USA

2) The implementation of COQ is very similar to that of the US industries for Canadian organizations. Canadian organizations strive to have significant impact on the operational activities that occur in the organizations. This usually provides the organization an instance as to portray how the particular process even though leads to the same outcome (i.e.) generating more cost benefits at a lower expenditure. This also shows the users and outside world the amount of work that is done behind the screens in order to get a product that is not only of high quality but also has high reliability that allows the users to have complete satisfaction. It helps the organization obtain a significant impact on the cost per sale ratio (refer to figure 35).

Since most organizations and the employees know where to have an impact, the customer's purchasing habit is most definitely well within the reach of the organizations research team. They can easily understand the need of the customers and this allows them to understand the changes in market. COQ implementation also allows them to manage the marketing strategy of the entire market sector enables them to match the needs to a certain extent that leads to the higher sales and understanding the quality system (Refer to Appendix: A figure 3). There are more factors that affect the implementation of COQ, such as the concentration of aiding the personnel to learn more and get more accustomed to the new techniques that are to be implemented in the future rather than hiring new persons as the need increases which may not exactly be sufficient when the cost. Profit is calculated in a ratio for checking the overall result of the system. This kind of activity also leads to increase in productivity. Implementation also helps the monitoring of quality work for the organization and identification of focus areas of where to reduce or increase cost based decisions.

The final reason for the cost effect on COQ is incompatibility of the existing systems. Most multinational companies only have a certain amount of tolerance to failure and complete overhauling of the existing systems is strictly prohibited. The results obtained are useful in showcasing how and why the existing systems must follow a regular procedure to be updated and replaced immaterial of how the system works. It is always considered best to have a backup plan when the new implementations are being installed. These are the reasons as to how COQ implementation affects the working of a system in most of the Canadian organizations.

3) For Indian organizations the main reason to be considered before the implementation of any new technique or process is the consideration of the work force due to the magnanimous size.

The power of the work force is large hence many types of environment specific calculations done before any such implementation is complete. This is most effective in IT and Manufacturing sectors and most of the organizations have the work outsourced to India due to lower labor costs. This causes the upper level management who are present abroad to think about the vast amounts of repercussions that may occur due to lack of facilities. There is a need for large amounts of cost to be implemented when a new process is being added as a large chunk of the work force will have to be considered for training. Other practical purposes that mostly lead to an increase in cost and the short term increase may be so high that it may not be able to recover the lost amount for a long period of time.

The calculations usually lead to finding out that, whenever there is a change in technologies or any such change in the working schema of things. This is usually considered as additional costs, this also leads to increase in additional time spent due to the fact that there will be additional time for training. Also an increase in cost due to the large number of employees, leads to the accounting difficulties and increase in complications of documentation that ensures, that a change in technique usually leads to a change in the overall cost of the project. This leads to the major cost increase in high cost implementation due to the lack of knowledge amongst the work force for most of the people. Hence it can be understood that in most Indian organizations the new techniques and processes that are usually trying to be implemented are mostly used as revenue builders.

The other factors that usually help the implementation and affect the COQ is that most of the organizations need concentrate on long term planning, which also leads to controlling the cost. This is usually associated with the large amount of money involved in changing and

optimizing the capital investment that usually leads to getting the cost to a level that helps in using COQ as a method for waste reduction. This also helps in meeting the supplier cost control as most organizations generally don't have the significant cost benefits that can accumulate and contribute to the positive growth of the organization.

The cost reduction instance is usually when associated with trying to implement any new technique at a lower cost with higher efficiency. Also allowing a high quality process to be implemented using the least amount of effort and allowing the user and/or organization to depend only on what is available without the need for high level technical specialists that help in implementing COQ. Lower productivity is another reason due to the lack of experts and hence implementation of COQ has to be thought of very carefully before being implemented.

4) In most organizations in the EU [European Union], the most important reason for being in favor of the implementation is due to the fact that it generates significant cost benefits. They may also have an ideal procedure that leads to the implementation of the lower quality cost. This eventually creates a positive change in the organization. The positive changes are usually associated with the growth of the organization, which produces high quality products due to the implementation of the techniques such as COQ. COQ is considered as a technique that leads to the various value added activities and services that lead to the product quality improvement and this ultimately leads to the cost control facilities that lead to the increase in revenue of the organization (refer to figure 36). Overall, this implementation process leads the organization to use COQ and its processes as a cost controlling technique or corresponds to the improvement of the product quality itself.

There are also several reasons as to why the organizations consider the usage of COQ as a hindrance and also is sometimes thought that implementation may lead to overall system failure (Refer to Appendix: A figure 1 and Appendix B: figure 25). This maybe comprehended using the following the key points of impact, the incompatibility with existing systems usually slow the overall impact on the system. This is because when a system that works properly is altered using a newly improved system (the process is considered to be superior) it leads to internal confusion. This leads to the need for new calculation of several systems and also the need for identifying and analyzing business as a whole process. Hence using this technique and identifying the impact on customers using the complaints analysis methodology the organizations can find out how much of a positive impact the system makes to the customers.

Based on the above discussion, one of the main reasons that usually help any organization decide whether a particular technique needs to be implemented or not is mostly based on how reliable the end results are for the organization. This is usually not very precise unless the organization has strategically understood what the overall results would be if the particular technique is considered a part of the quality planning. Budgeting this also is considered to be important when the technique allows the organization estimate monetary changes that affect the overall system and also helps in increasing the credibility of the decisions made on the budget front.

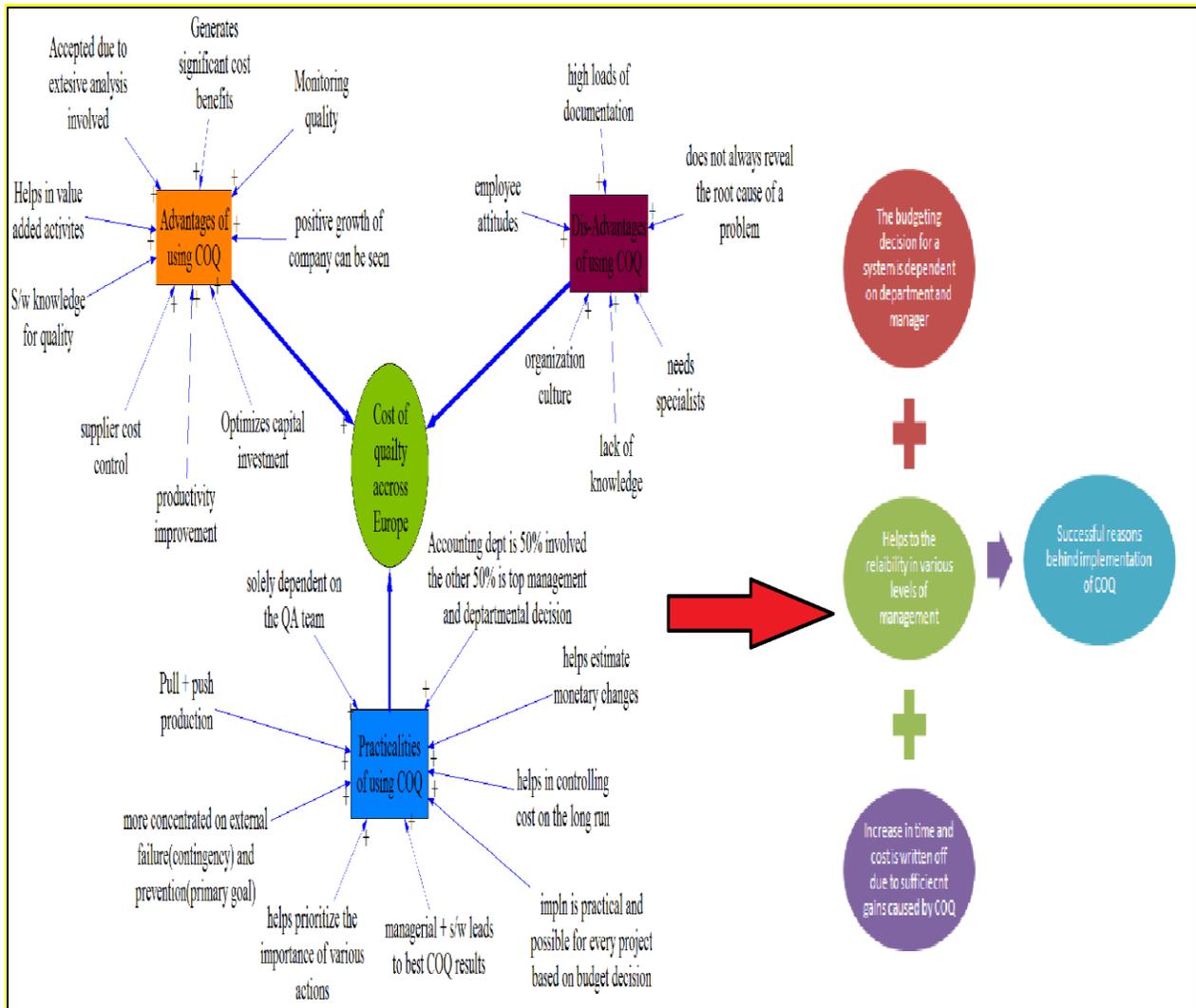


Figure 37: Causal representation of organizations across the Europe

5) The South Asian countries usually are more bent towards the obtaining of low cost labor and getting more work done than in other areas of the globe. The strategy being more people know the system and also this leads to more people having the expertise in a particular domain. This leads to the possible chances of getting the work done at lower cost but may not lead to the possible chance of it being a product or service of high quality (Refer to Appendix: A figure 1 and Appendix B: figure 50). But the tradeoff is so minute that the lack of high quality to the amount saved on lower costs of cheaper labor leads to the overall output that is acceptable across

the globe and also has a key beneficial aspect in leading the organization to get financial gains in very short period of time.

The employee attitude and employee work culture are so entwined in this part of the globe that it falls as a majorly important area of consideration as most of the organizations must take all these factors into account when making any such decision. This affects the overall organization as a whole and also leads to changes that impact the employees and also the outcome that is usually intertwined with how the employees feel about a particular system (refer to figure 37). This make the organization decide how the overall impact affects the financial growth of the organization. Also how this usually gives the public and the customers an eye on how they tackle such issues that are delicate. This serves as purpose of advertising the notion of how quality aspects are important and at the same time how the overall revenue of the organization is affected in a positive direction.

Furthermore, there are often more significant results that are corresponding to the software knowledge for any process to have any significant impact on the overall business. This is because most of the organizations in the Asian region are concentrated upon the software. Automation of the whole process ultimately leads to the need for the system to have a strategy that helps them obtain a particular result that is orientated with, how the results are obtained for showcasing the importance of the various COQ activities. This eventually shows how to focus on the regional points of importance that helps the organization sustain and grow quickly.

These are the main reasons that show the discrepancies between the various countries and how they operate on a business front. This also confines to the understanding of the changes in work culture and also the operational changes that occur in various countries even though the

final result is the same for all the countries, “Achieving high quality and productivity at relatively lower costs”.

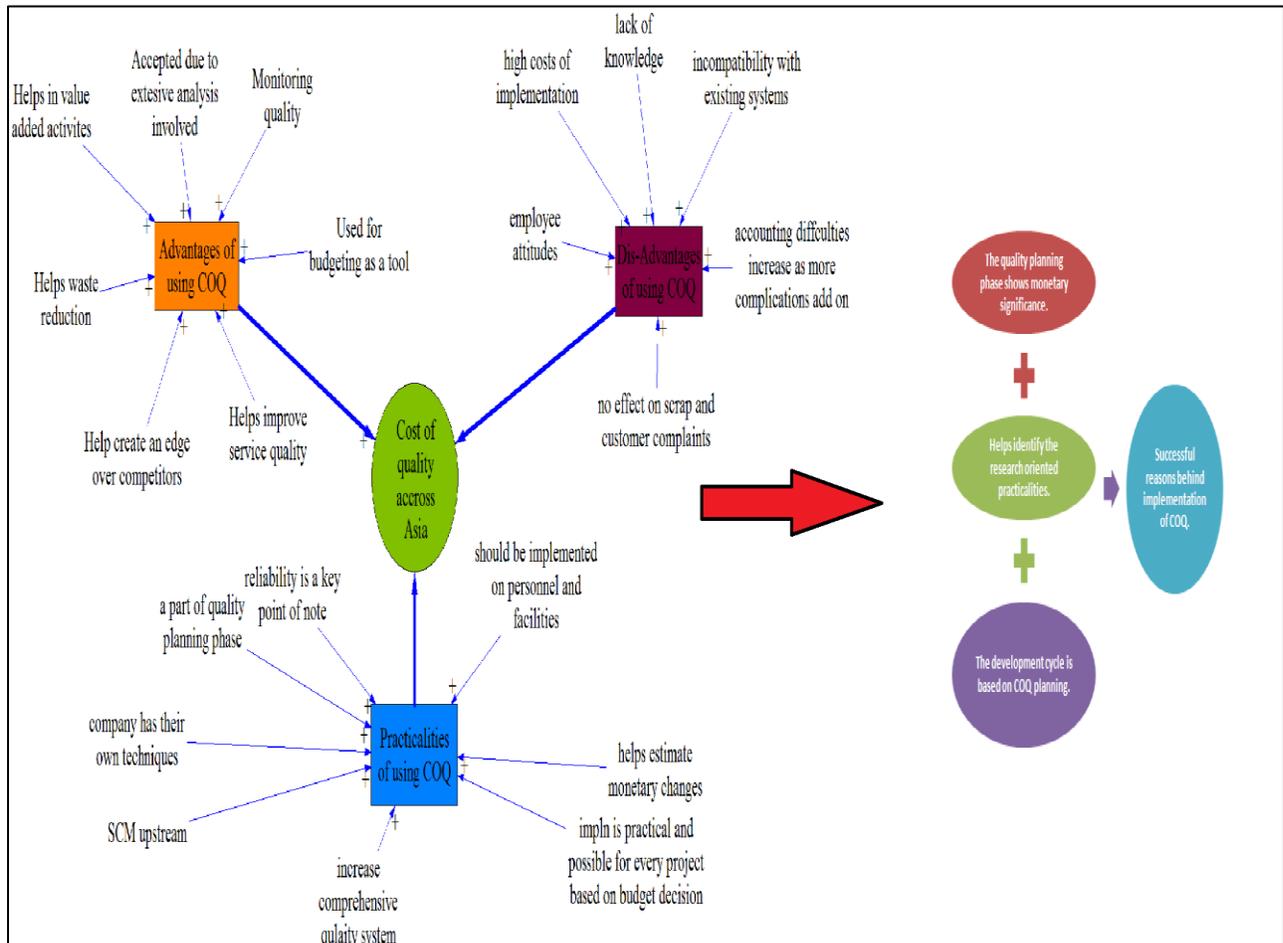


Figure 38: Causal representation of organizations across the Asia

### 5.8 Summary:

This section is useful to understand the behavioral pattern, from the various categories collected from the demographic information section. Furthermore this section gives the idea of the various research gaps initially presented earlier in the thesis and how they are handled. This section is mainly composed of information with regards to the effects on Industries, Departments, Workforce, Workforce size, Job positions and finally Countries. Using the

information obtained from the various sections, it is possible to find out the behavior of the sector while implementing COQ and how the effects help the organization or the user to decide if the implementation would be useful to them or not. Based on past literatures, it has been highlighted about how COQ is important, how COQ can be used and how COQ helps obtain financial gains. But there have been no specific mentions by any of the authors on the factors affecting the various organizations and also as to how the organization can make a difference to their existing business with the implementation of COQ.

This section also serves as key factor identifier as it helps the readers understand the differences between some very similar factors and these were not highlighted in previous literatures. The idea of identifying these factors helps in understanding the interrelationship amongst the various factors and how controlling one or more factors that are usually considered insignificant can make a major difference on the overall working of the organization. This section can also be used to decide whether an organization can use the technique for implementation or not with the backing that, implementation of COQ does not guarantee success to the organization or the user. Finally this section can be concluded stating that organizations need to know the various key points that are affected when implementing a technique such as COQ so as to make the maximum profit that they usually crave for.

## Chapter 6: Concluding remarks

The following conclusion shows the various areas of impact that help understand why certain industries need to concentrate on particular actions alone. This action helps in finding out the differences amongst industries that produce similar products or services or have similar procedures. In return the organization implementing COQ has a very good chance of avoiding situations where implementation could cause several problems in the future. The following tables summarize the results:

*Table 12: Evidence on factors that affect the implementation of COQ – Industry types*

Area of Interest	Positives to concentrate on	Negatives to concentrate on	Areas that can make an Impact
<b>Mechanical</b>	Helps obtain higher 1) Waste reduction  2) Supplier cost control  3) Productivity improvement  4) Technological advancement	The implementation of COQ leads to the increase of: Customer complaints and Rework and scrap	COQ is used to determine the products/processes overall quality
<b>Communication</b>	Accounting dept. is 50% involved the other 50% is top management and departmental decision	Warranty cost expenditure cost and Prevention plus appraisal costs are sometimes overwhelming on the long term.	The costs due to COQ are considered as an important component while estimating the budget of the project
<b>Manufacturing</b>	A part of quality planning phase needs to be alongside the each manufacturing procedure. This allows the company to track the changes easily and reduces burden on the QA team.	COQ implementation leads to increase in project completion time and The implementation of COQ is not easy.	COQ helps quantify overall quality improvement.

<b>Information Technology</b>	Should be implemented on personnel and facilities	Failure costs are at times proportional to Total quality cost.	COQ helps improve control of quality activities
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Based on table 12, the factors that have most influence on how implementation of COQ affects an organization and how the behavior of an organization is affected overall with respect to COQ. It can mainly be brought down to these few points which show that an organization that runs a mechanical core concentrates on waste reduction and productivity improvement factors. They also try and reduce the factors that cause rework in the organization and cost more money and finally the usage of COQ as a quality checker for most of their processes. Similarly Communication and IT based organizations work using quality in planning phase and find out when and where are the best ideal situations to implement COQ. They also need to find out how to control failure costs that are proportional to overall quality costs and decide how the improvement in quality factors can serve as a practical solution to the organization.

*Table 13: Evidence on factors that affect the implementation of COQ – Department types*

<b>Area of Interest</b>	<b>Positives to concentrate on</b>	<b>Negatives to remove</b>	<b>Areas that can make an Impact</b>
<b>Finance</b>	Aids in strategic quality planning and budgeting	The implementation of COQ is not easy.	COQ helps to estimate the monetary worth of individual quality activities
<b>Sales</b>	Helps improve service quality	COQ implementation leads to increase in Sales volume.	Company Specific Techniques are more significant in nature
<b>Accounts</b>	COQ system helps justify investments in prevention activities, which lower total quality costs	COQ highlights the problems that occur in a system more easily.	The accounting department is responsible for COQ statistics

<b>Engineering</b>	Generates significant cost benefits and Used for budgeting as a tool	COQ is not implemented because of: Lack of knowledge about COQ and High costs and Insufficient benefits.	The prime responsibility of the implementation of quality control methods lies here
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Table 13 is useful to find out how the department behaves as a result of implementation of COQ. The table also highlights how COQ affects the finance and sales departments strategic planning that helps decide whether implementation of COQ is justifiable. The table also highlights that implementation of COQ helps the engineering departments to generate cost benefits and improve service quality in a very good way. The COQ implementation also causes some disturbances in terms of complexity, specifically in the accounts department as the implementation of COQ usually increases the volume of work. Finally, the lack of knowledge is a common complaint amongst the sales, engineering and the financial department. This is a major cause that leads to increase in training costs which is at times more than the cost of implementation of COQ. This as a result makes the organization think twice before going for the implementation. At times the Sales and Engineering departments need to also verify if the monetary changes are suitable for one department is suitable for another as well (this shows the problems with respect to interoperability for the sales and engineering department) for the company. Finally if there are enough experts responsible for quality based activities facing cause for concern for all the departments.

*Table 14: Evidence on factors that affect the implementation of COQ – Hierarchy based*

<b>Area of Interest</b>	<b>Positives to concentrate on</b>	<b>Negatives to remove</b>	<b>Areas that can make an Impact</b>
<b>Top Level Management</b>	Accepted due to extensive analysis involved	Cumulates to forming Un-necessary expenditure on the long run	Helps prioritize improvement actions
<b>Bottom Level Management</b>	COQ implementation leads to a positive growth	Difficulty in collecting COQ data. Incompatibility of existing accounting system. Lack of senior management commitment.	Creates a more comprehensive quality system and Helps increase competitiveness

Based on tables 14 and 15 it is evident that top level management is very positive towards the implementation of COQ, which is usually forced upon lower level employees. This table also helps conclude that lower level management needs to spend more time and money on knowledge transfer and it is essential that the employee mentality with respect to implementation of COQ needs to be kept positive, because the positive attitude helps in faster learning and faster implementation. The high revenue organizations have more chances of experimenting with the technique to fine tune it and find a good balance suitable to the kind of work done in the organization, whereas the low revenue organizations must concentrate on the standard procedures to get the maximum of what they have invested on.

Using the results in table 16, it can be seen that the employees with higher experience have the luxury to experiment with a technique like COQ and if flaws turn up in the implementation it can be used as negative case study. With higher experience the employees also have the idea behind how the performance measure for the process must act and if there are any deviations it can be identified. Whereas their counterparts (the employees with lower experience) use it based on the instructions of high experienced employees to create an edge over the existing

process and external competitors. The implementation difficulties are mainly the reason as to why employees who lack the experience tend to not want to use the process. Finally, the practical solution for both the employees with high or low experience it can be assumed that implementation of COQ can be used as a savings based procedure and of the implementation helps identify the factors to concentrate on to create a reduction in overall implementation costs.

*Table 15: Evidence on factors that affect the implementation of COQ – Revenue types*

Area of Interest	Positives to concentrate on	Negatives to remove	Areas that can make an Impact
<b>High Revenue Based Orgs</b>	COQ helps obtain advanced performance measure	COQ does not help sustain quality of activities/processes when there are procedural changes	Helps establish marketing strategy and Helps control cost.
<b>Low Revenue Based Orgs</b>	Organizations use COQ technique results as benchmark against other companies	Lack of interest from employees + Low ROI	The most important feature in the use of COQ techniques is their Functionality and Reliability

*Table 16: Evidence on factors that affect the implementation of COQ – Experience*

Area of Interest	Positives to concentrate on	Negatives to remove	Areas that can make an Impact
<b>High Experienced Personnel</b>	COQ is used to identify high-cost problem areas	Existence of other easier quality control methods.	Reduce the prevention cost a company should start with the reductions on equipment and On facility and On personnel.
<b>Low Experienced Personnel</b>	Implementing COQ helps create an edge over competitors	Lack of information. Employee attitudes. Organization culture.	Savings are more enticed based on Managerial and Software techniques

*Table 17: Evidence on factors that affect the implementation of COQ – HR size*

Area of Interest	Positives to concentrate on	Negatives to remove	Areas that can make an Impact
<b>High Number of employees</b>	Proper understanding amongst employees is needed and obtained	Need for continuous reporting and documentation.	Implementing COQ in every stage of the SC Management is vital
<b>Low Number of Employees</b>	The COQ implementation needs specialists.	Un-necessary expenditure.	COQ solves occurrence of repetitive problems

Finally, the results present in table 17 show that when the number of employees in an organization is high then there needs to be a proper synchronization amongst the organizations employees and departments. This usually causes a problem due to the need for loads of documentation and with the chance of implementation complexities in several stages of the system. Whereas in organizations with low number of employees there is a chance of COQ being considered as extra expense and also the need for specialists at times makes it more complex. Finally, the probability of COQ aiding in removal of repetitive problems can show how implementation of COQ affects the overall working of an organization and the various units associated with it.

### **6.1 Research questions answered:**

Based on the results obtained in this research, the following conclusions can be made on the basis of the research questions that were introduced at the beginning of the thesis and these are the results that highlight the reason as to how the implementation of COQ can affect the organization in a positive, negative and practical way.

**Research Question 1:** What are the positive effects due to the implementation of COQ in an organization?

- Implementation of COQ notifies the organization about areas that need preventive measures which are otherwise neglected.
- Implementation of COQ helps increase waste reduction that can produce the needed financial edge.
- Implementation of COQ identifies the departments that need to be more involved in quality based activities.
- Implementation of COQ shows areas that need more quality experts or more quality based activities.
- Implementation of COQ helps in finding out which part/phase of the project needs to work more on quality based activities.
- Implementation of COQ increases accuracy in financial planning (mainly in long term usage).
- Implementation of COQ increases the accessibility of quality processes and procedures.
- Implementation of COQ leads to positive growth measures (financially and time based).
- Results obtained on implementing of COQ can be used as a benchmark for other organizations that are planning to implement COQ.

**Research Question 2:** What are the problems experienced in implementation of the COQ program?

- Implementation of COQ is usually not liked due to its incompatibility with pre-existing quality based activities.
- Implementation of COQ does not highlight the problems that occur due to other quality cost models that may be already existing in an organization.
- Implementation of COQ causes disadvantages when not implemented correctly, hence the backtracking of the process is expensive.
- Implementation of COQ identifies critical problems but does not always show the solutions needed to rectify it.
- Implementation of COQ increases volume of work (documentation, re-work etc). Even though the usage of COQ is advantageous this large amount of work is not justifiable.
- Implementation of COQ leads to increased dependency on knowledge employees (internal and external), which increases costs in an exponential manner (due to the need for training and hiring of experts).
- Implementation of COQ causes companies to focus on monetary benefits only and would not change the process even if the overall work environment becomes complex.
- Implementation of COQ increases the completion time of unimportant jobs (even though the end result may be of high quality, the time spent on a process may sometimes not be meaningful)

**Research Question 3:** Does the implementation of COQ have variable effects on different factors?

- Implementation of COQ helps identify if a particular factor affects the overall quality and if it needs to be analyzed.
- COQ can be used as an improvement technique. Sometimes the implementation creates an understanding on how changes (with respect to quality) occur at regular intervals of time and how frequently these changes occur.
- Multiple usage of the same resources (who are highly experienced in terms of COQ) is usually feasible in small companies but not in big ones. This creates the need for a more generic COQ methodology to reduce the number of employees.
- Implementation of COQ increases the quality level of a product or service. At the same time it increases the workload on some employees, this may at times be meaningless because of the time spent on documentation is more than the quality process itself.
- Improvement actions may be the long term plan but if implementation of COQ is a part of the plan then it must be planned at initial stage. It cannot be added in between as an emergency process.
- If COQ is being used as a marketing strategy then it needs to be a part of the quality planning phase. (This extra time and cost spent on planning might be a critical factor to decide on whether to implement COQ or not).

*Figure 39: Conclusive evidence*

Hence from the above answers to the research questions it is evident that based on the objectives initially claimed as unsolved this thesis throws some light on the missing links.

**Research question 1** helps identify the factors that cause the organization to identify the factors that affect the implementation positively in terms of their businesses. The question also helps you understand how an already well designed process can be made better and as a result the benchmark can be set higher than before.. These results may serve as a portfolio or a guideline in case of an organization trying to make COQ as a main part of their product and also while trying to implement COQ in a stage wise analytical process.

**Research question 2** helps the organization identify the areas where they need to show more focus on. As most organizations would stereotype that when there is an area that causes problems they simply try to neglect it, overlook it or at times even try hide it but COQ does not

allow or take these chances. The problematic areas are found and once they are found the root cause for it is to be found. If that is not possible the problematic area must be reported so that further work can take place with an idea that a particular area is affected negatively due to implementation of COQ. The organization is aware of what can happen if things go out of control. This is an important reason as to why there must be a COQ process in order to capitalize on the effects that may cause the organization to bring the positive changes into effect and the bring the negative effects to a halt to a halt. This shows how the negatives also serve as a positive in identifying the net possible worth of the project. And finally, **research question 3** helps answer the questions that a particular factor may have both positive and negative effects when COQ is implemented. These factors have to be under consideration when implementing COQ as they might help the organization decide if they need COQ or not. Alongside this reason research question 3 helps identify the key reasons that form the core of most quality based activities and how the organization must handle them while implementing COQ.

Hence we can conclude that on implementation of COQ the company increases the quality of the product or the service. The implementation also provides the company with a chance to see which factors affect the overall process of the company and how the implementation of COQ affects these factors. Hence we can conclude that COQ is a well versed technique to understand the quality based processes of an organization.

## **Chapter 7: Contribution**

From the previous literature reviews and research made by several authors, the most significant contributions that help to highlight the usefulness of this thesis and portray its uniqueness are described as follows:

- Research with respect to factors affecting the implementation of COQ has not been conducted before.
- A study using a statistical questionnaire with in-depth analysis on how the implementation of COQ affects the organization has not been performed before.
- The number of respondents for questionnaire and number of interviews conducted is very high. A sample size (for the questionnaire) of this scale has not been used before.
- An in-depth analysis on the factors with respect to:
  - Industry types
  - Work force size
  - Revenue of the organization
  - Job positions of the employees
  - Organizational departments and
  - Countries

has never been conducted and the results between each of the factors have not been identified before.

- An analysis based on the mentality of how COQ is perceived between people/organizations that know COQ and do not know COQ is conducted using the questionnaire. Such results have never been obtained before.

- A graphical representation of the various factors that form a part of the implementation of COQ using Vensim PLE has never been done and using this representation the minimum and maximum values for each of the factors can be varied to identify the main points of focus.
- A causal relationship has never been created to identify the various inter-relationships amongst the various factors that have an impact on implementation of COQ.
- This study can be used to understand the behavioral differences that occur amongst different sectors (based on the demographic data), which helps to study the impact on the implementation of COQ.

Thus from the following results, we can see the main contributions from this thesis are **the factors obtained with respect to implementation of COQ that can help an organization decide whether implementation of COQ would be good for them or not.** The thesis also provides an idea that enables organizations to make the changes not only profitable, but also effectual on the long run as the organizations implement COQ to gain the advantages that make the management understand the quality needs for a product or service. This thesis can be used to **prioritize the factors that can affect the overall quality process if COQ is implemented.** There is always a tradeoff for any process and it is the same for case Cost of Quality. **Implementing COQ gives the organization the ability to find the right balance between costs, time and needs for better quality processes.**

Hence it can be concluded that Cost of Quality is a good technique such that any organization willing to that is willing to provide time and cost for the COQ implementation process can obtain very good results with respect to quality. This study provides in-depth

analysis of how a particular factor affects the outcome of the process. Using this analysis the organization could make assumptions on major factors that would affect the overall outcome in terms of quality for a given procedure. This thesis also highlights the various dynamics that are present between several factors in different types of organizations, which were never found or concentrated upon before. These dynamics provide a substantial amount of benefits that would serve the purpose of getting the perfect balance between cost and quality factors to obtain the optimum results that an organization would generally seek.

### **7.1 Future Direction:**

As a possible research option, future researchers can form an analysis based on the demographic data that already exists in this thesis and can be blended with other geographical localities. Using this general idea researchers can create an in-depth analysis on the behavior of different organizations can be studied on a global scale. Future researchers may also find out if the behavioral pattern of the low context areas (countries or organizations with more emphasis on work/employee cultures) and the high context areas (countries or organizations with more emphasis on results and monetary gains) behave in a similar way or differently. This idea also provides the future researchers the chance to find out trends that keep changing between different time eras and how COQ was implemented before and how it is implemented now. This idea can provide very useful insights on whether the COQ techniques used in the past are useful in the modern world or not and if the methodology of implementation of COQ has changed over time. This allows the future researcher to create a comparative analysis on how COQ affects business today and how it used affect business before.

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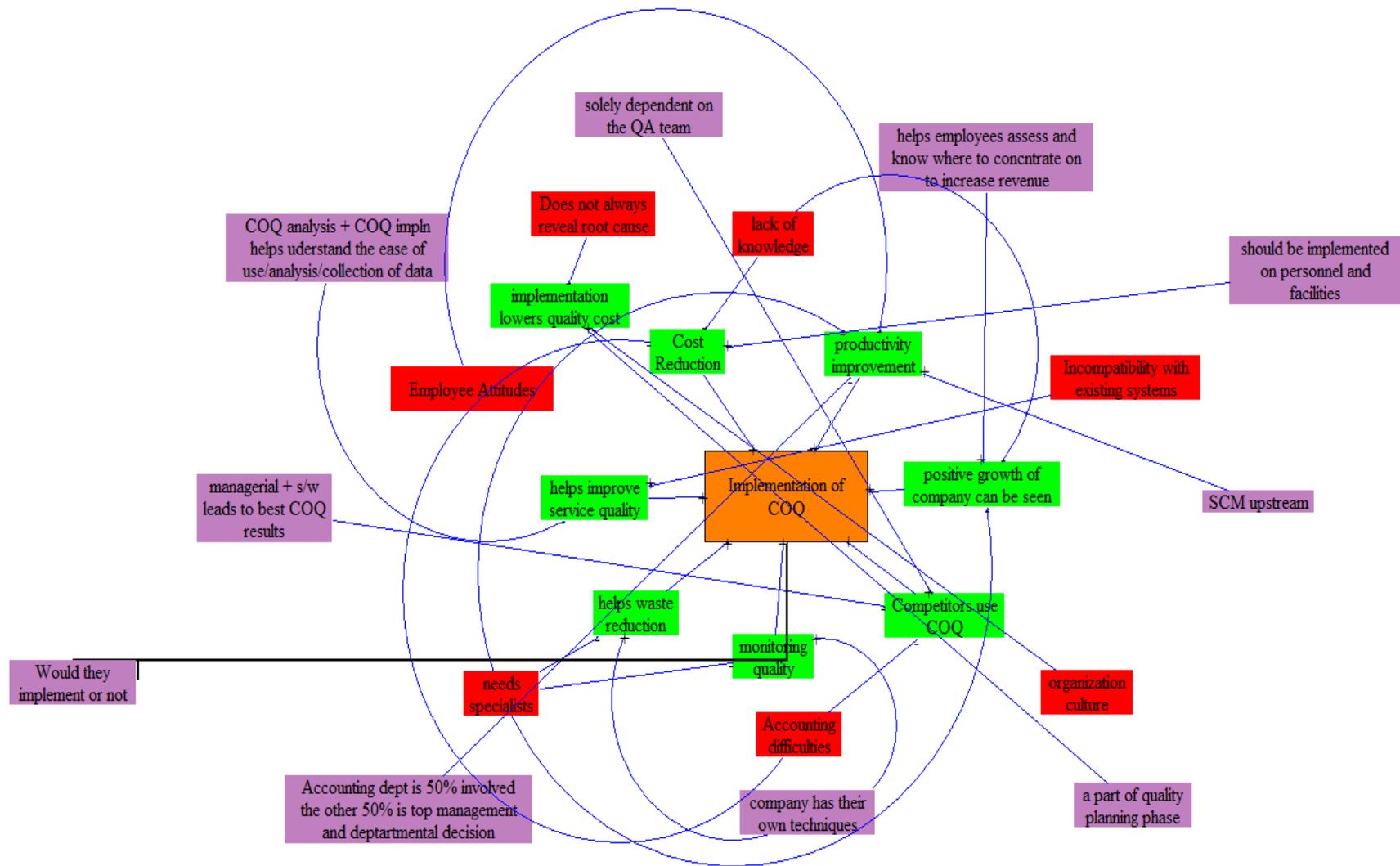
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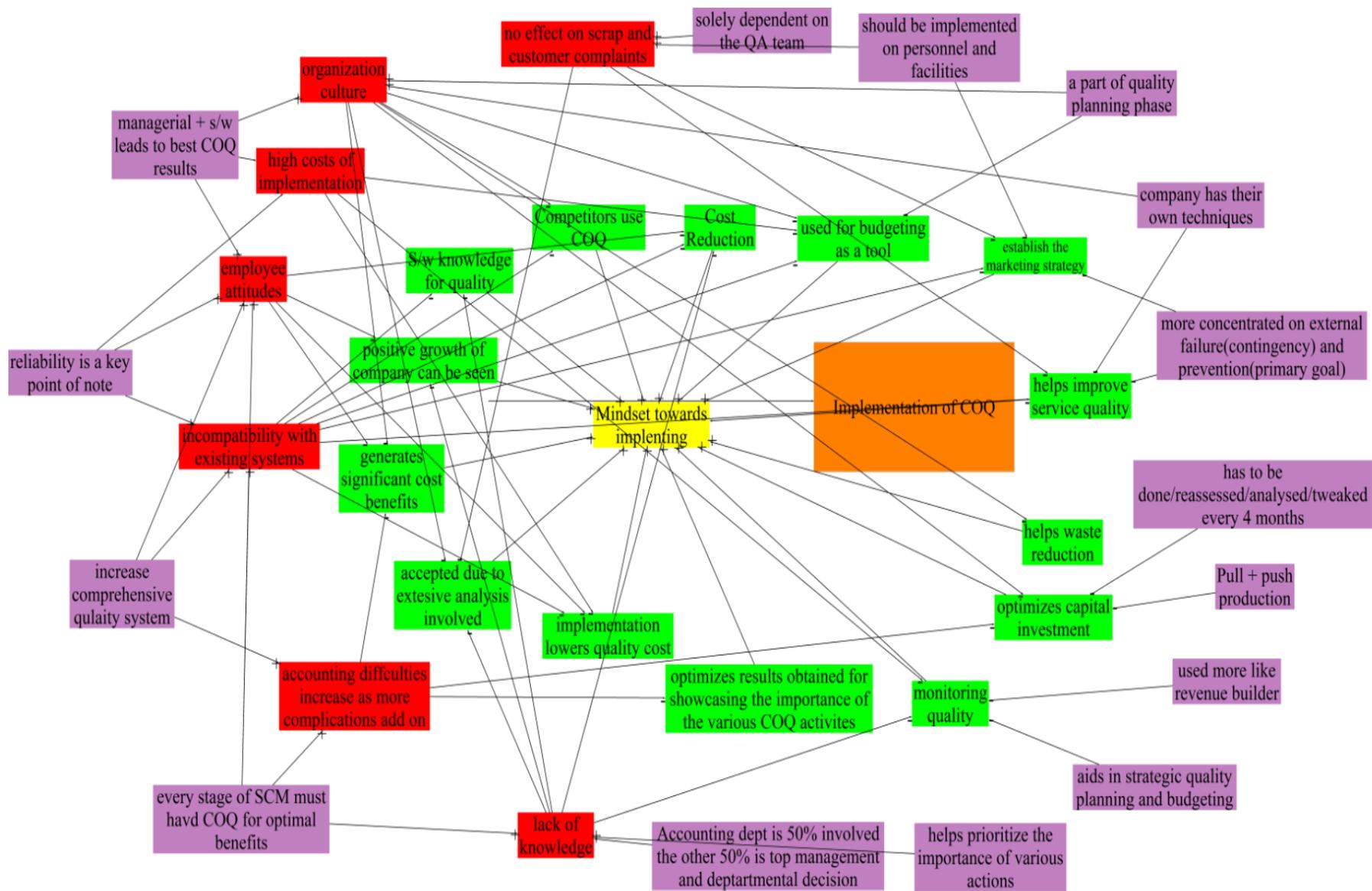
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**Appendix A:[Graphical representation Models]**

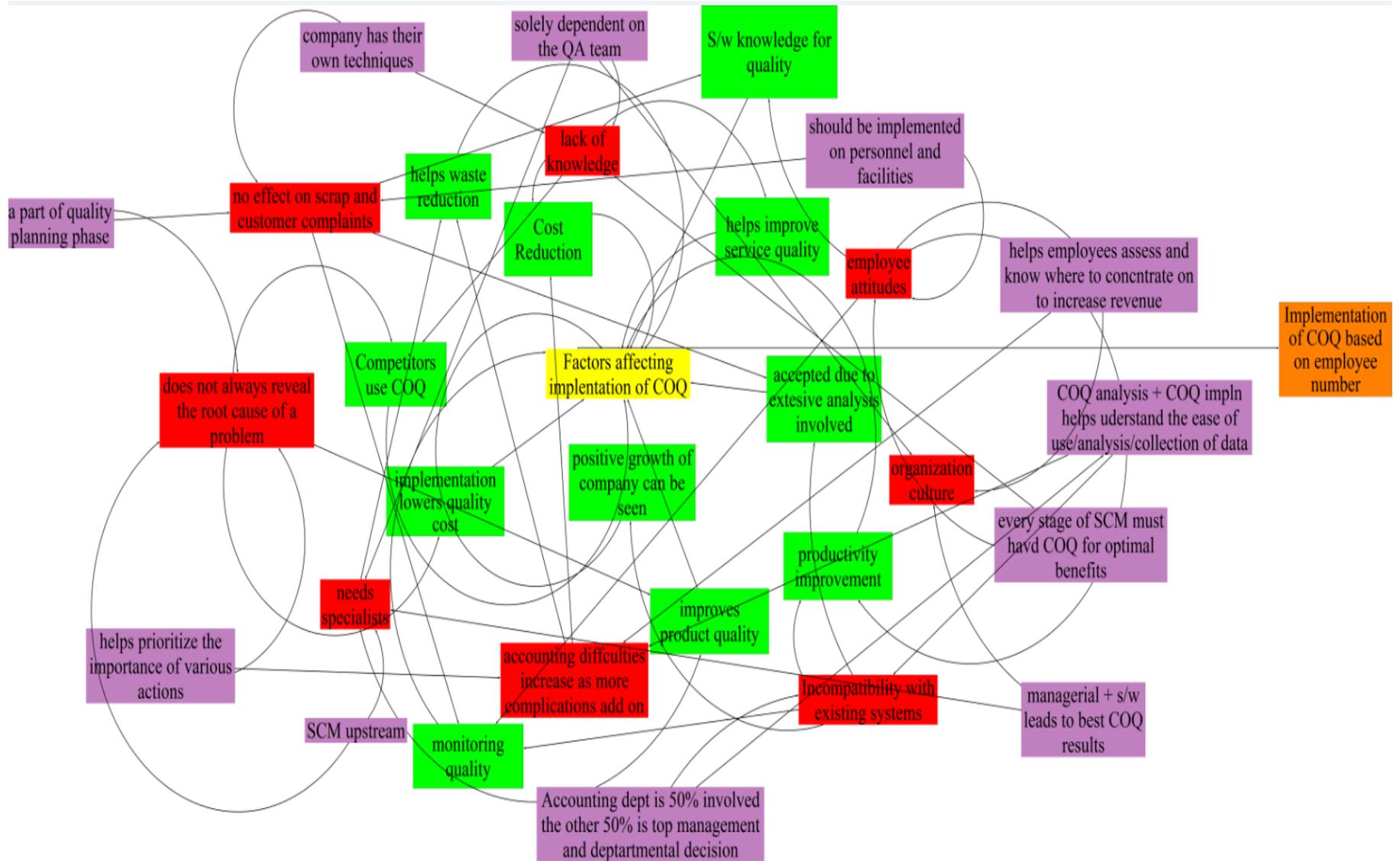


**Figure 1. Effect of implementation of COQ across different countries**

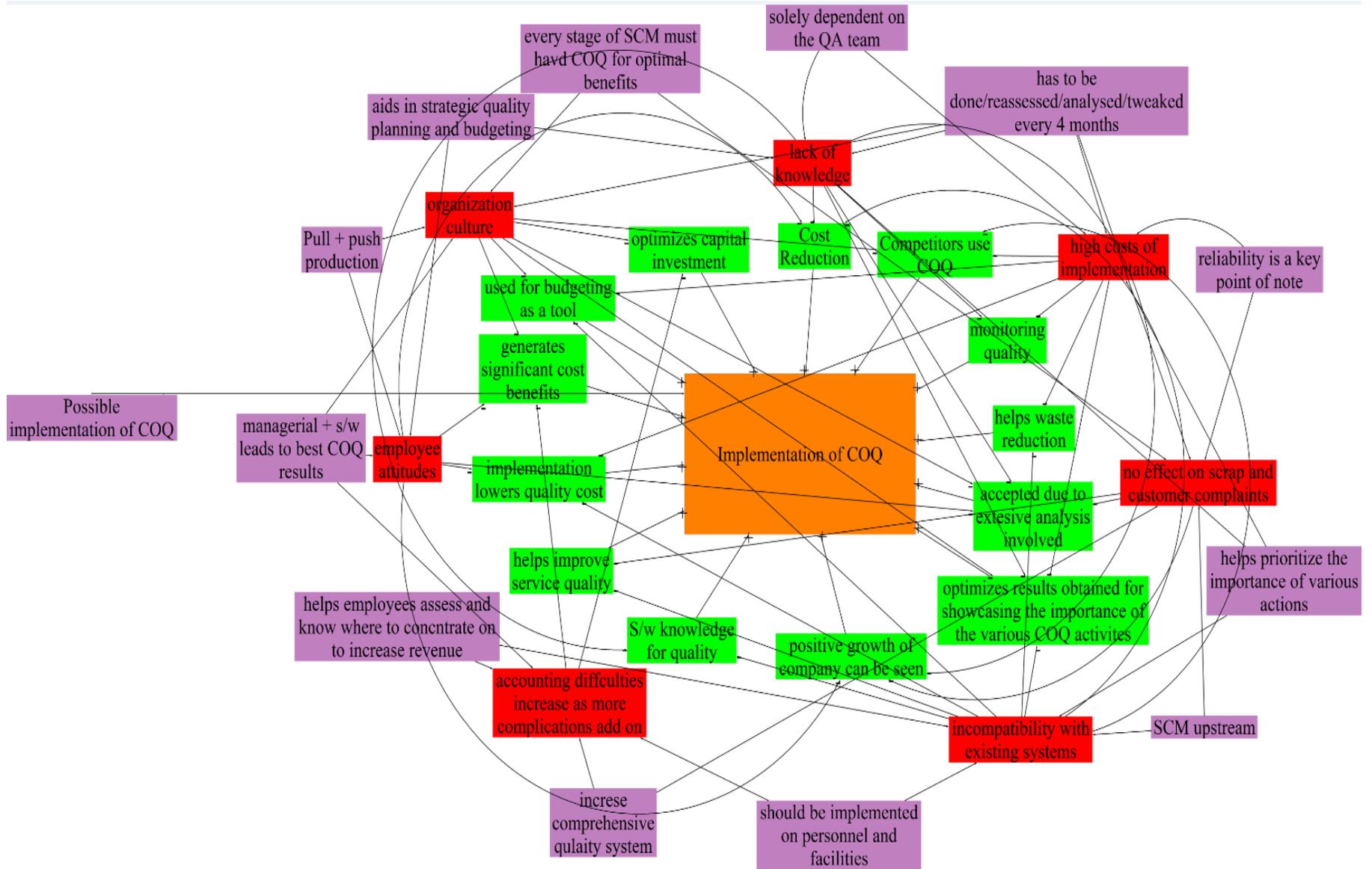


**Figure 2. Effect of implementation of COQ based on experience**





**Figure 4. Effect of implementation of COQ based on Number of Employees**



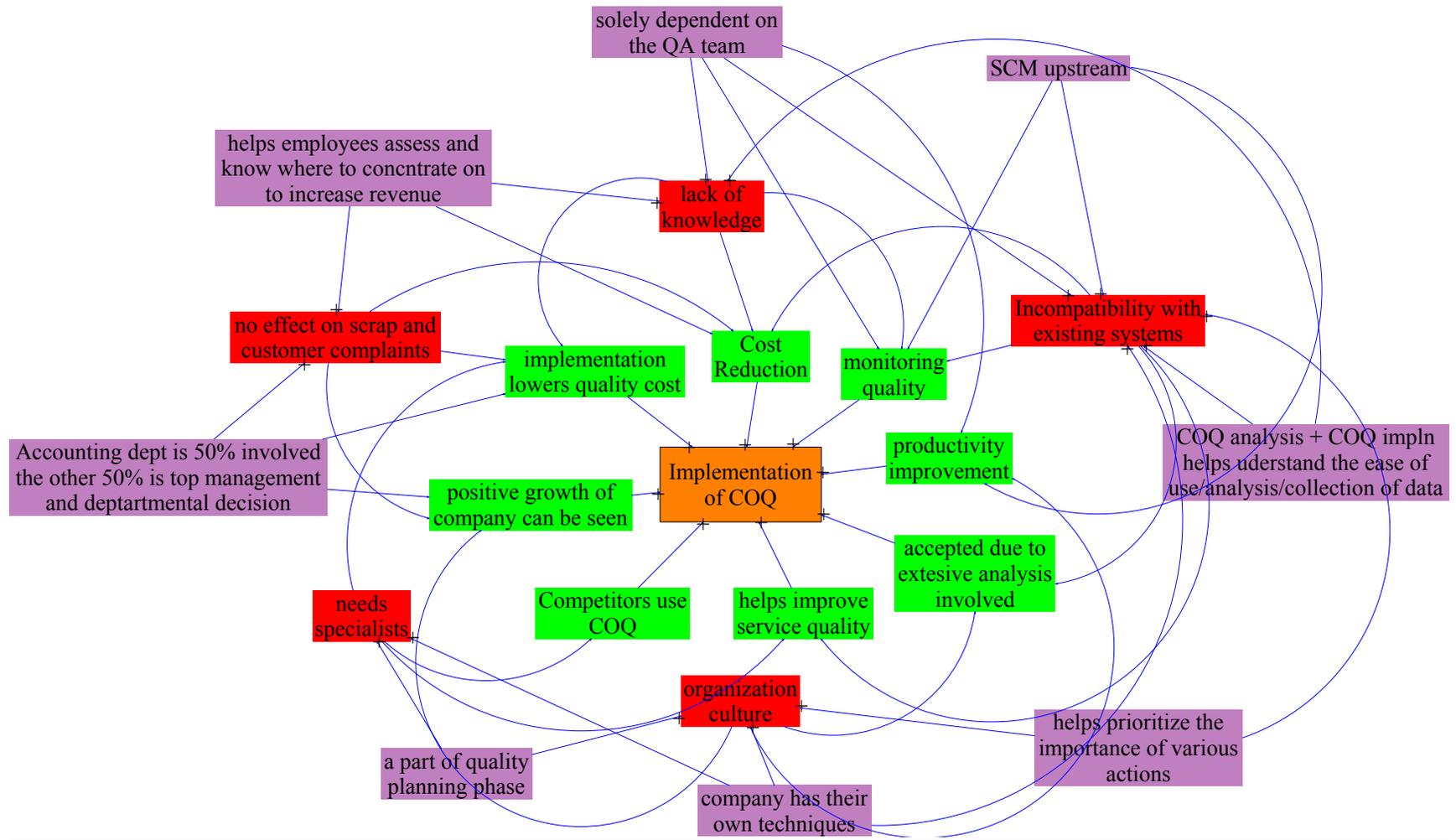
**Figure 5. Effect of implementation of COQ based on Employee Job Title**



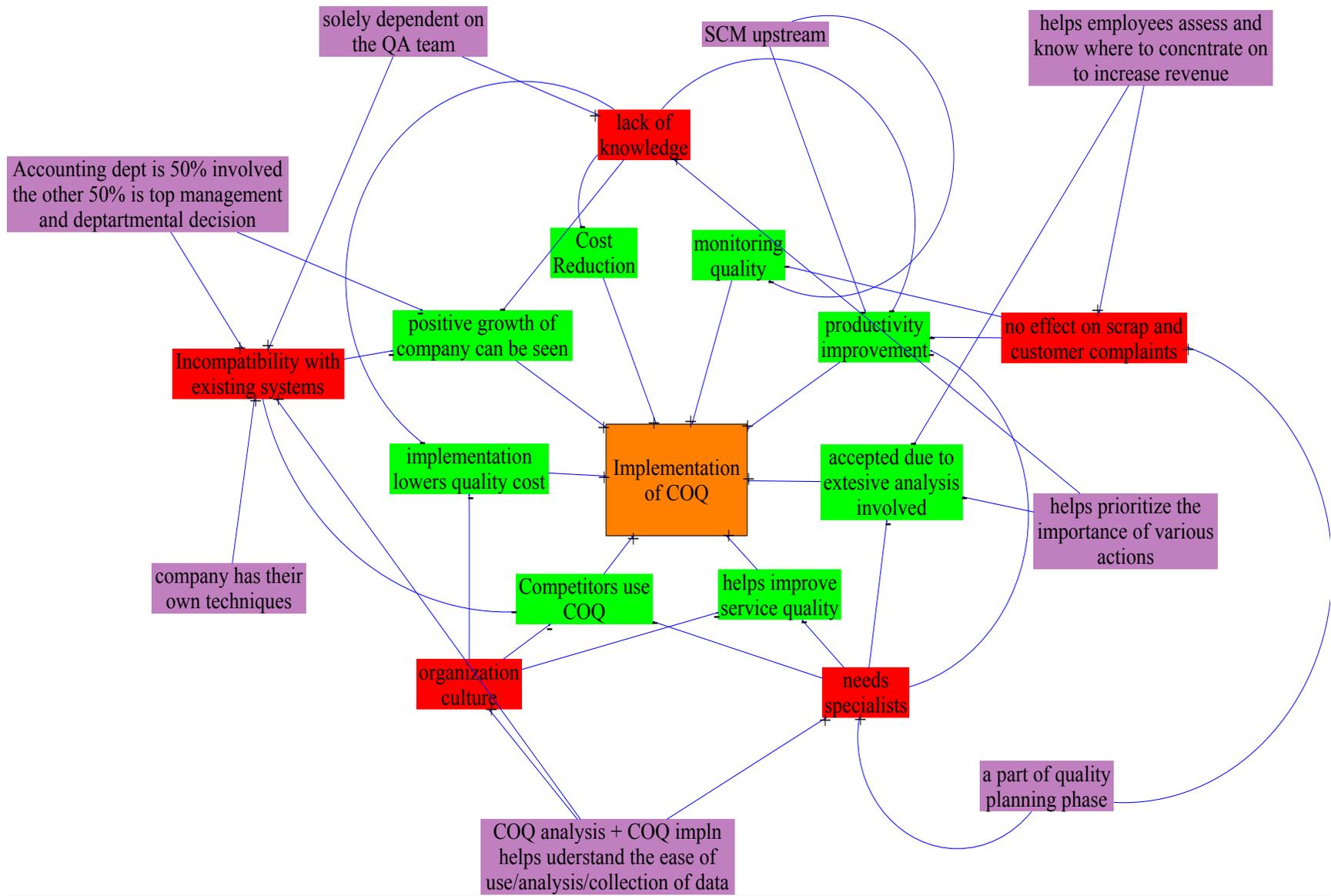


**Appendix B:[causal diags]**

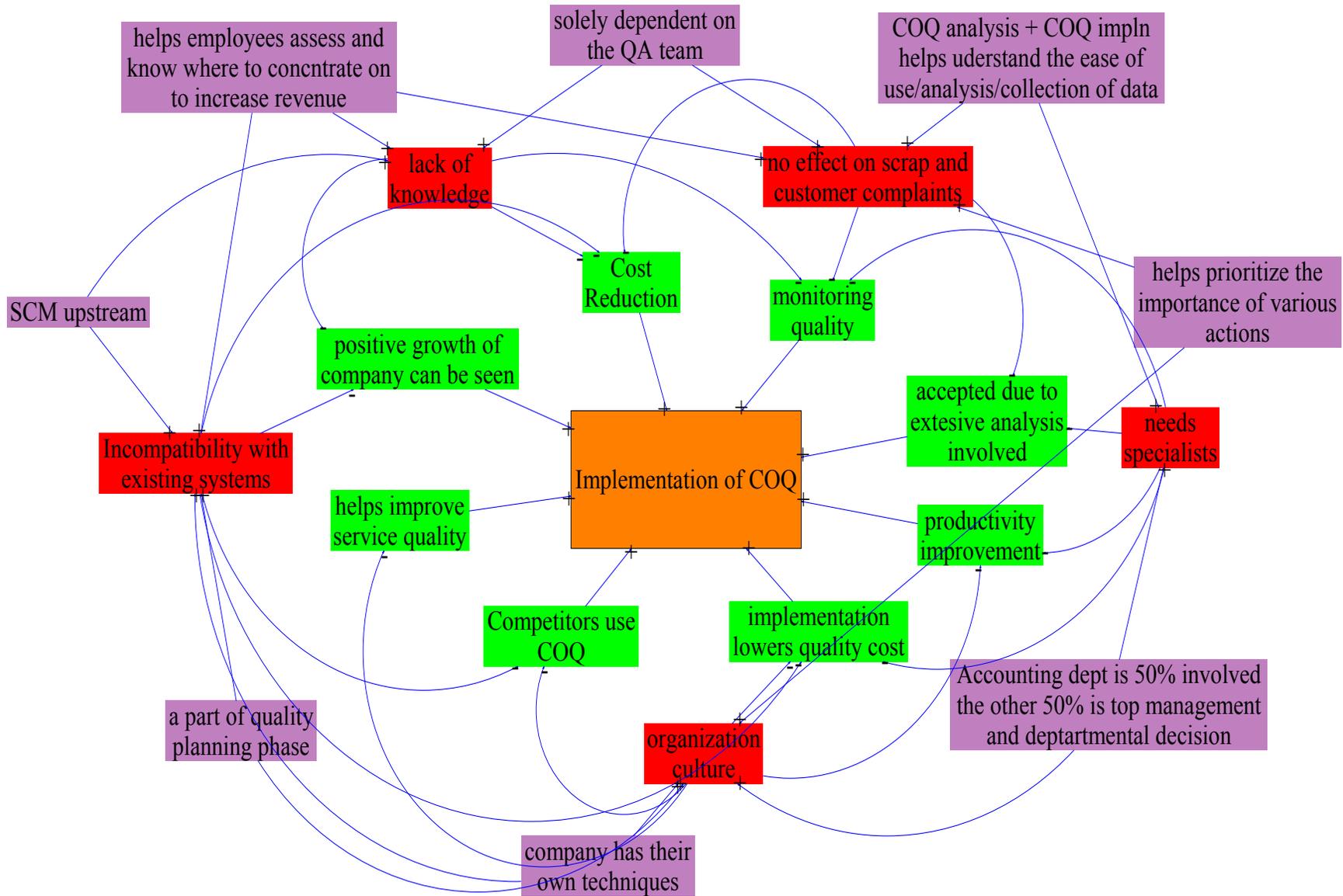
**Causal Diagrams Based on different countries:**



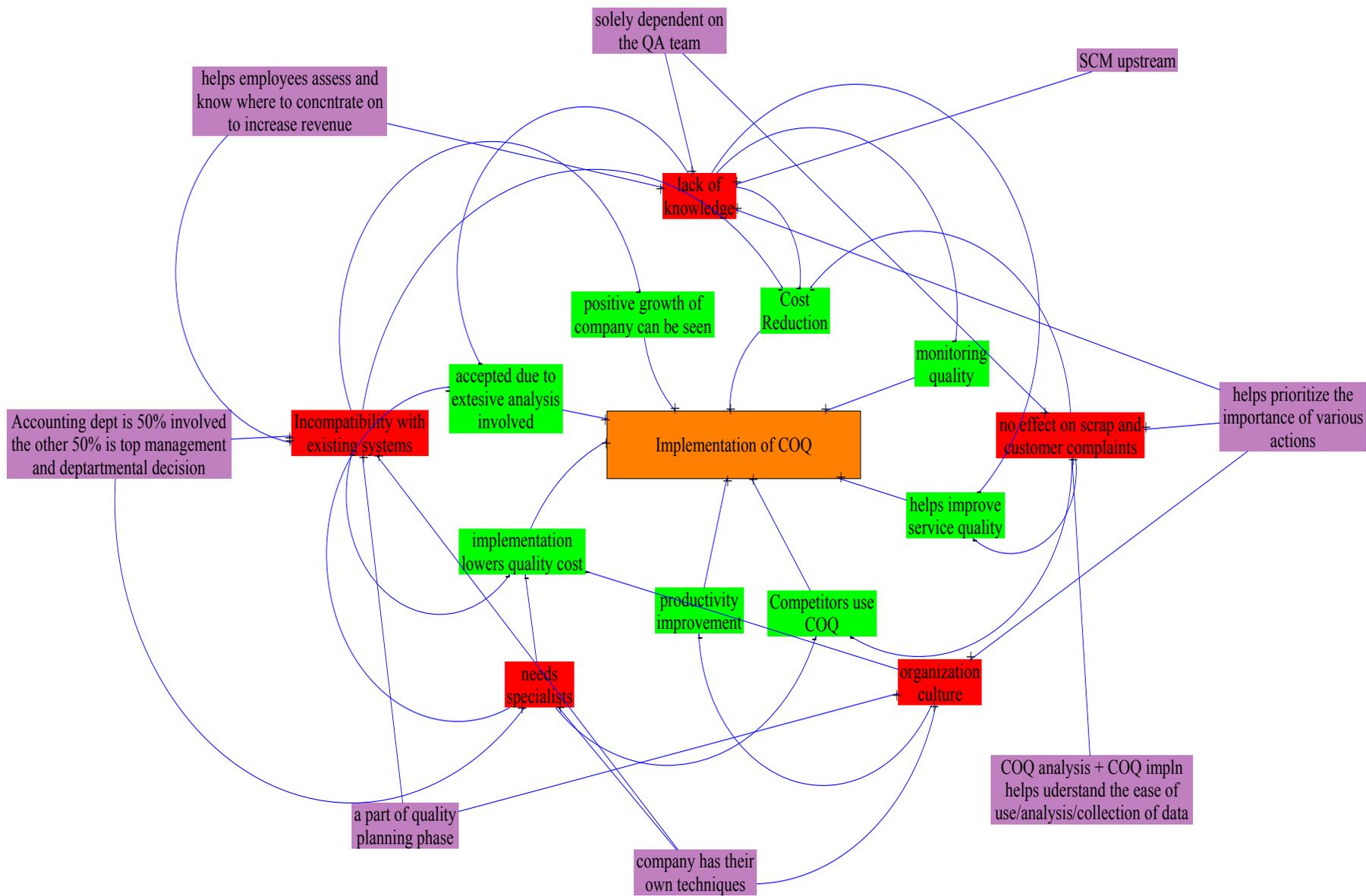
**Figure1. Canada**



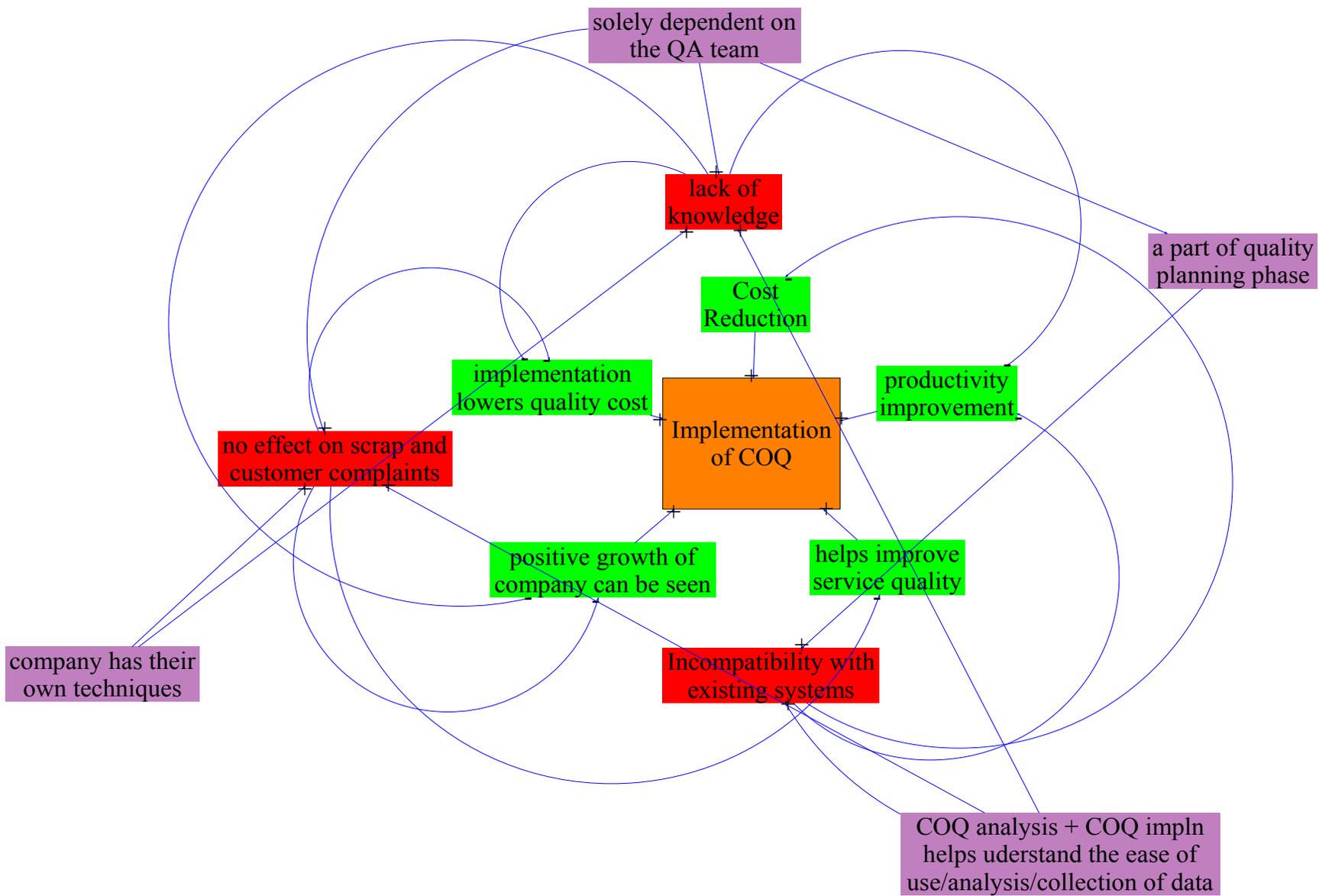
**Figure 2. Europe**



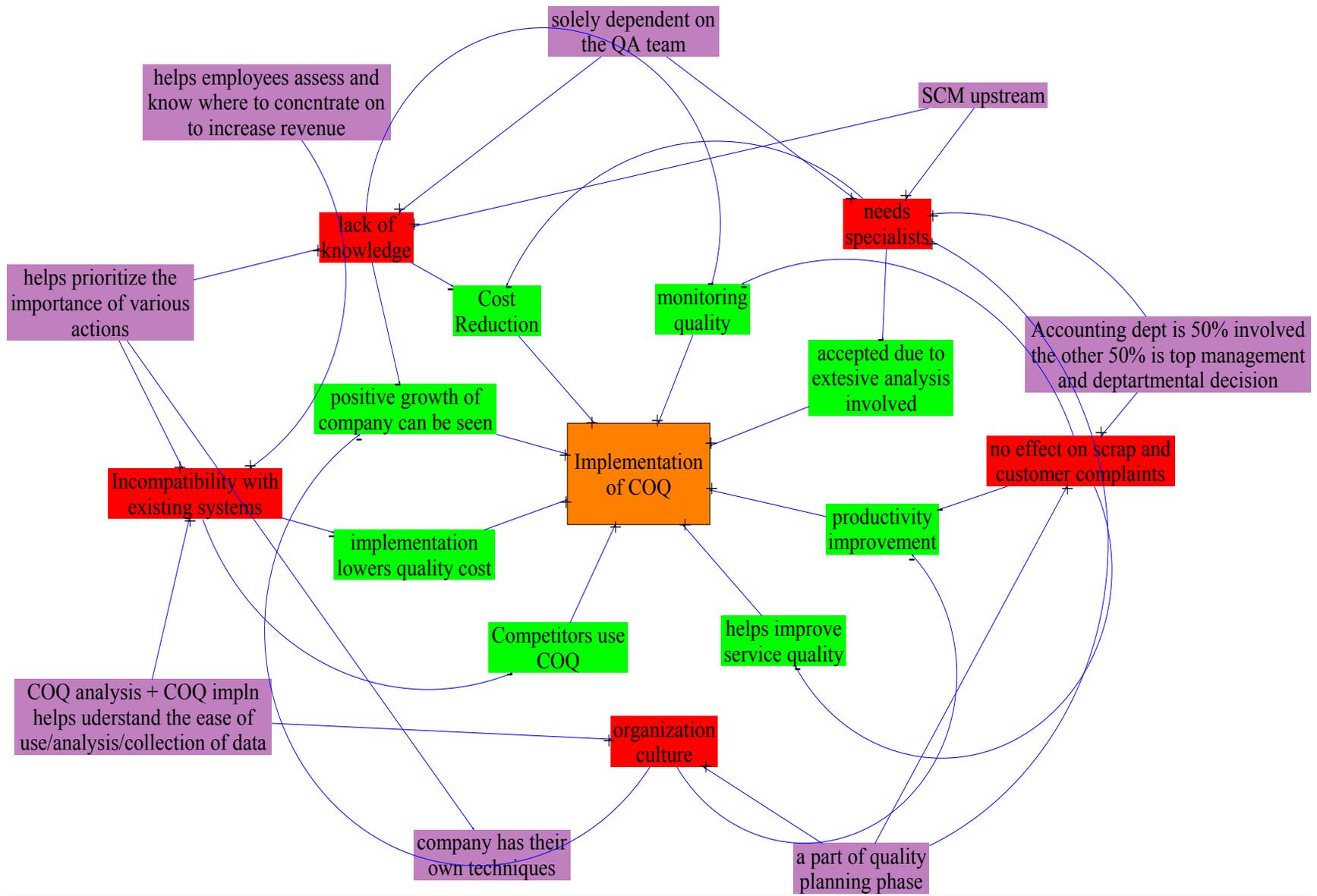
**Figure 3. South American Countries**



**Figure 4.USA**

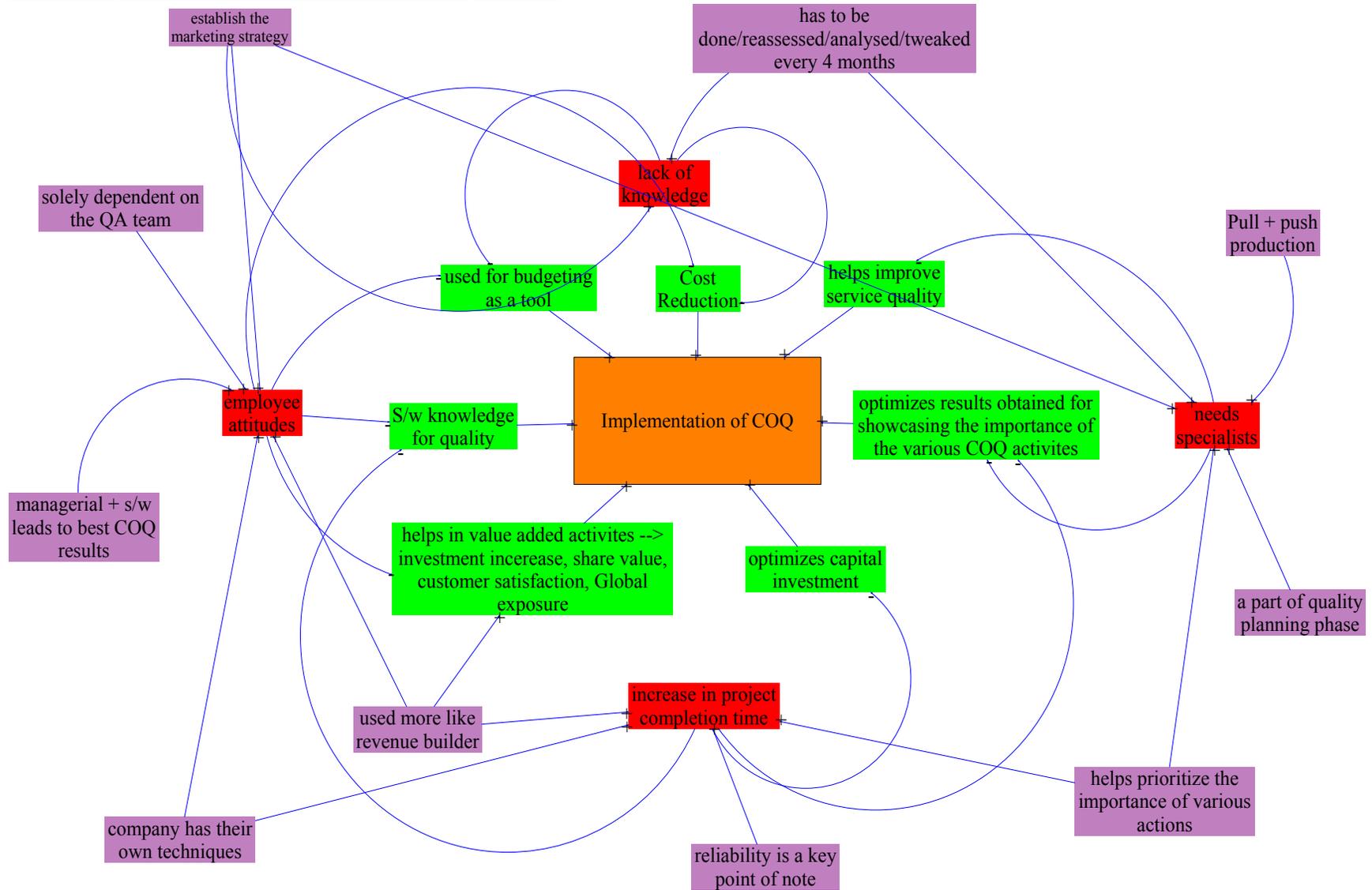


**Figure 5. Other Asian Countries**

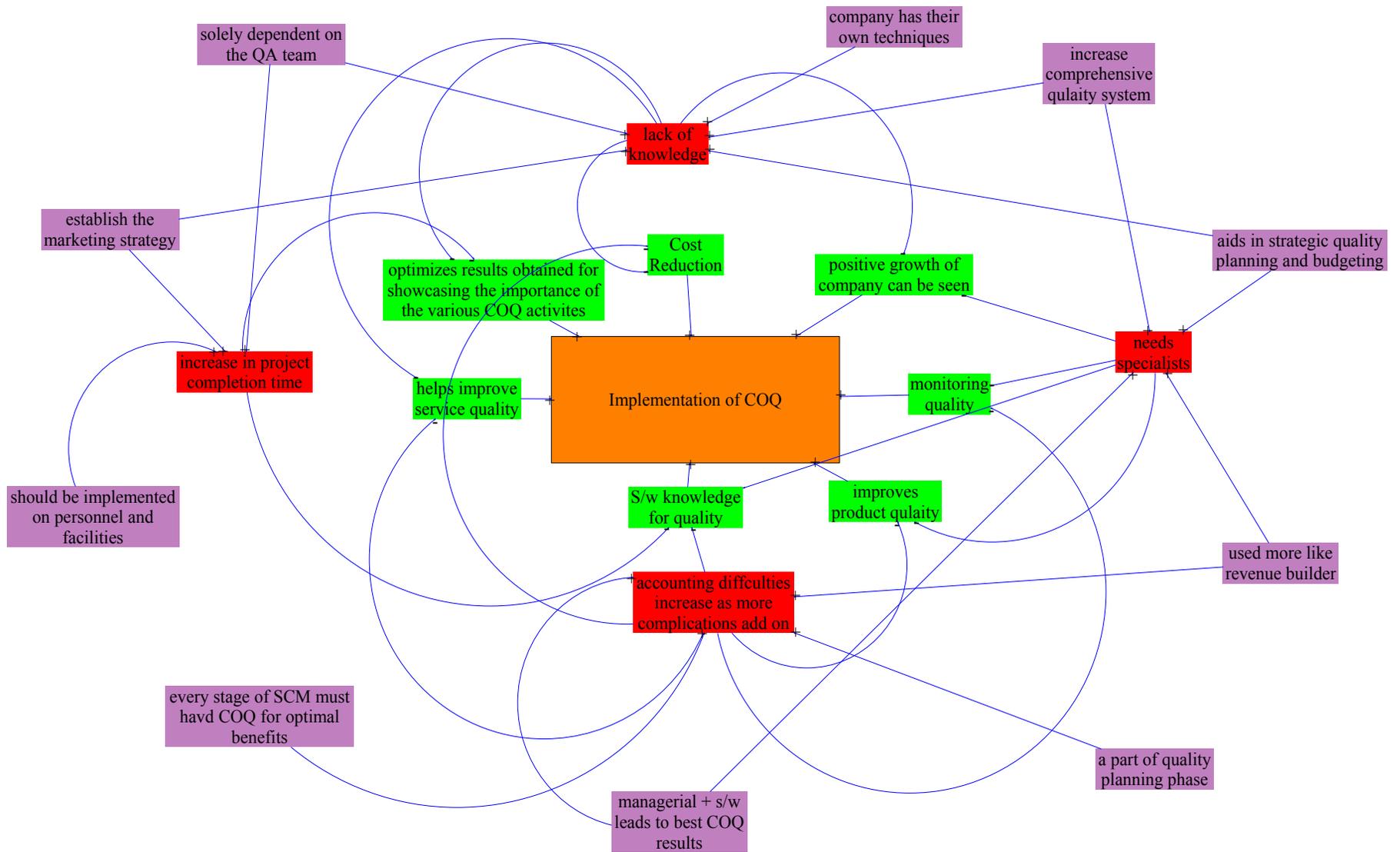


**Figure 6. China**

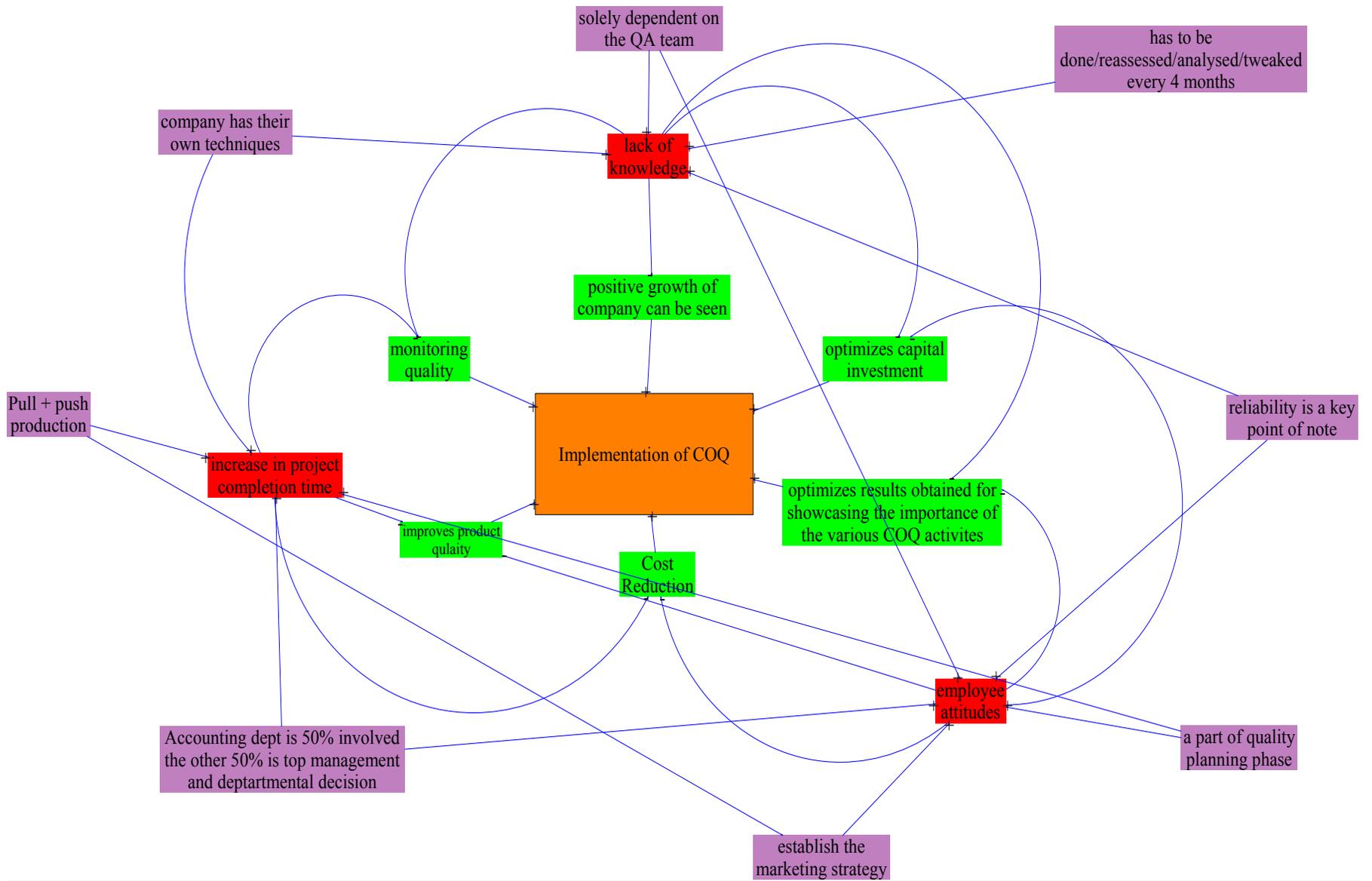
**Causal diagrams based on different years of experience:**



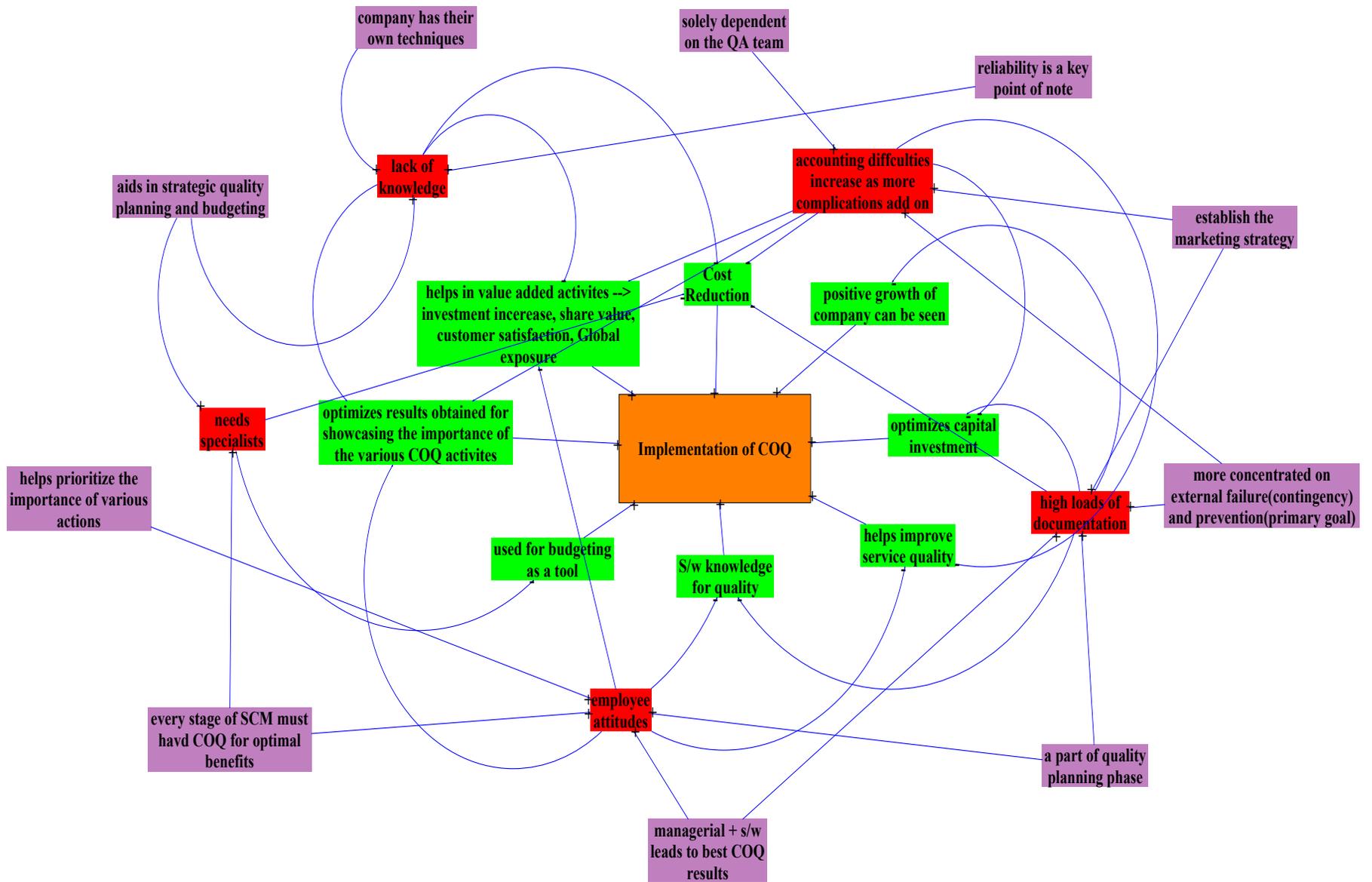
**Figure 7. Less than 1 year experience**



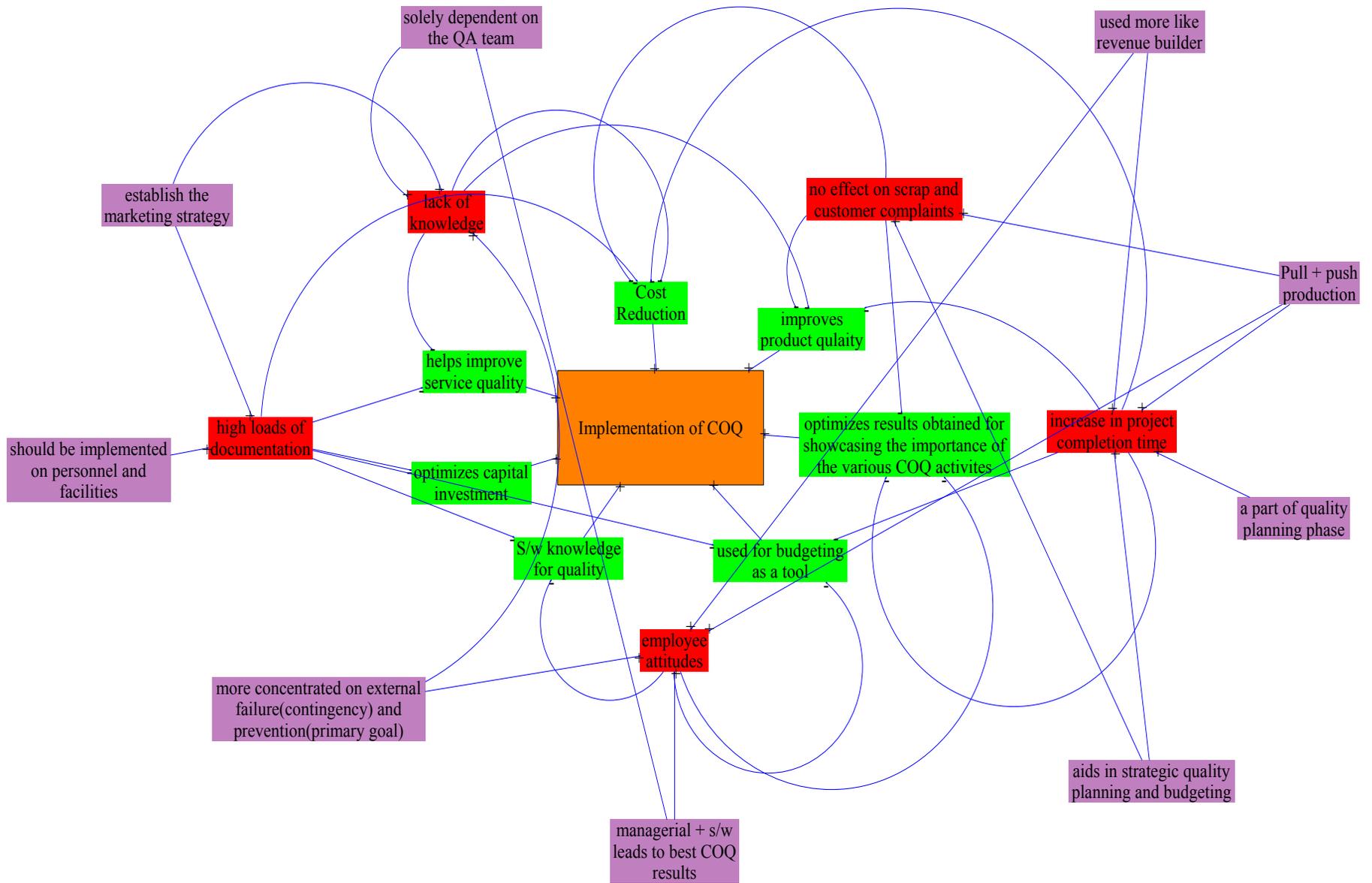
**Figure 8. 1 to 3 years of experience**



**Figure 9. 4 to 6 years of experience**

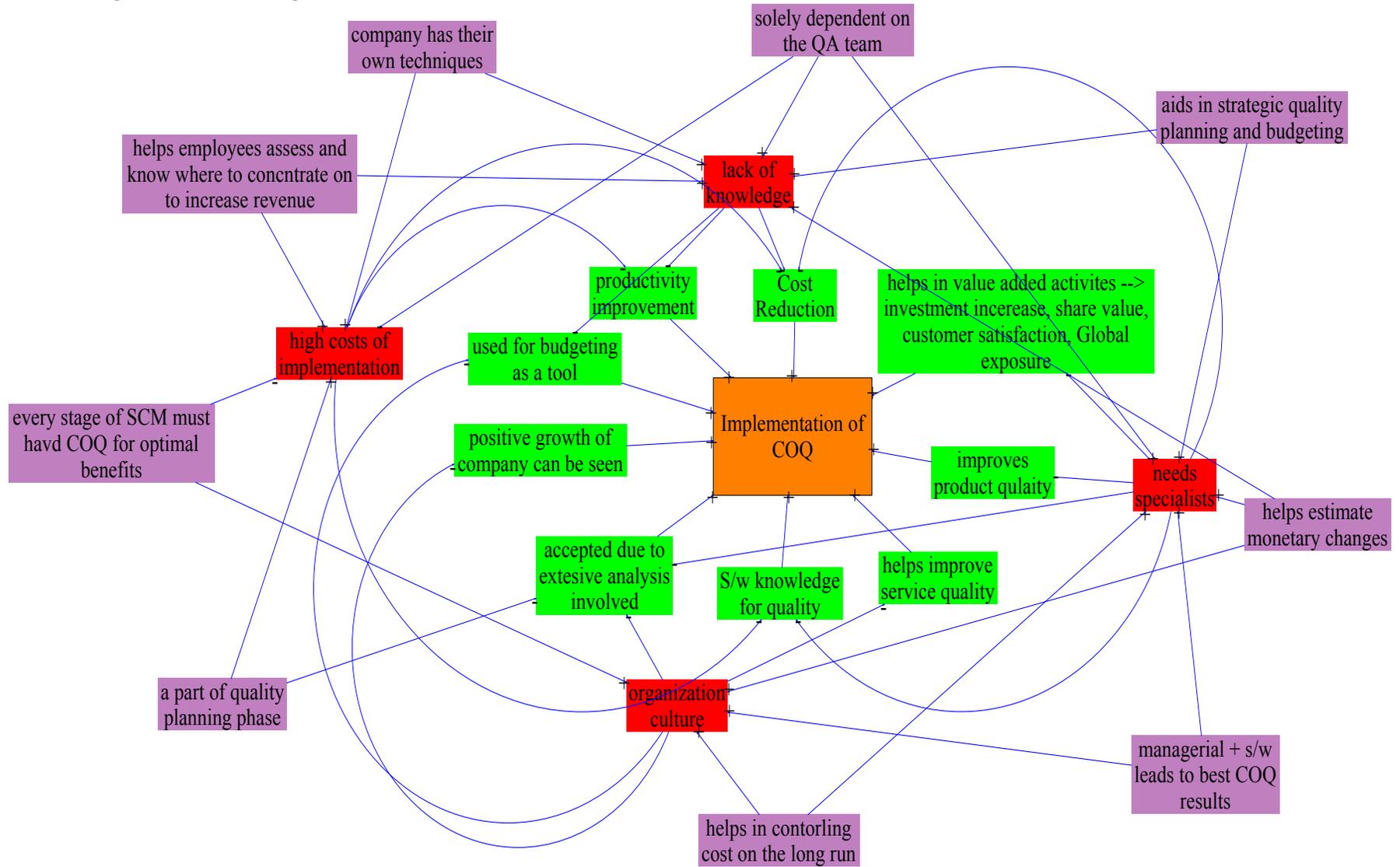


**Figure 10. 7 to 10 years of experience**

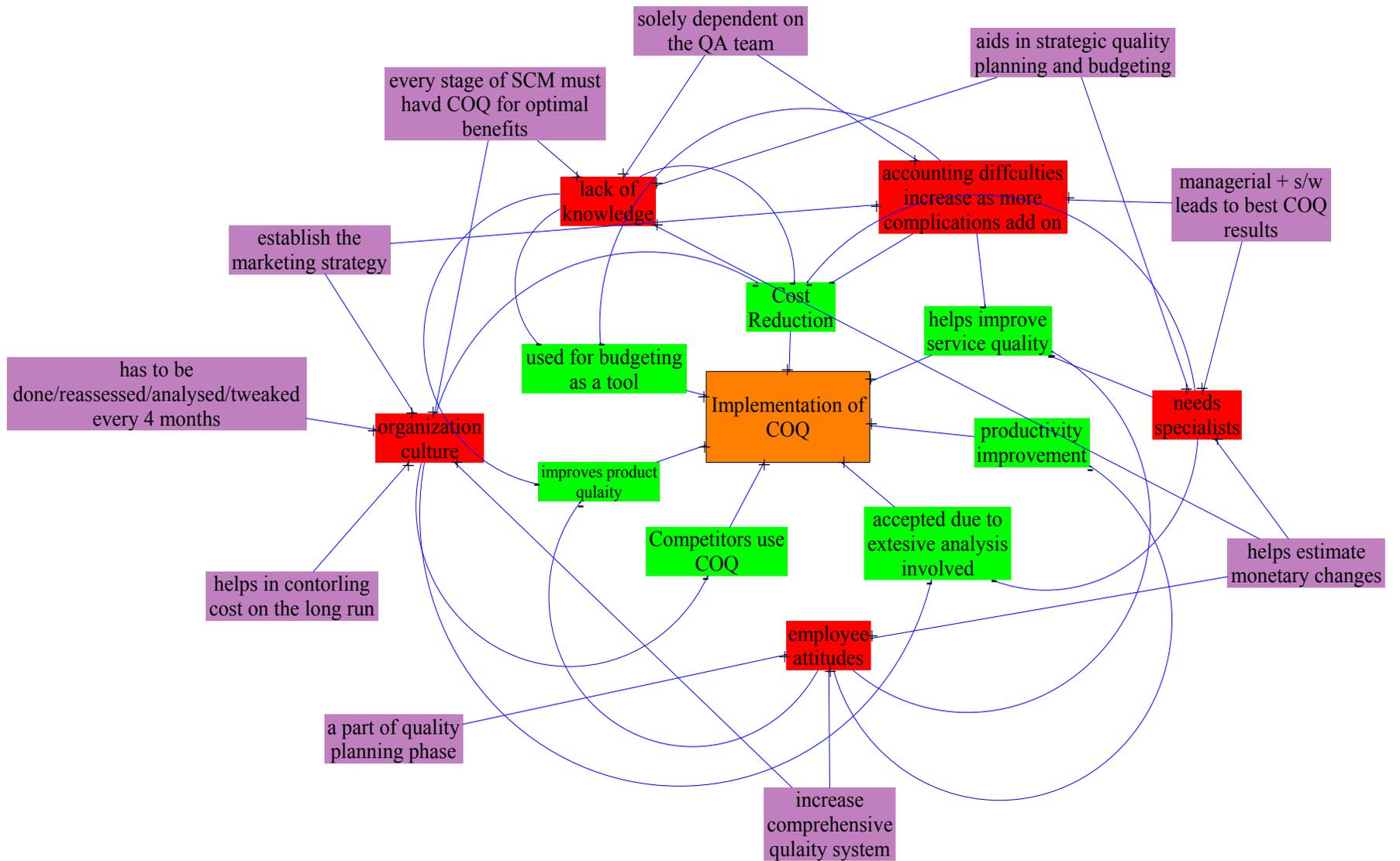


**Figure 11. Experience of 11 years and above**

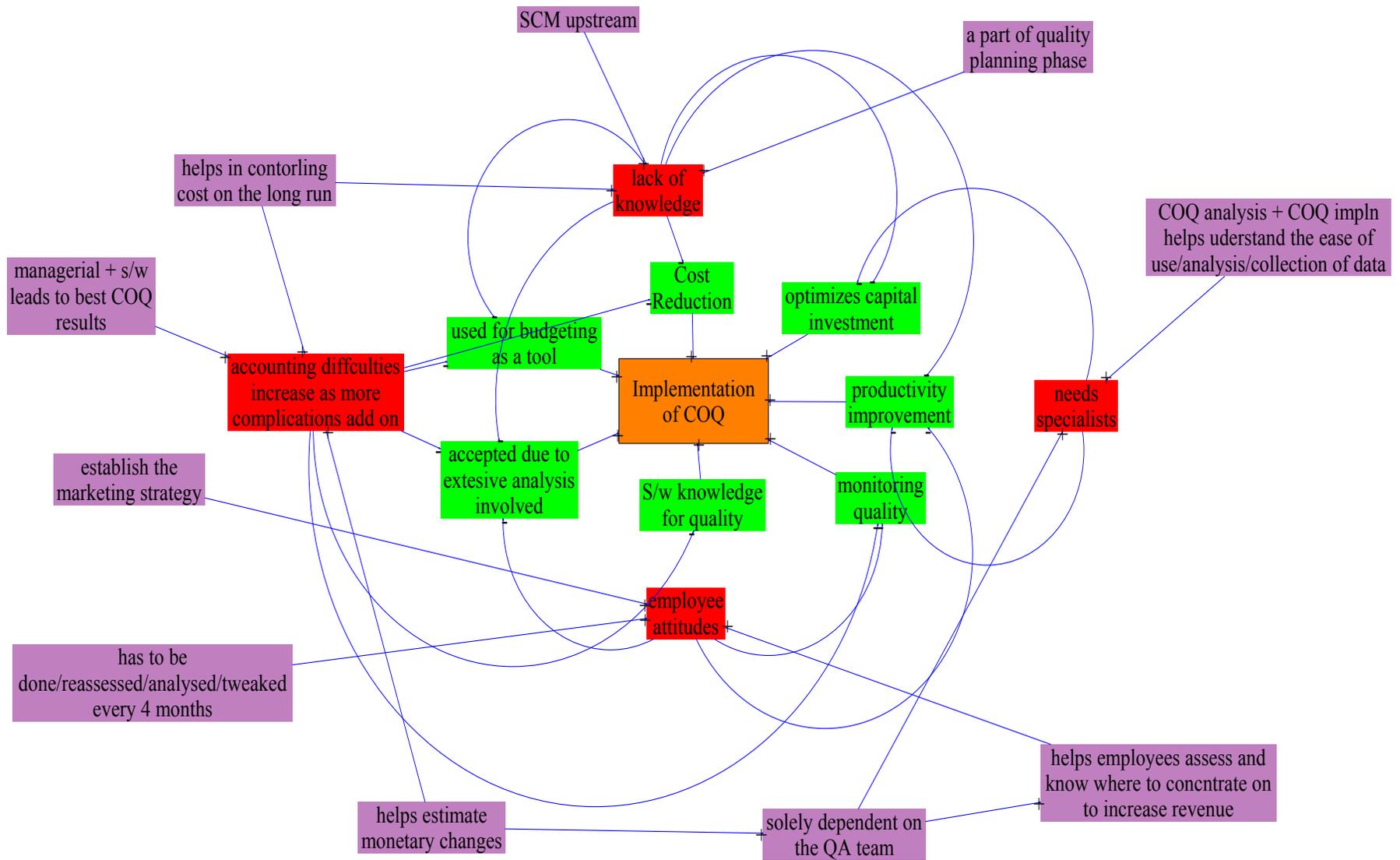
**Causal diagrams based on organizational revenue:**



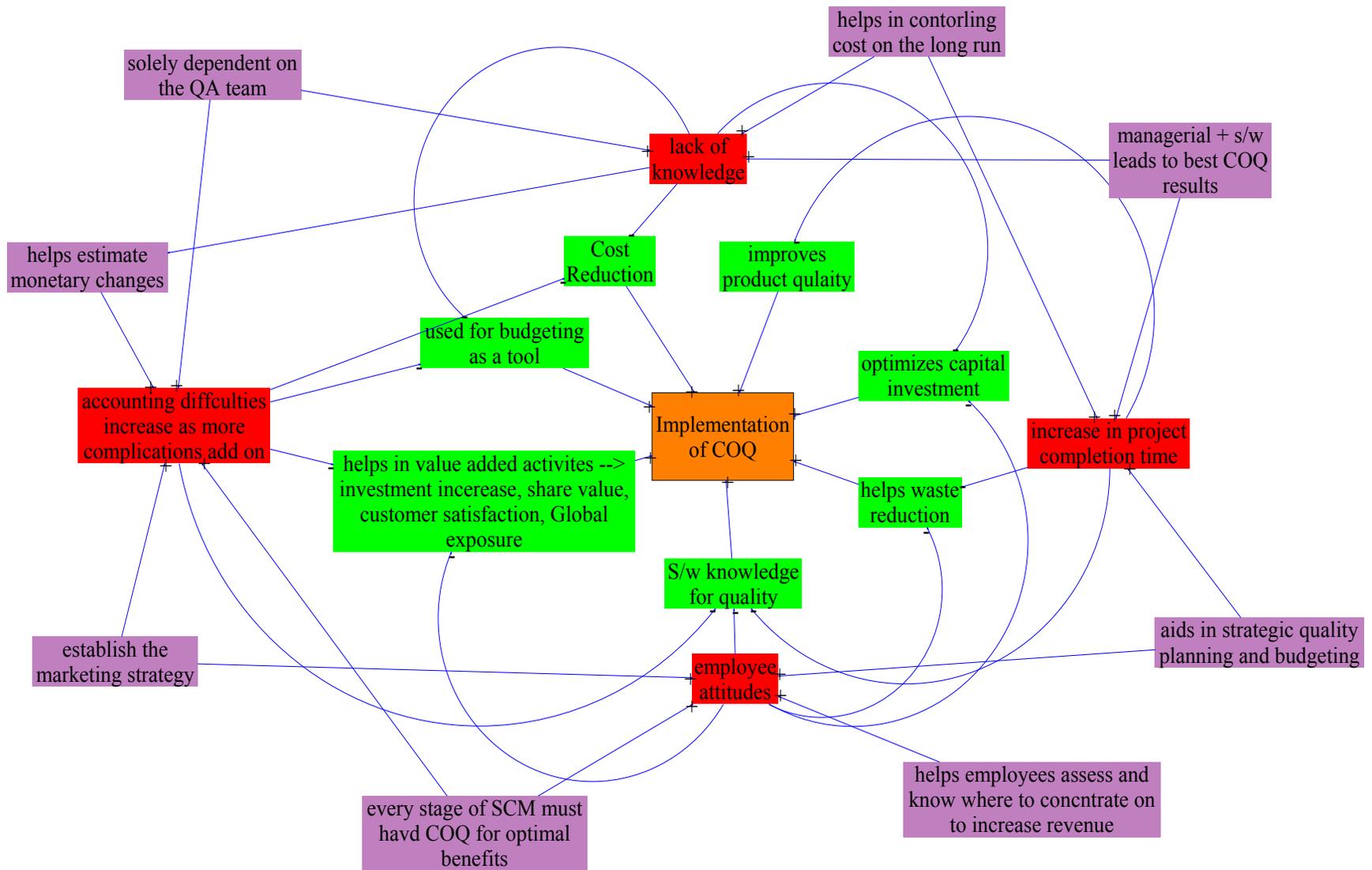
**Figure 12. Revenue less than 1 Million dollars**



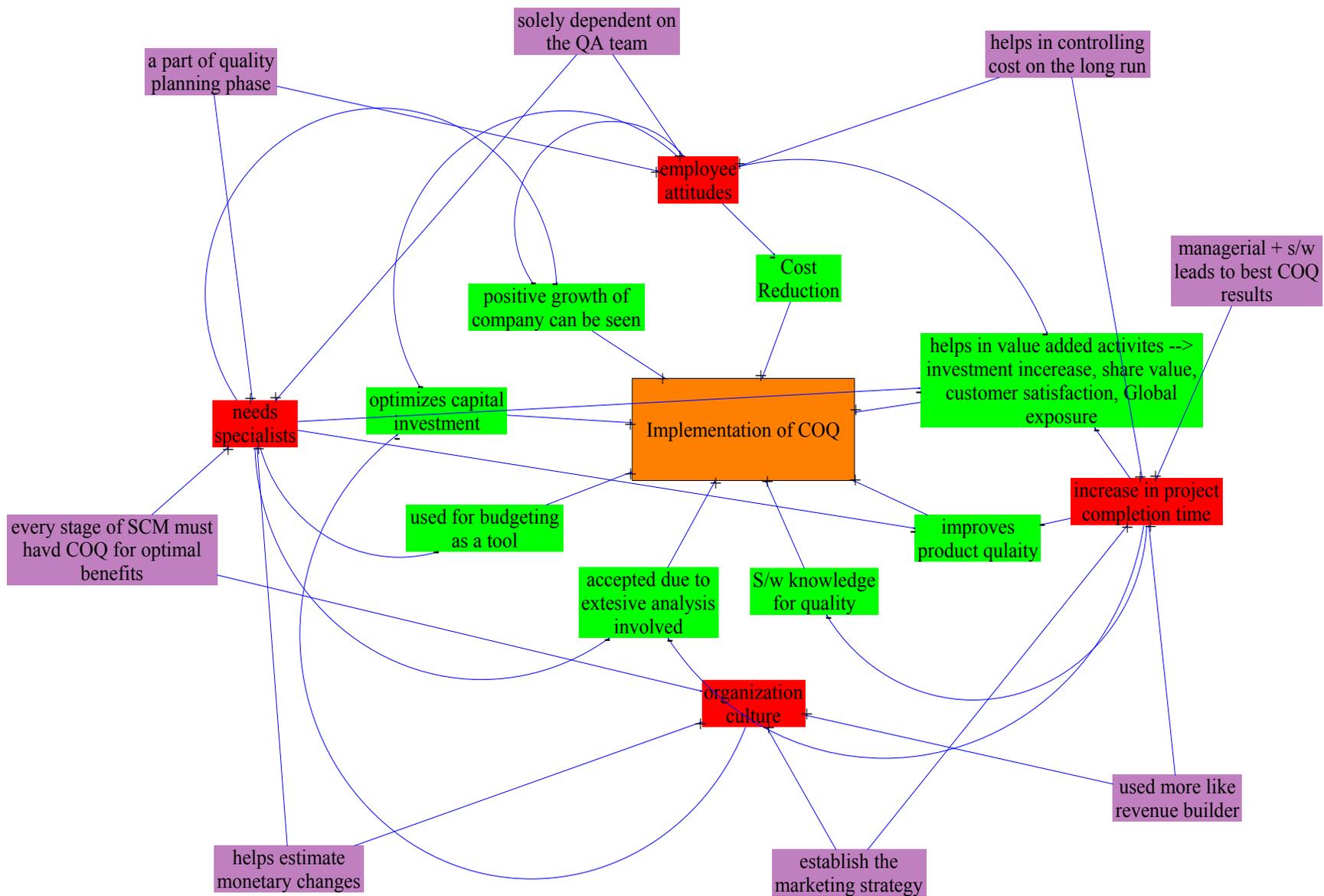
**Figure 13. Revenue between 1 to 5 million dollars**



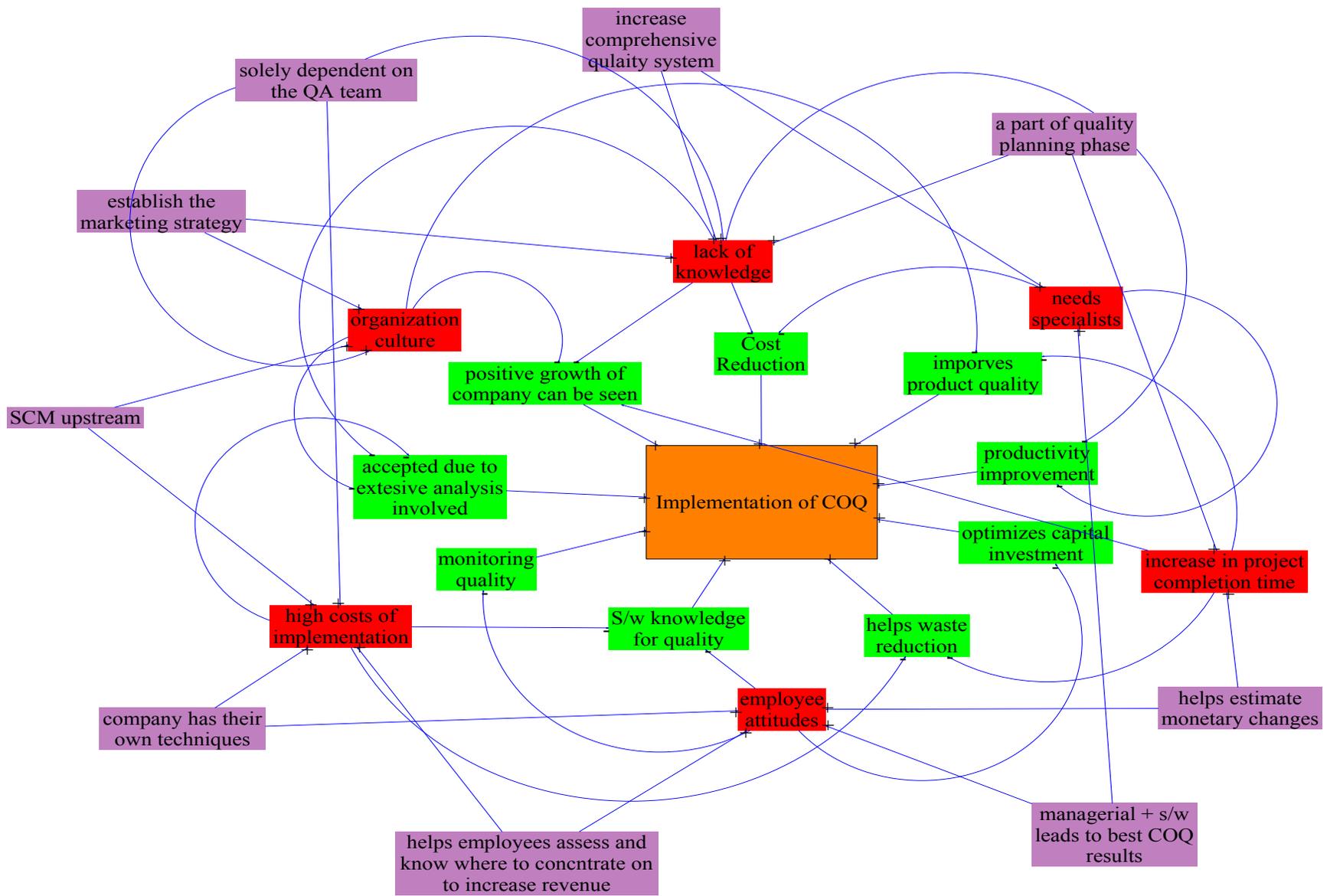
**Figure 14. Revenue between 6 to 25 million dollars**



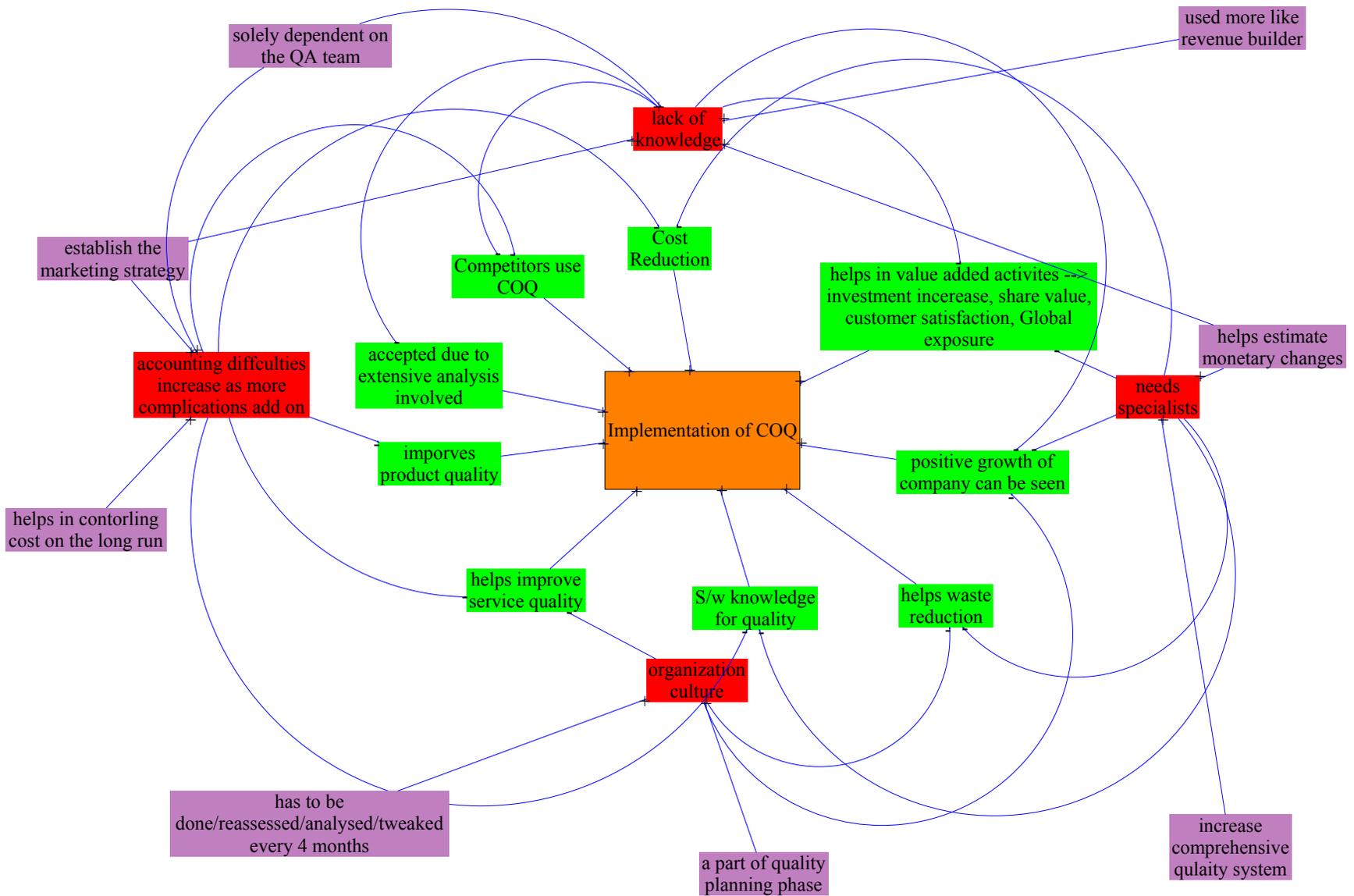
**Figure 15. Revenue between 26 to 50 million dollars**



**Figure 16. Revenue between 51 to 249 million dollars**

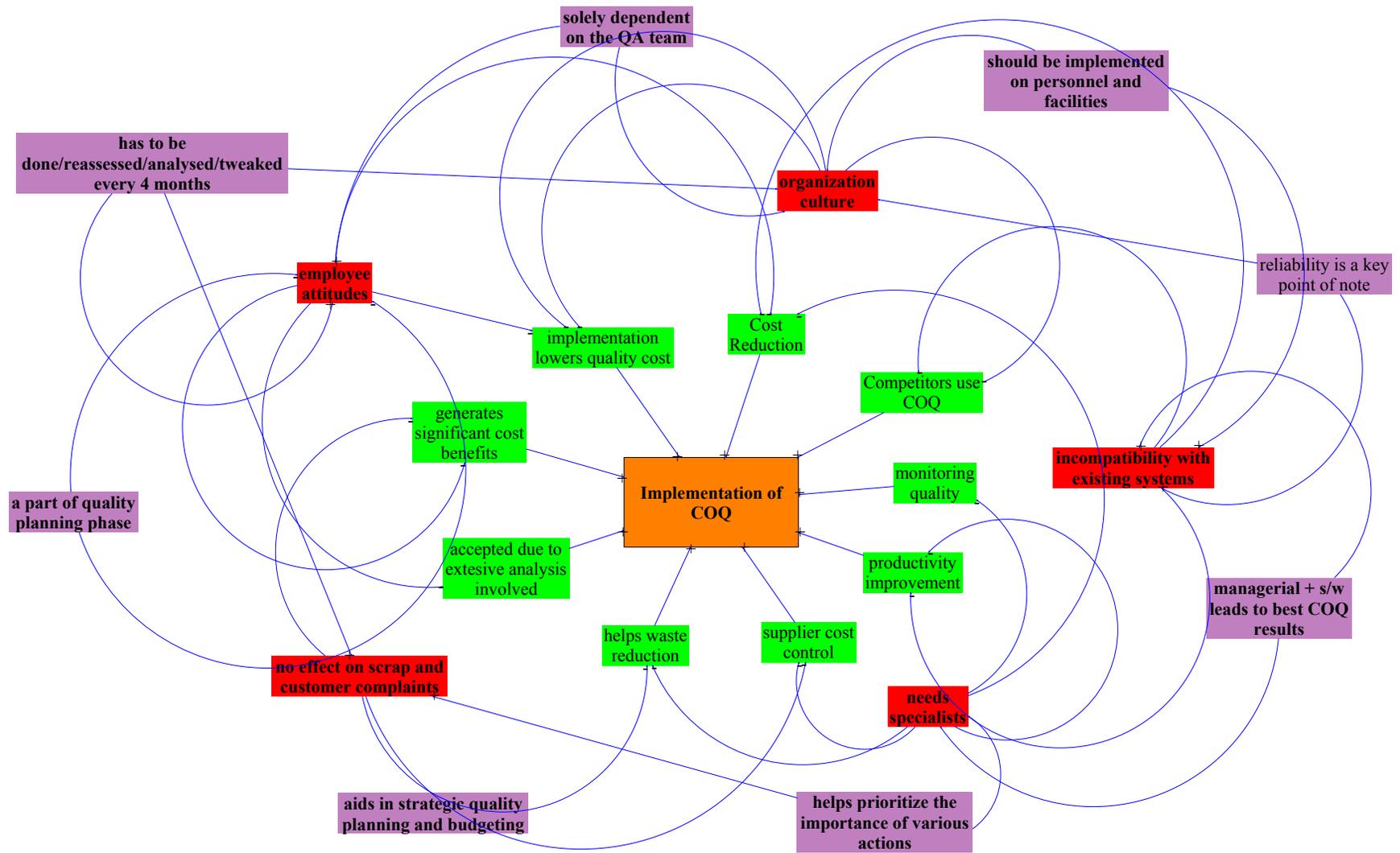


**Figure 17. Revenue between 250 and 499 million dollars**

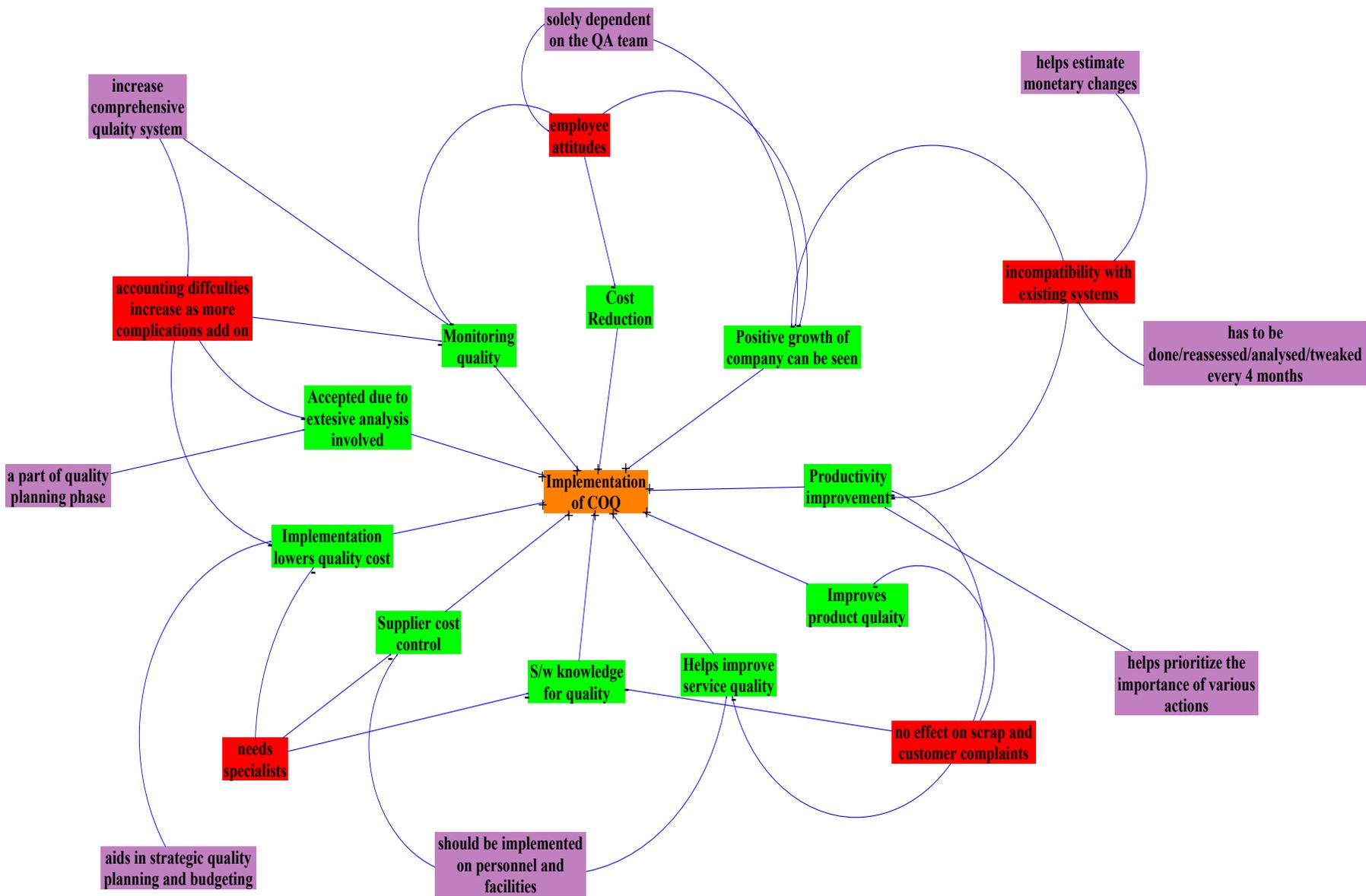


**Figure 18. Revenue for 500 million dollars and above**

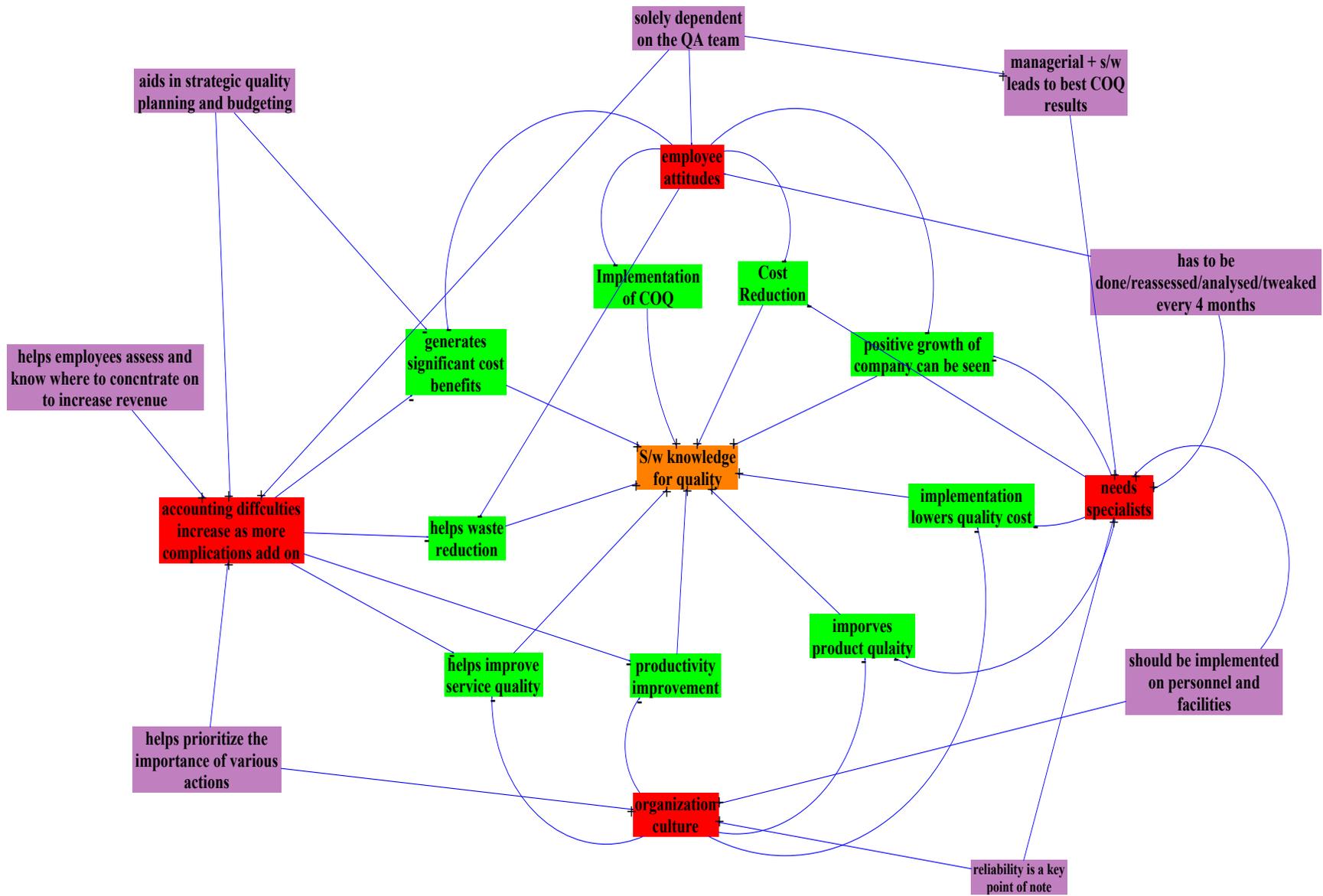
**Causal diagrams based on Department type:**



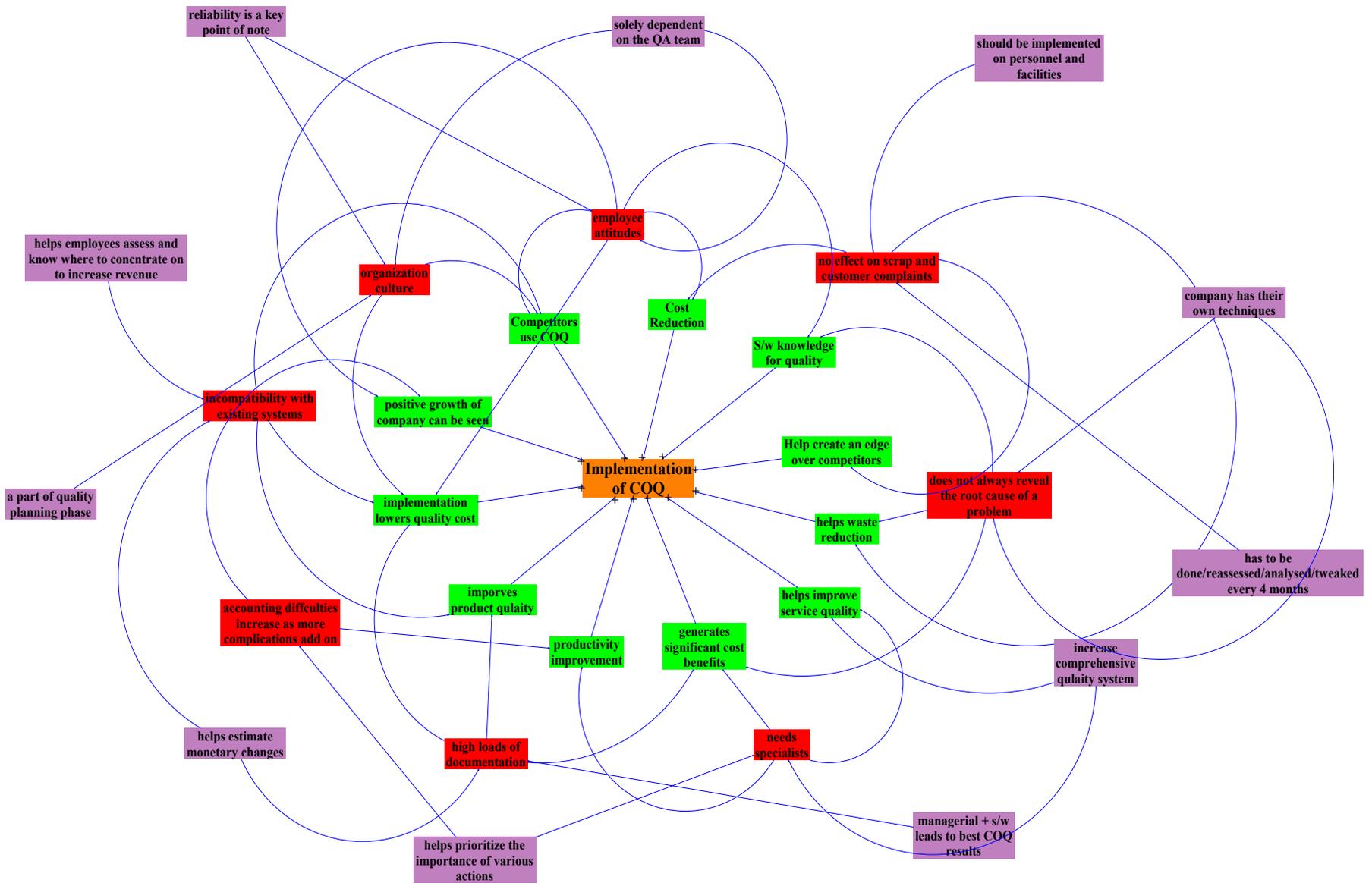
**Figure 19. Accounts Department**



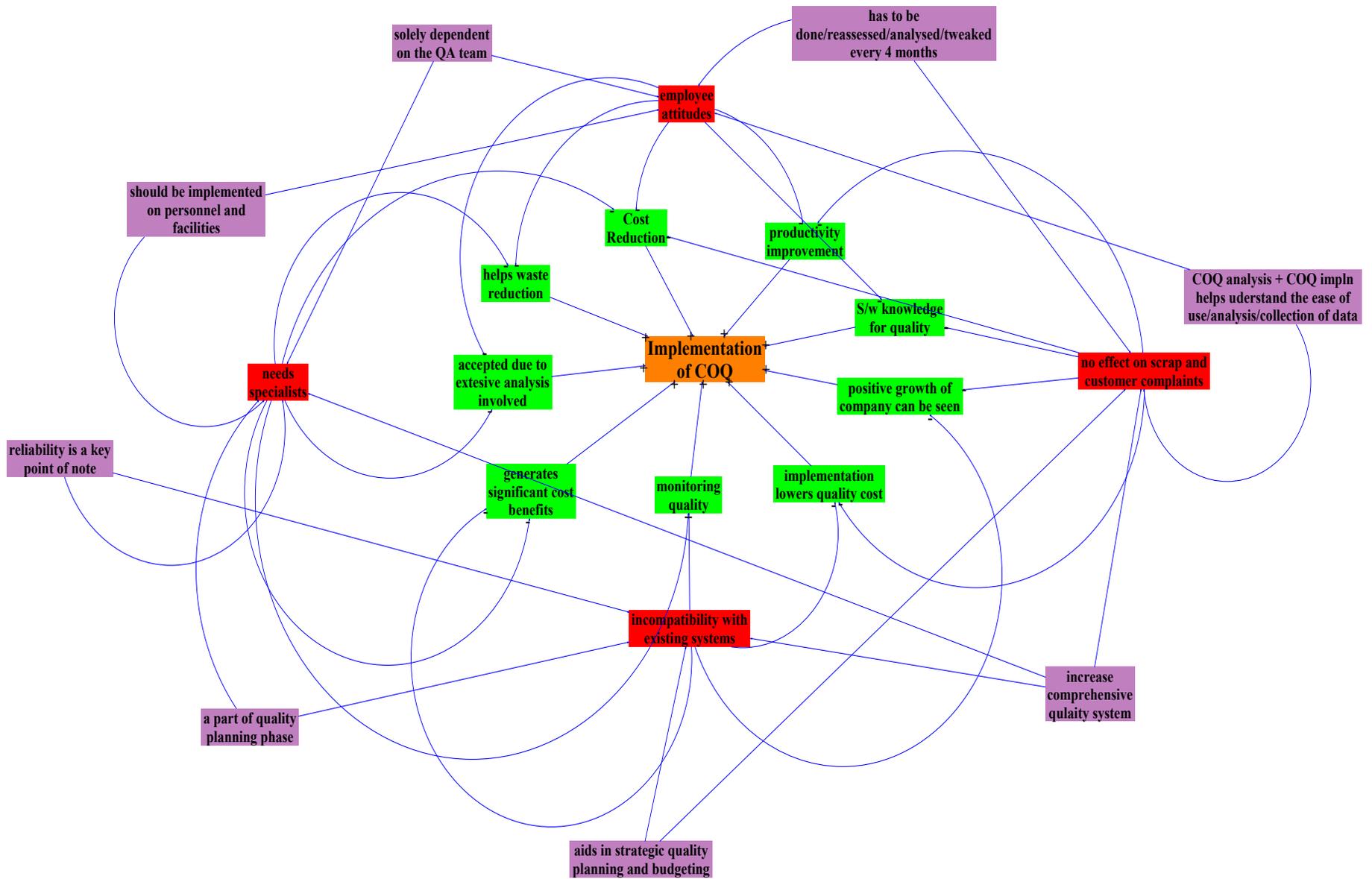
**Figure 20. Marketing**



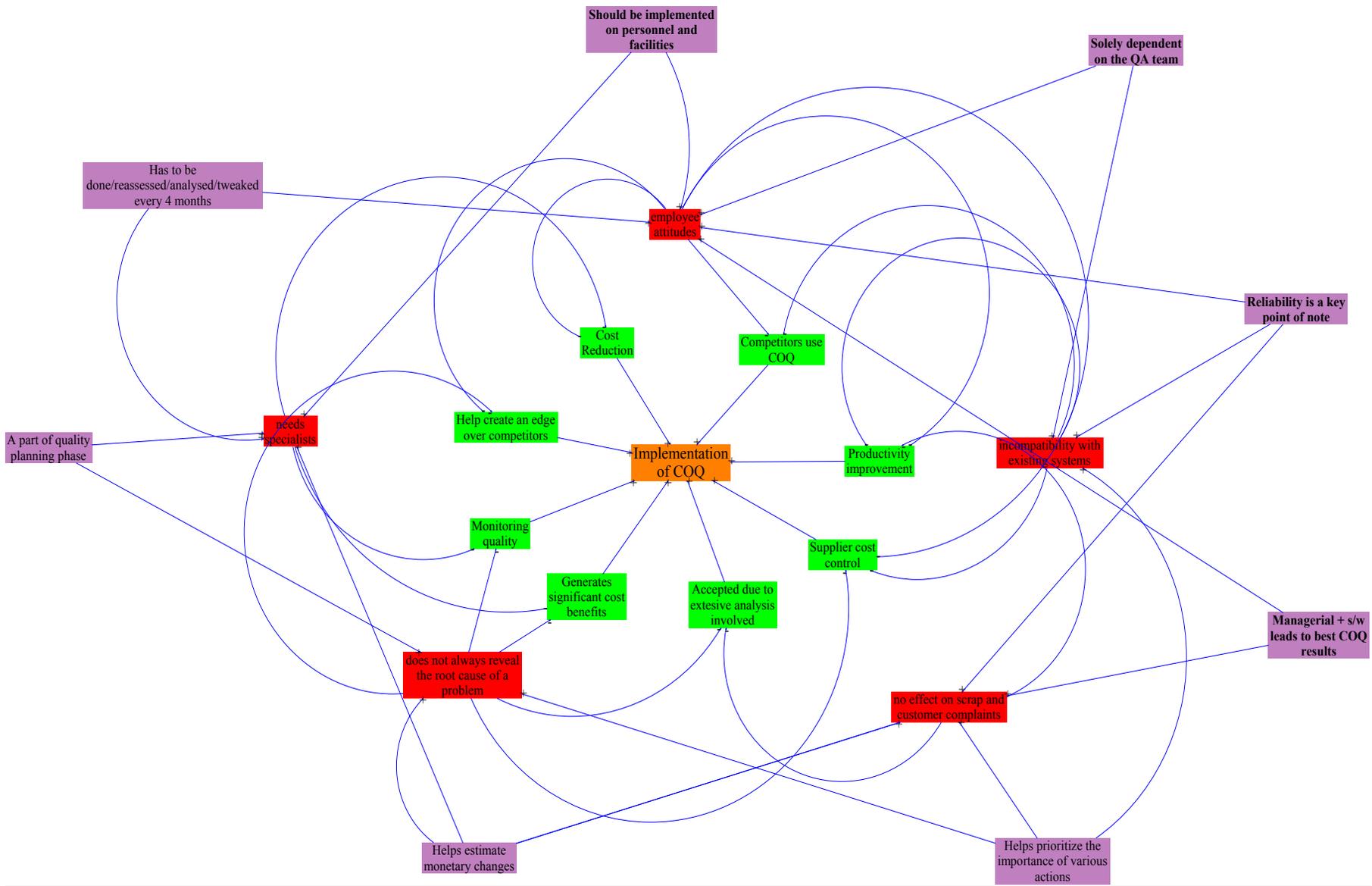
**Figure 21. R&D**



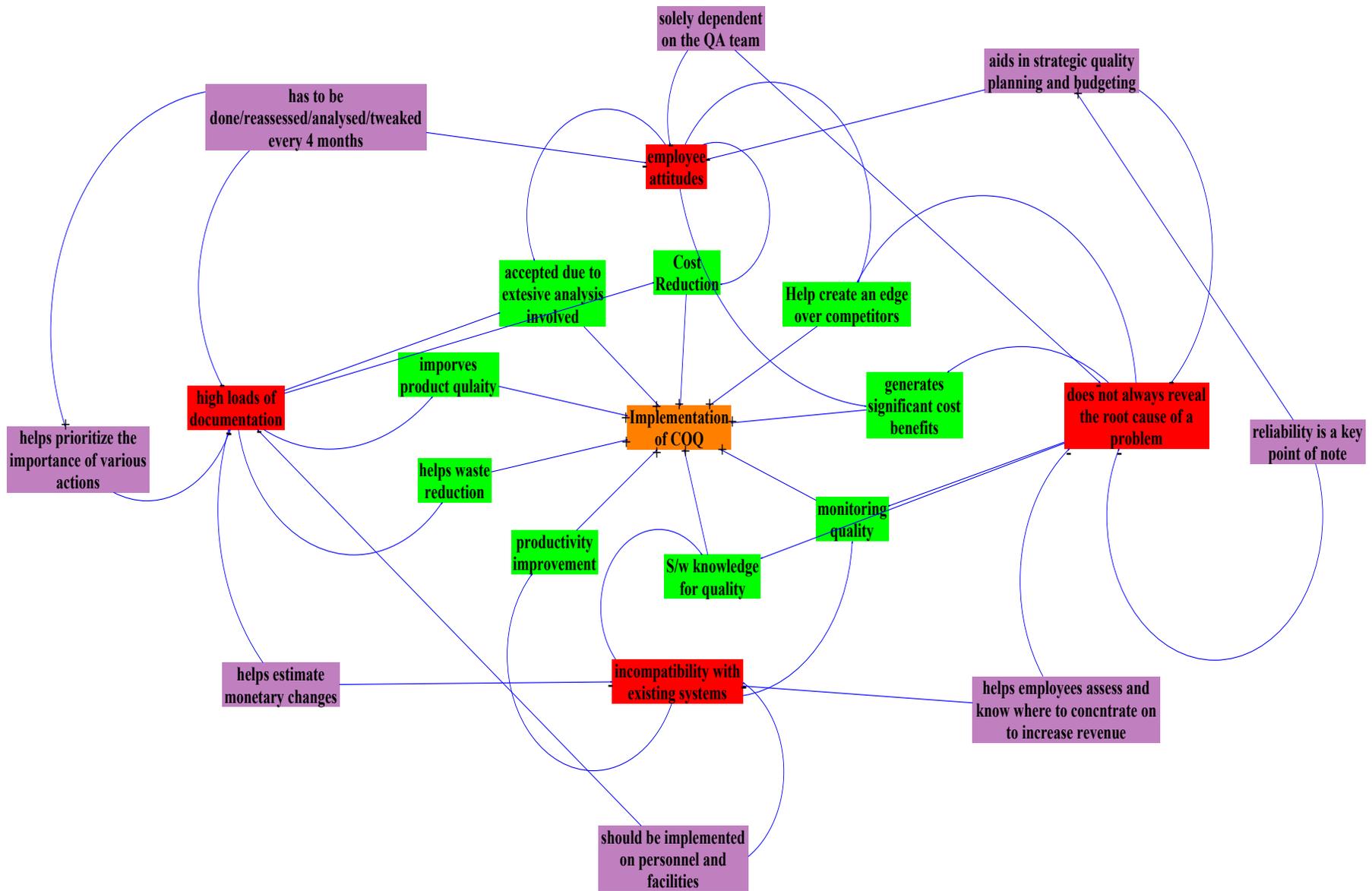
**Figure 22. Engineering**



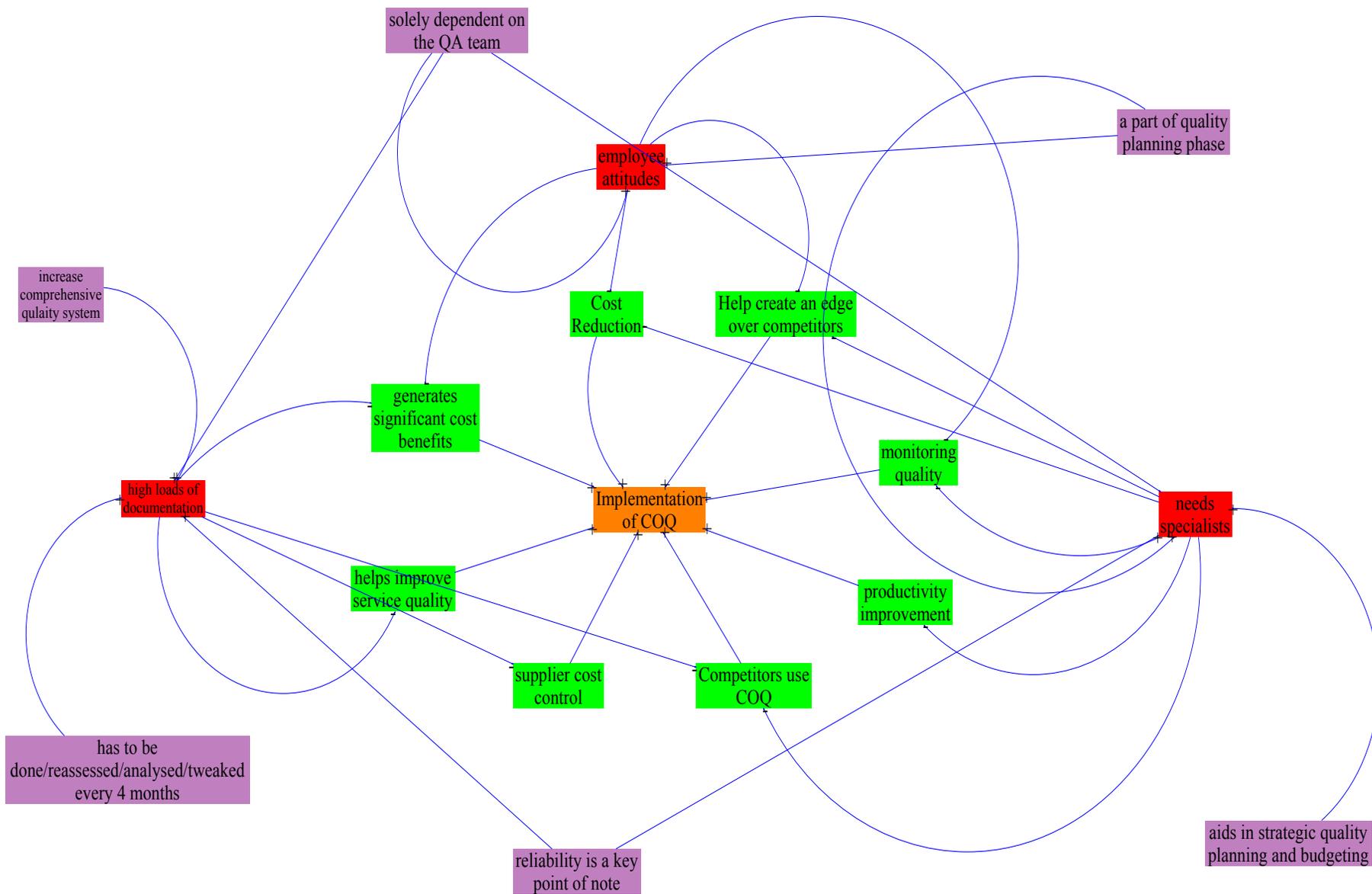
**Figure 23. Finance**



**Figure 24. HR**

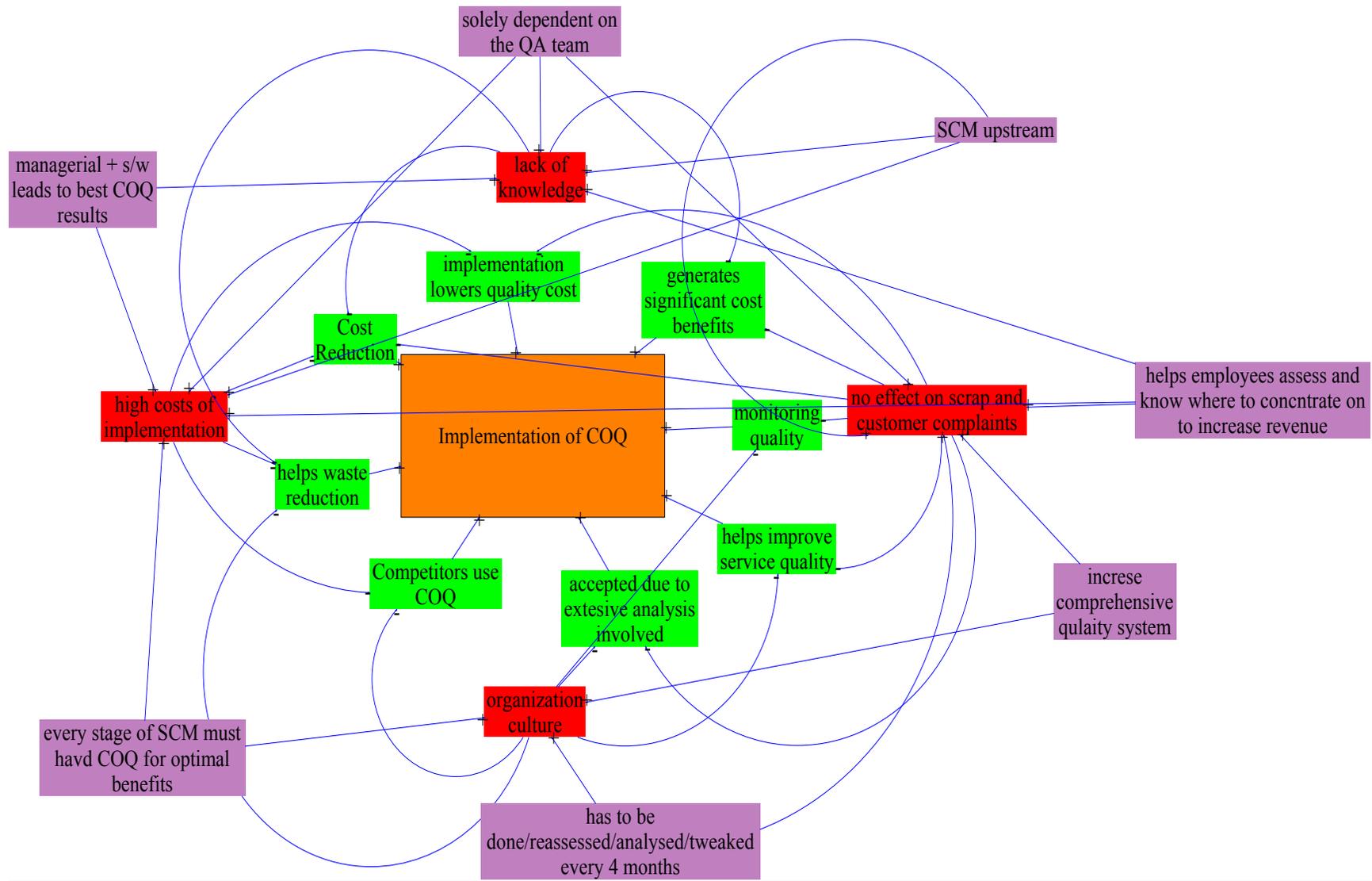


**Figure 25. Sales**

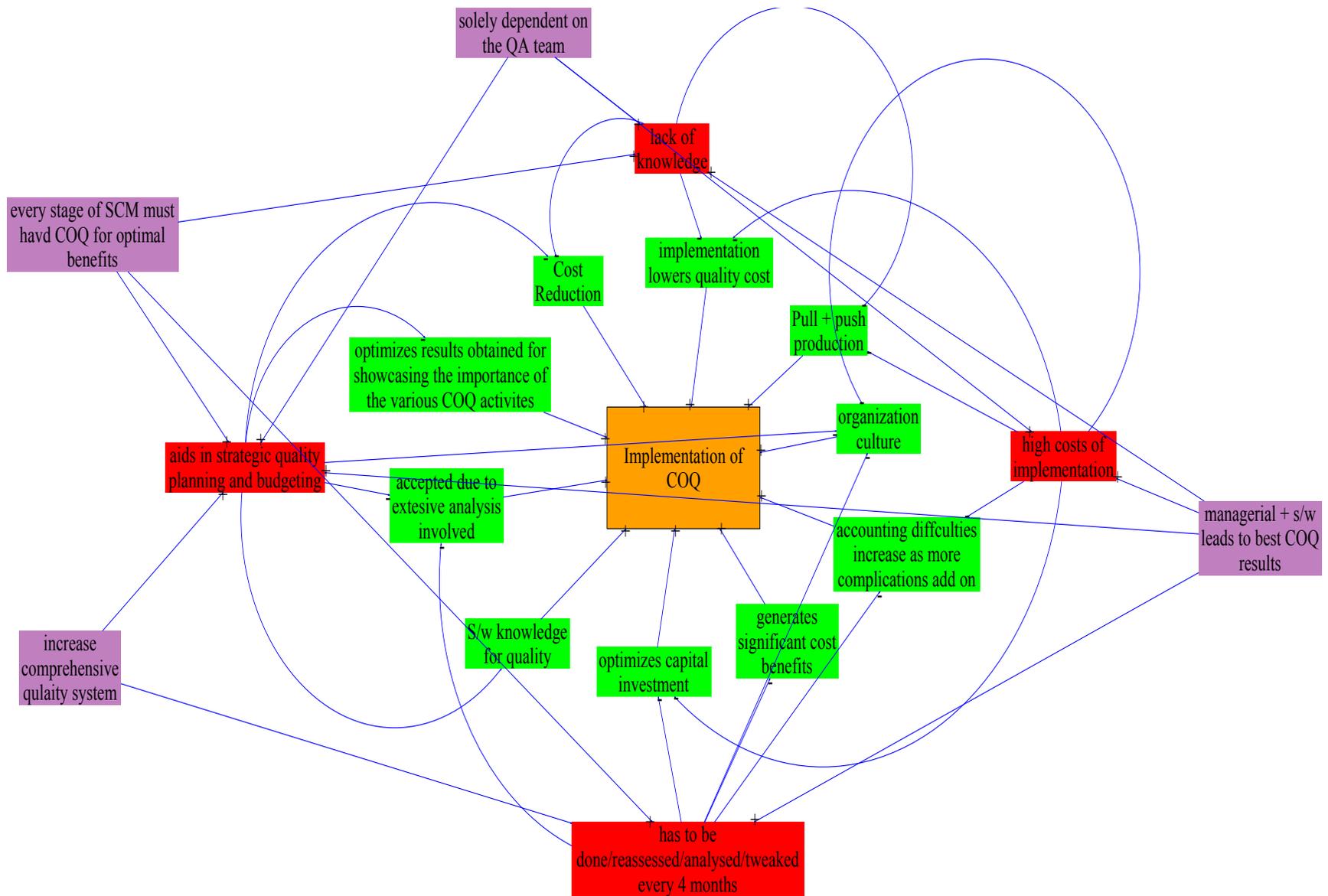


**Figure 26. Other Departments**

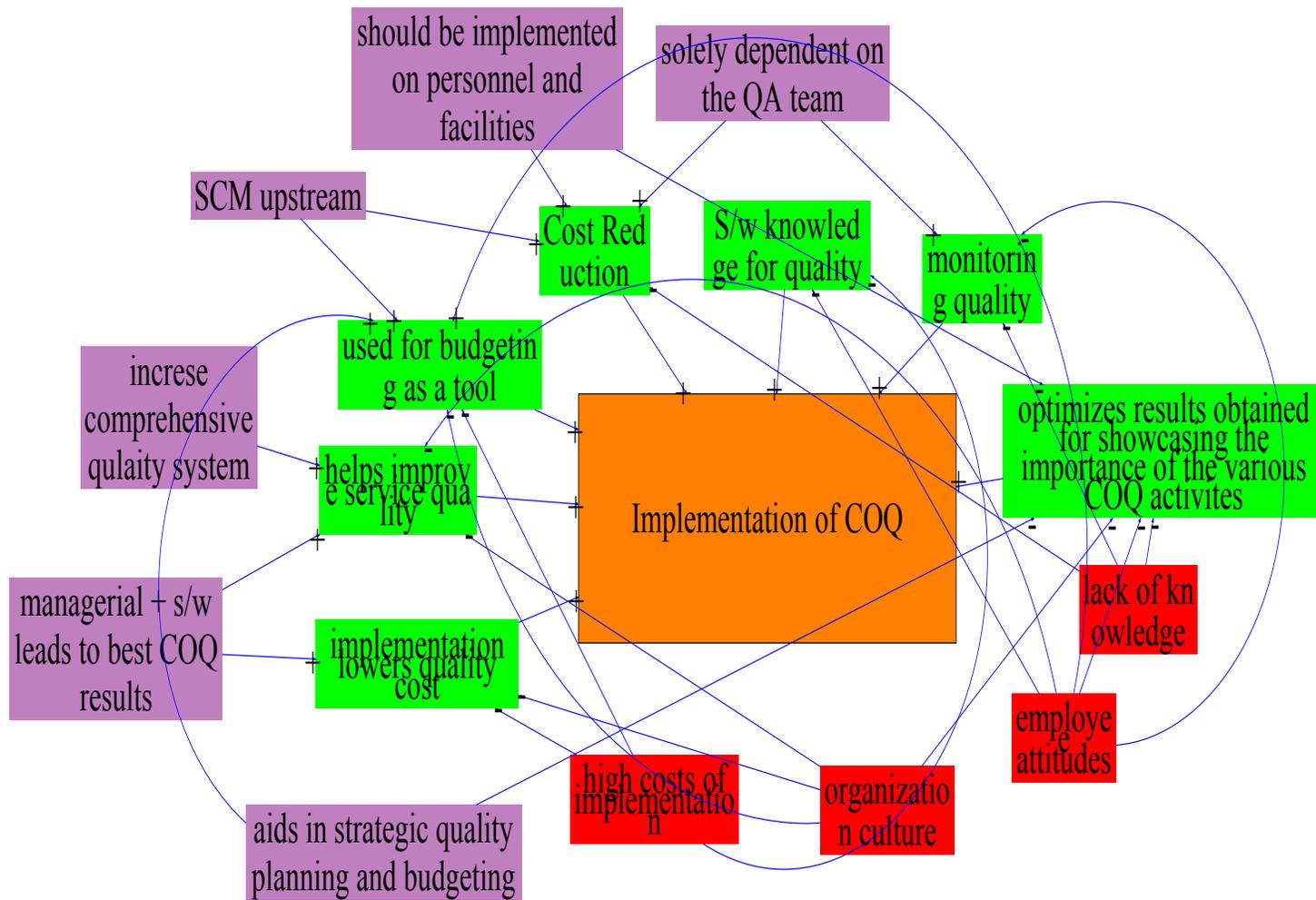
**Causal diagrams based on Job Title:**



**Figure 27. General Manager**



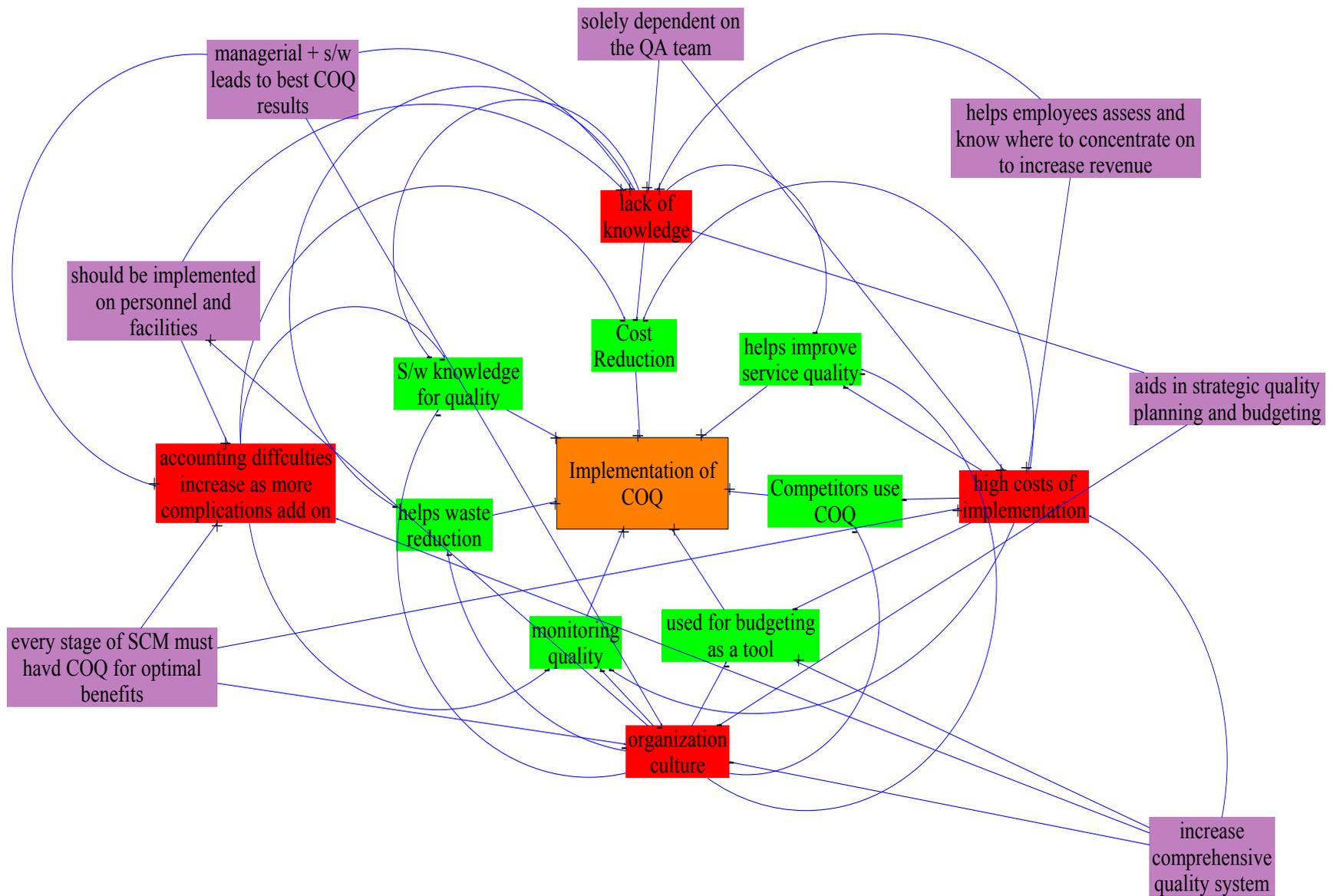
**Figure 28. Manager**



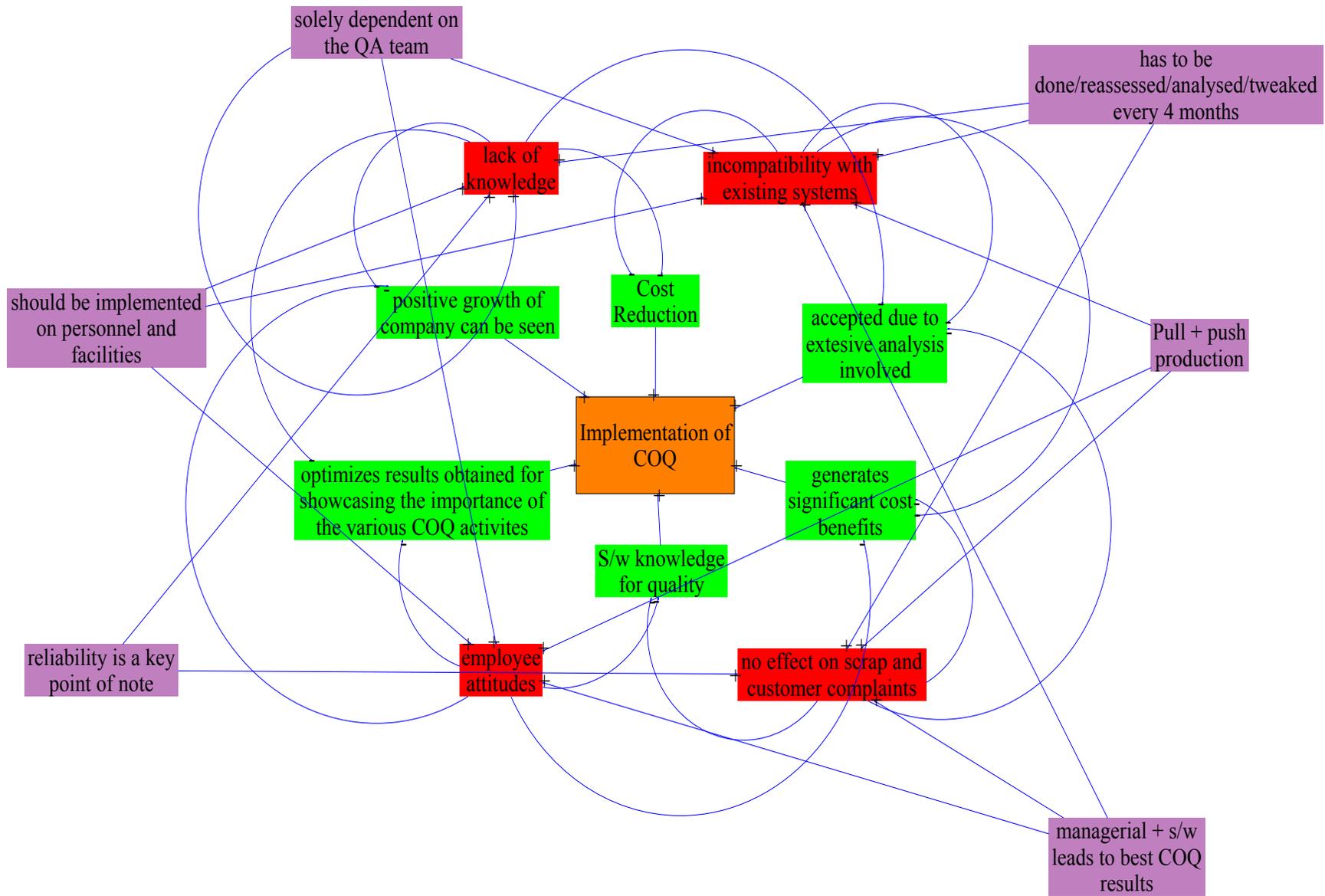
**Figure 29. Owner**



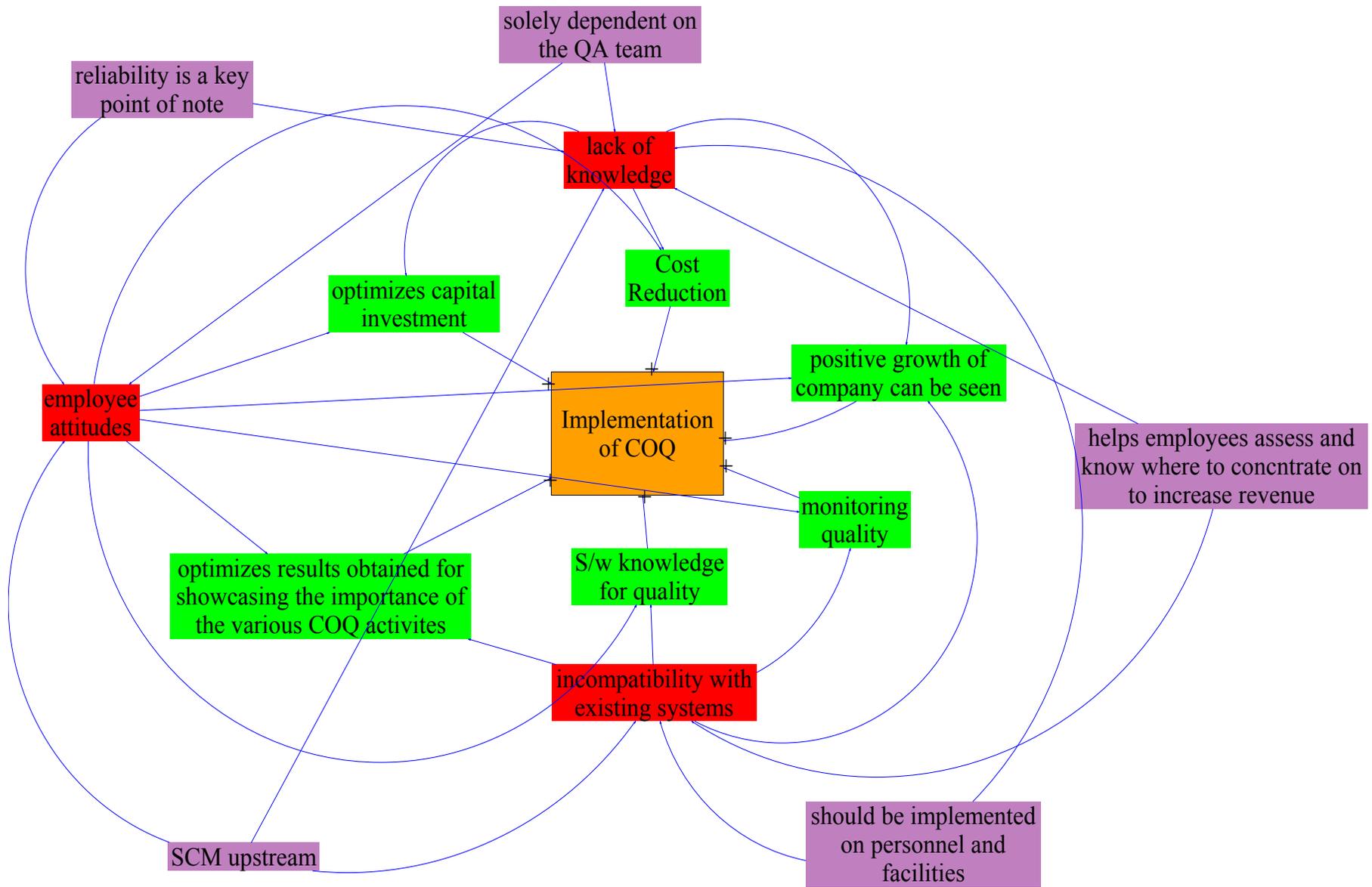
**Figure 30. Service related position**



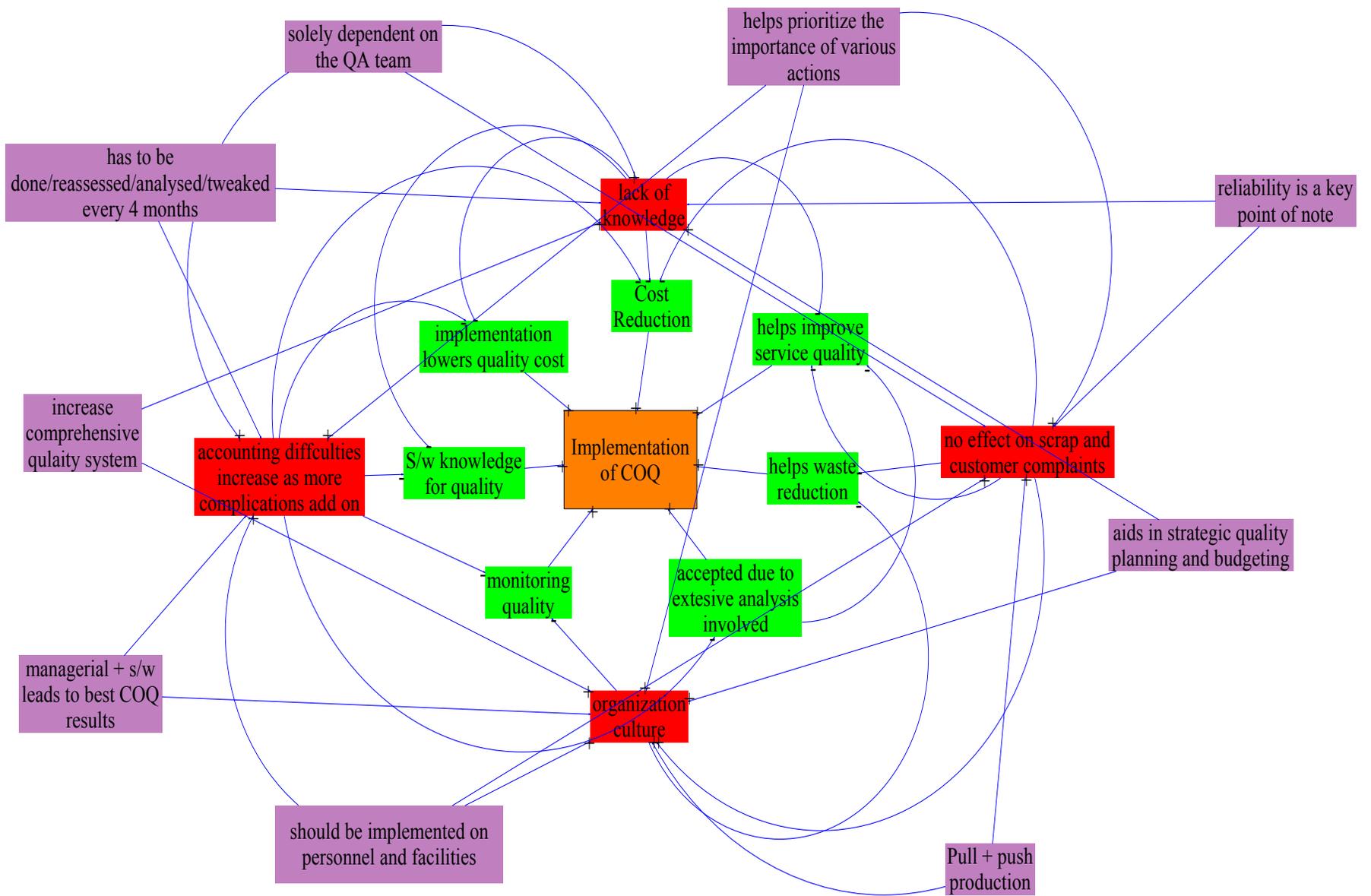
**Figure 31. Supervisor**



**Figure 32. Accounting related position**

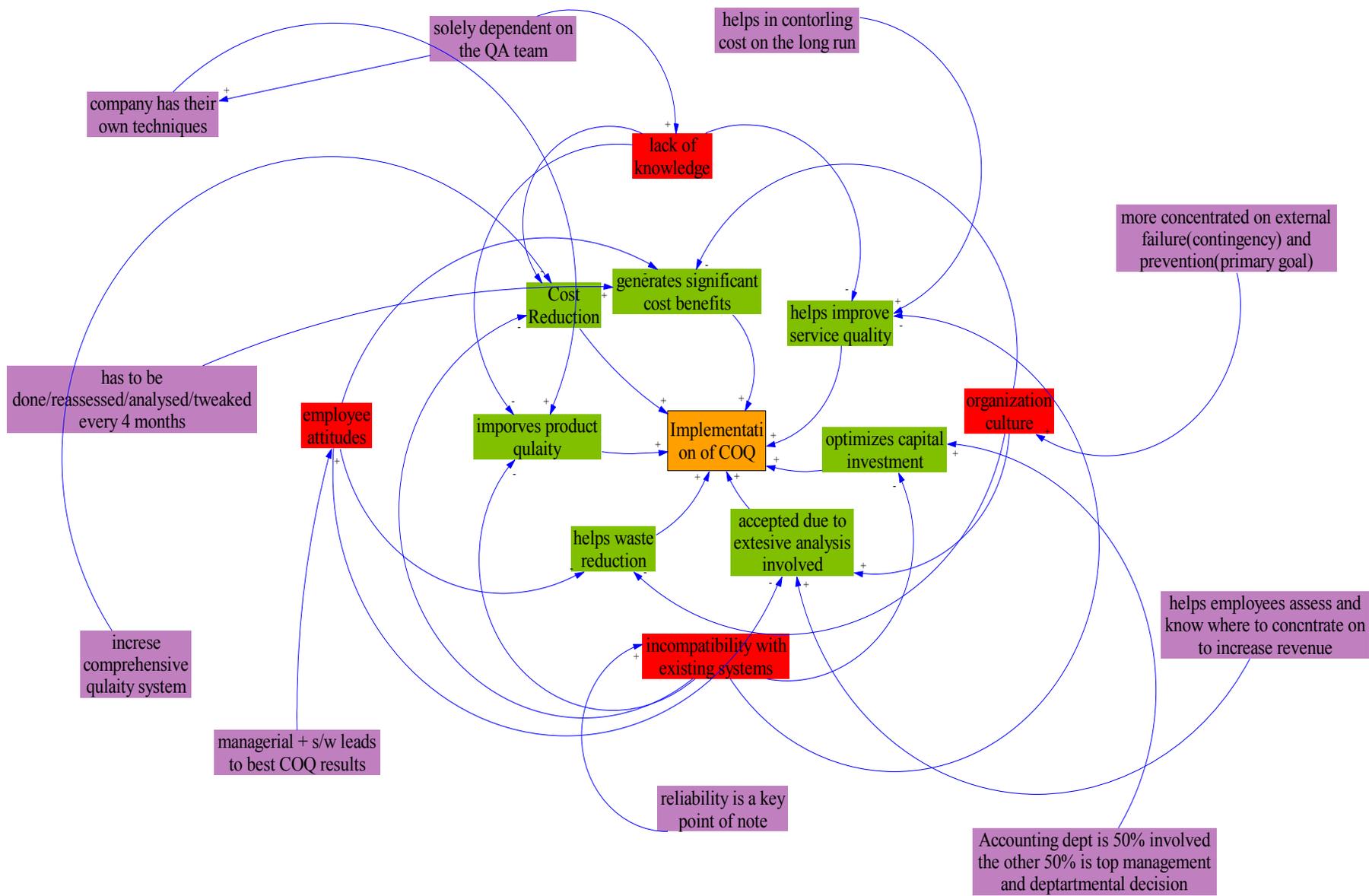


**Figure 33. Project Leader/Team Leader**

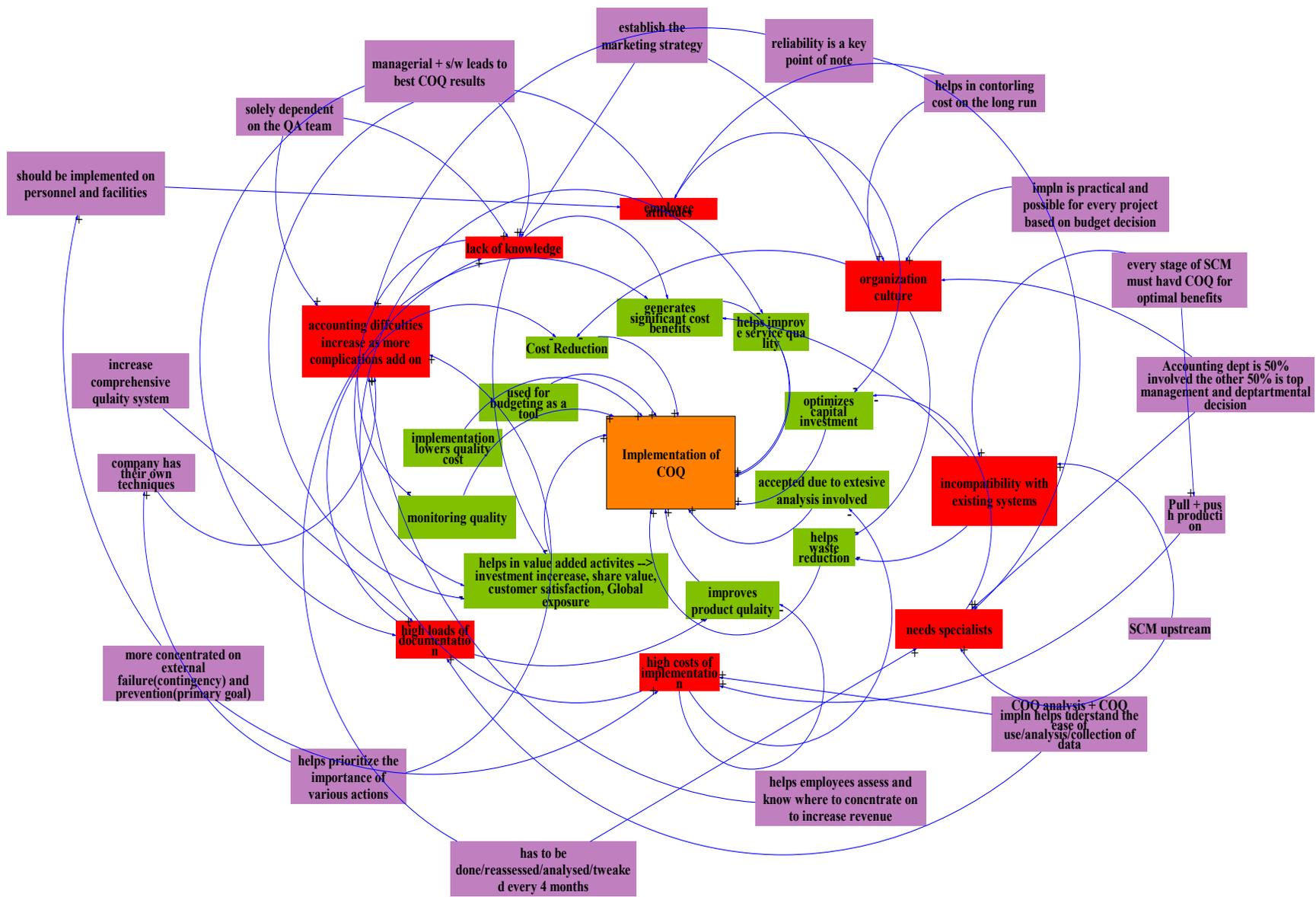


**Figure 34. Project Manager**

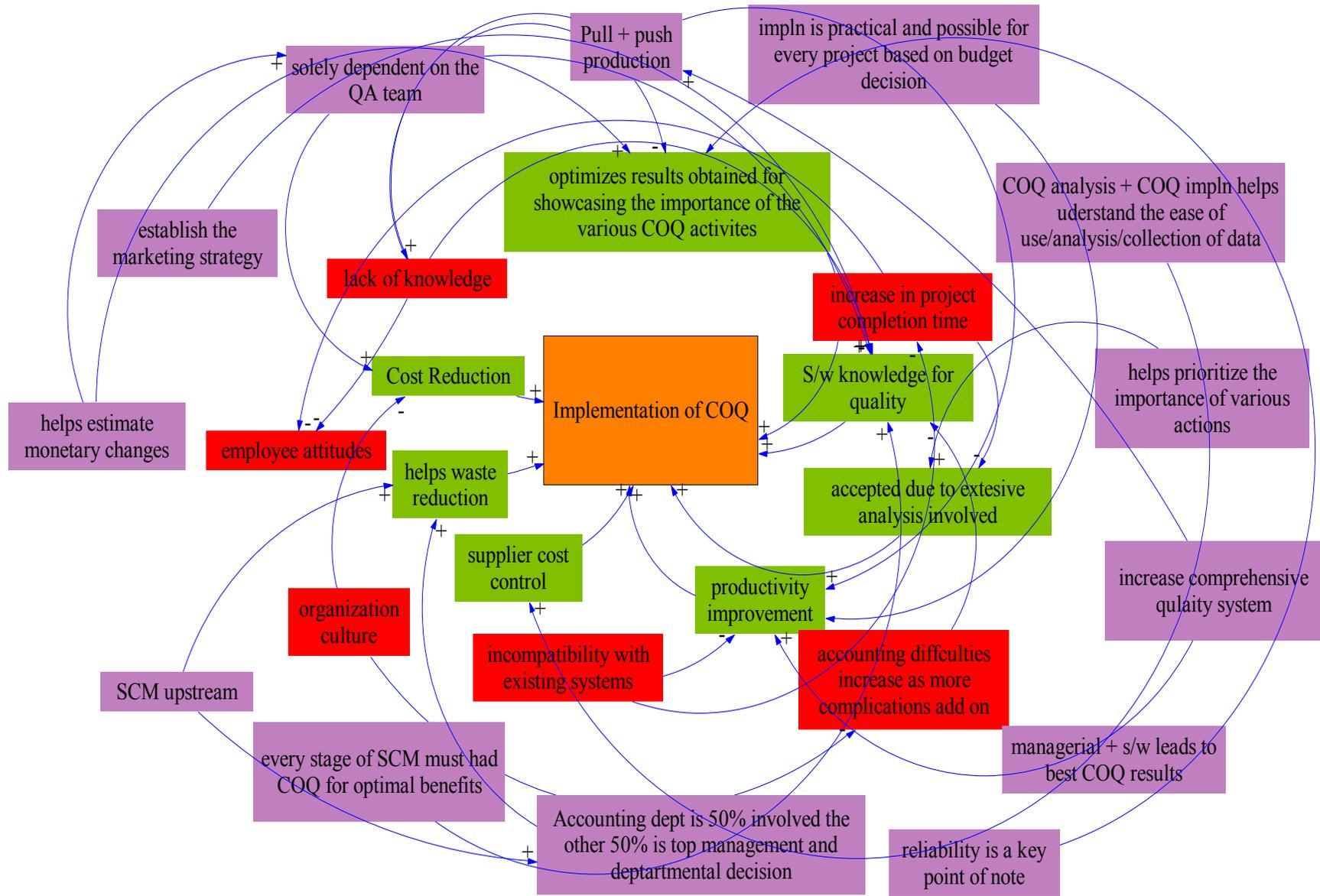




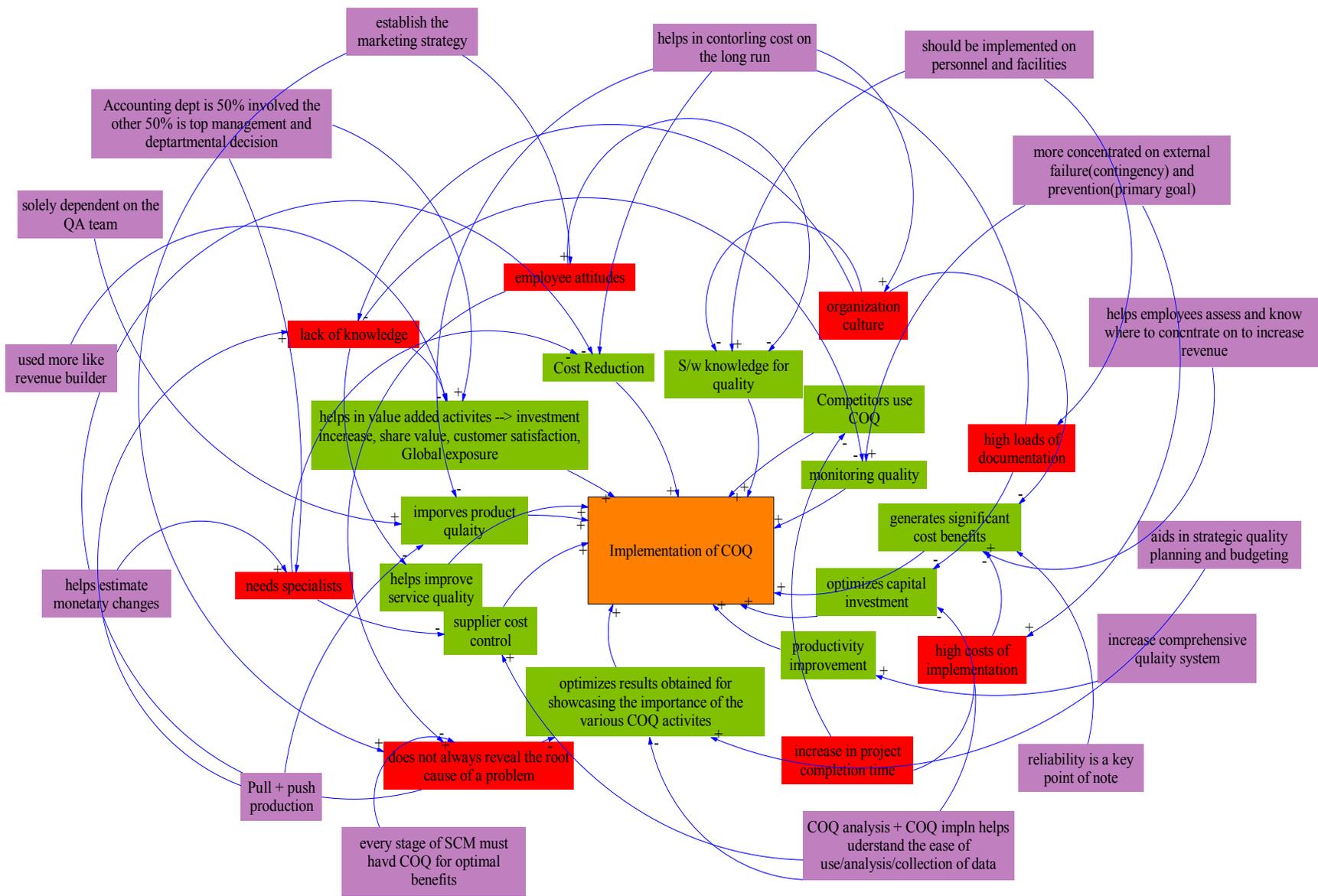
**Figure 36. Chemical Industries**



**Figure 37. Communication**

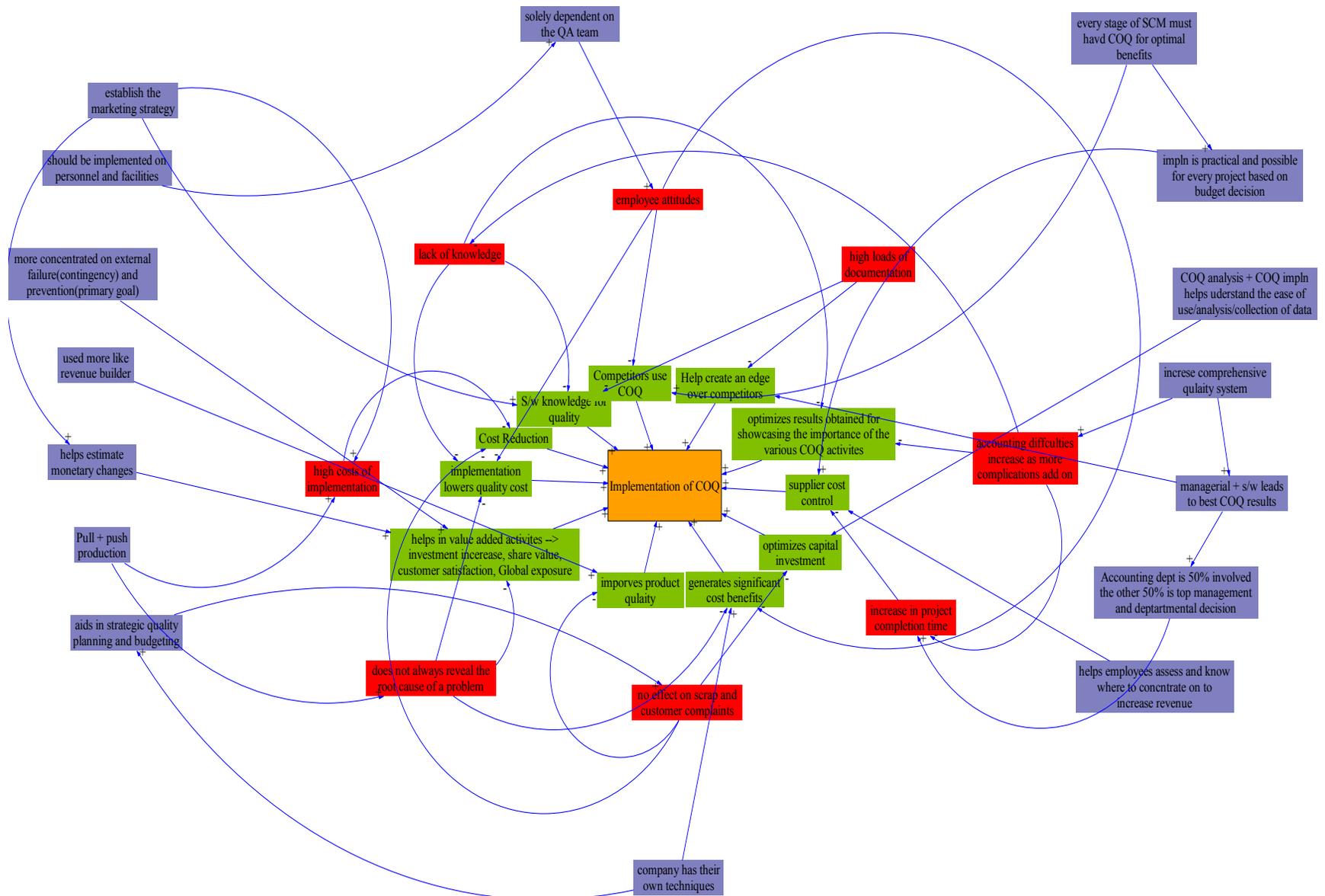


**Figure 38. Construction**

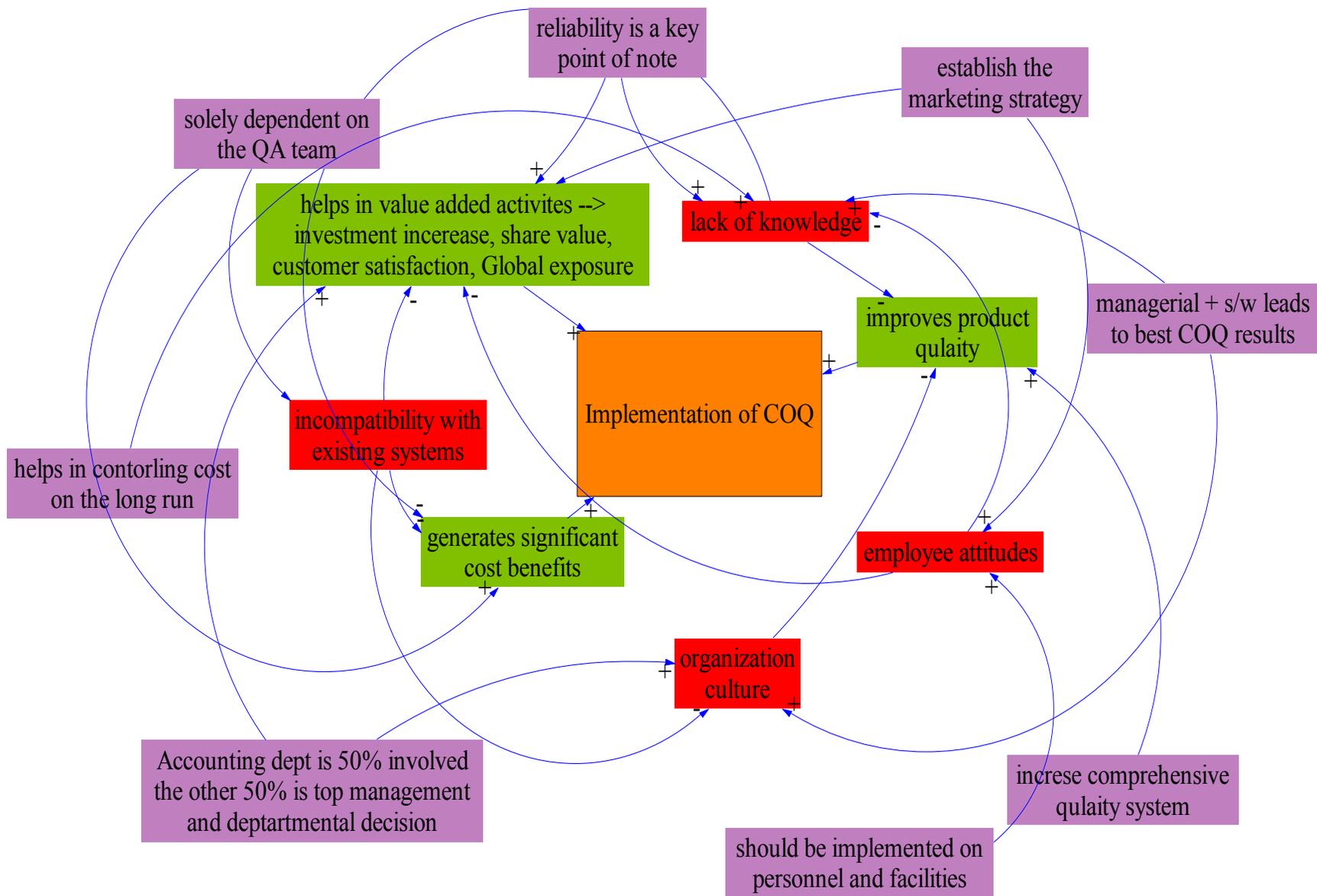


**Figure 39. Electronics**





**Figure 41 . IT**

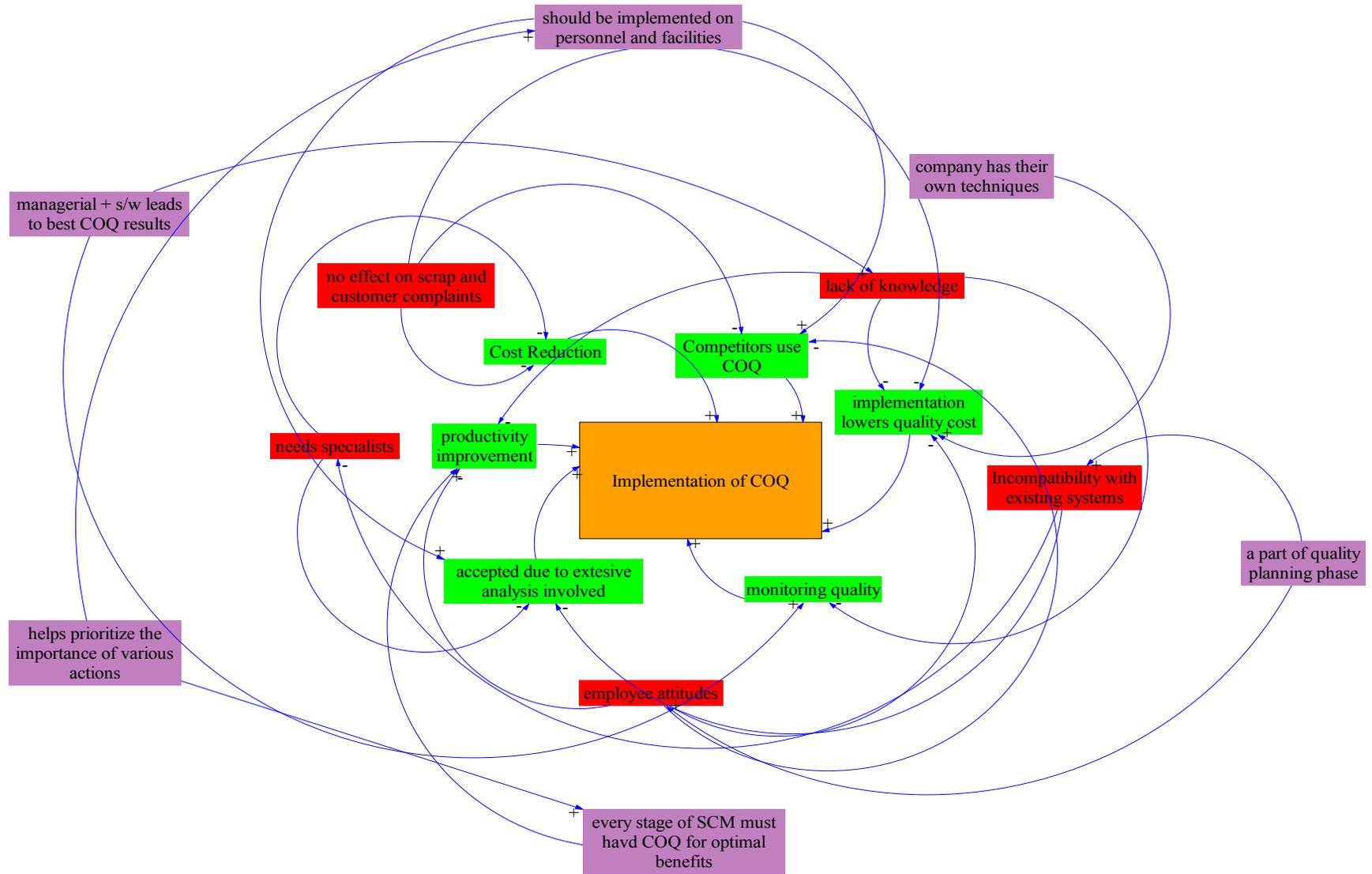


**Figure 42. Medical**

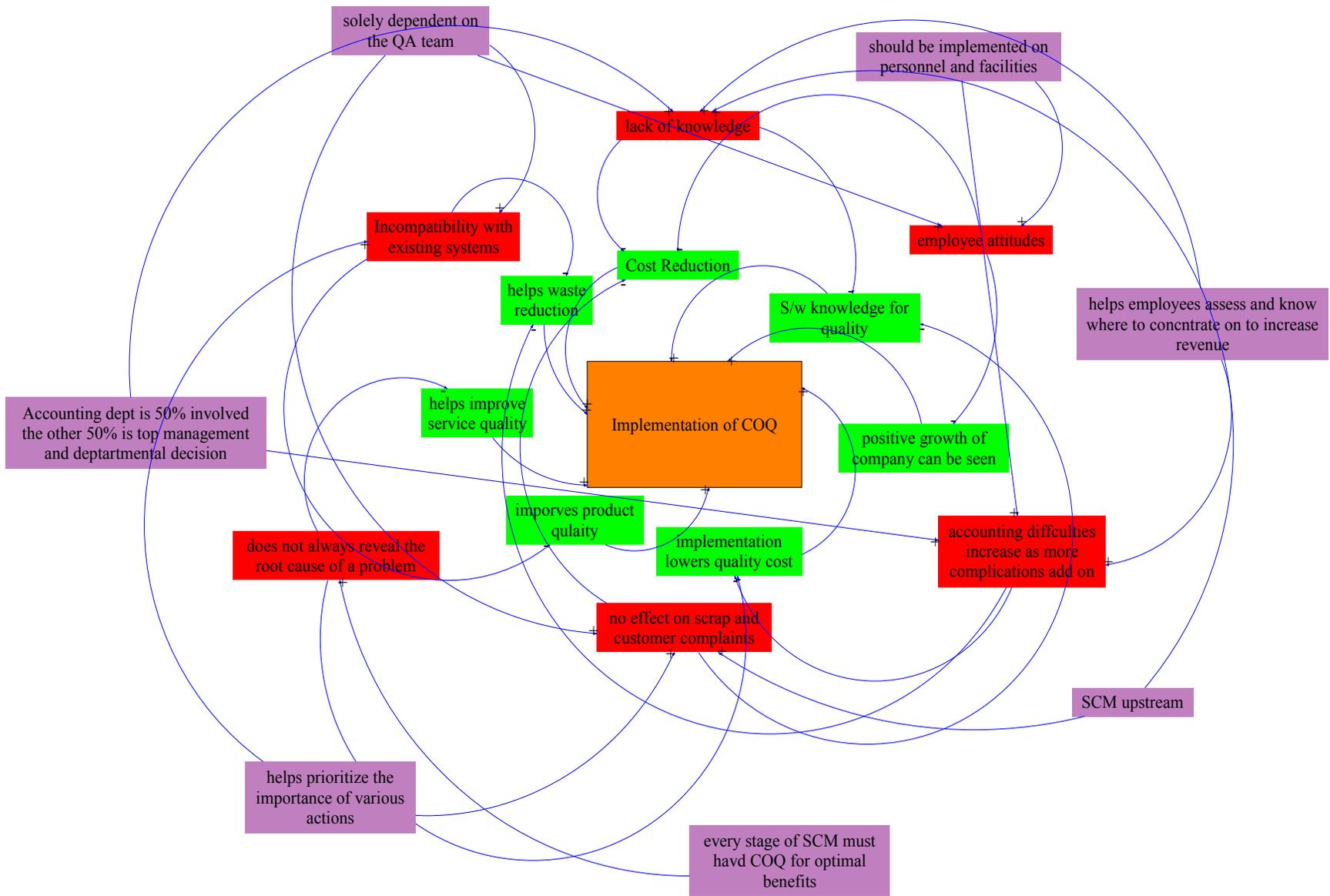




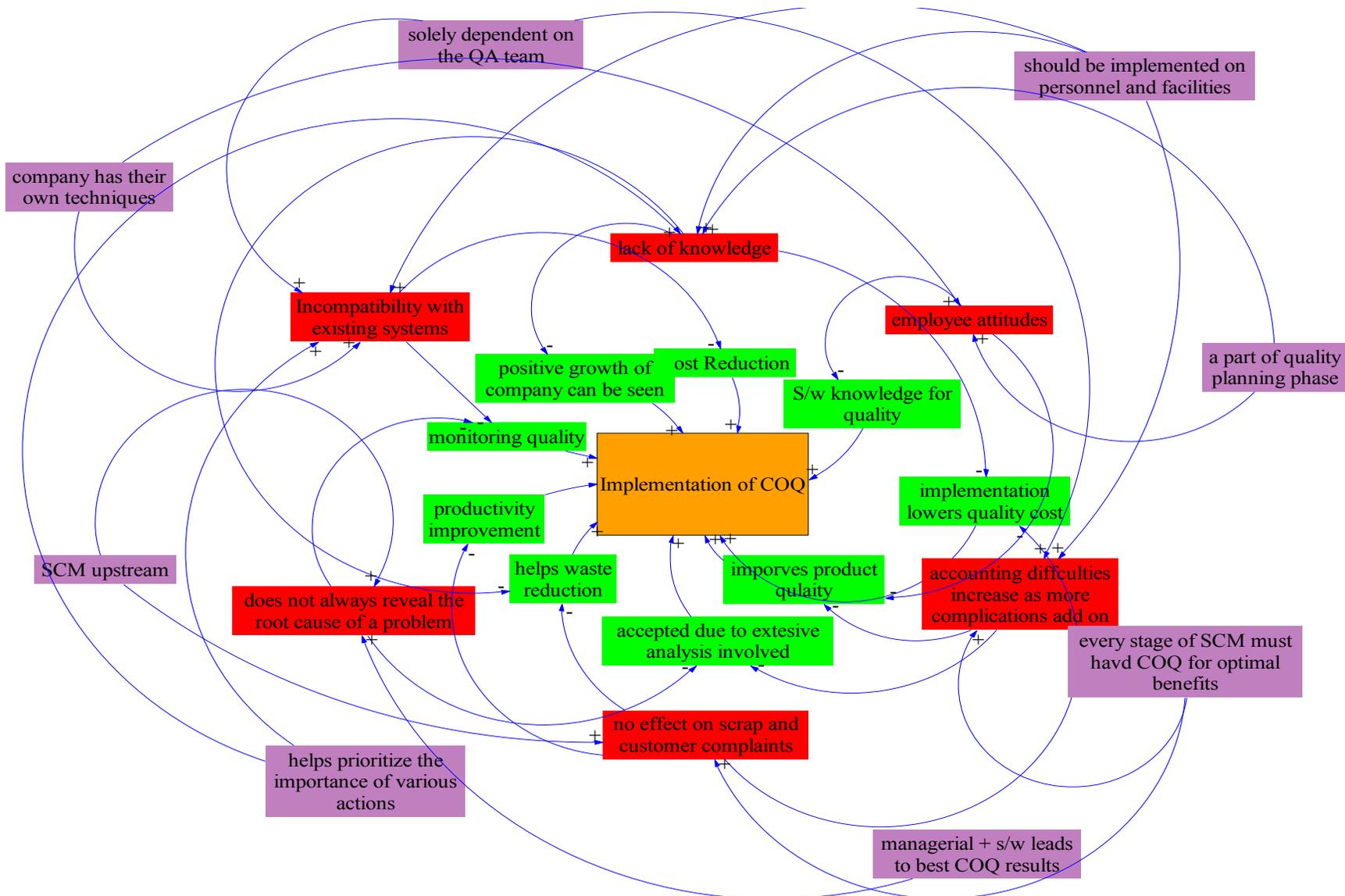
**Causal diagrams based on Number of employees:**



**Figure 45. Employee size 50**



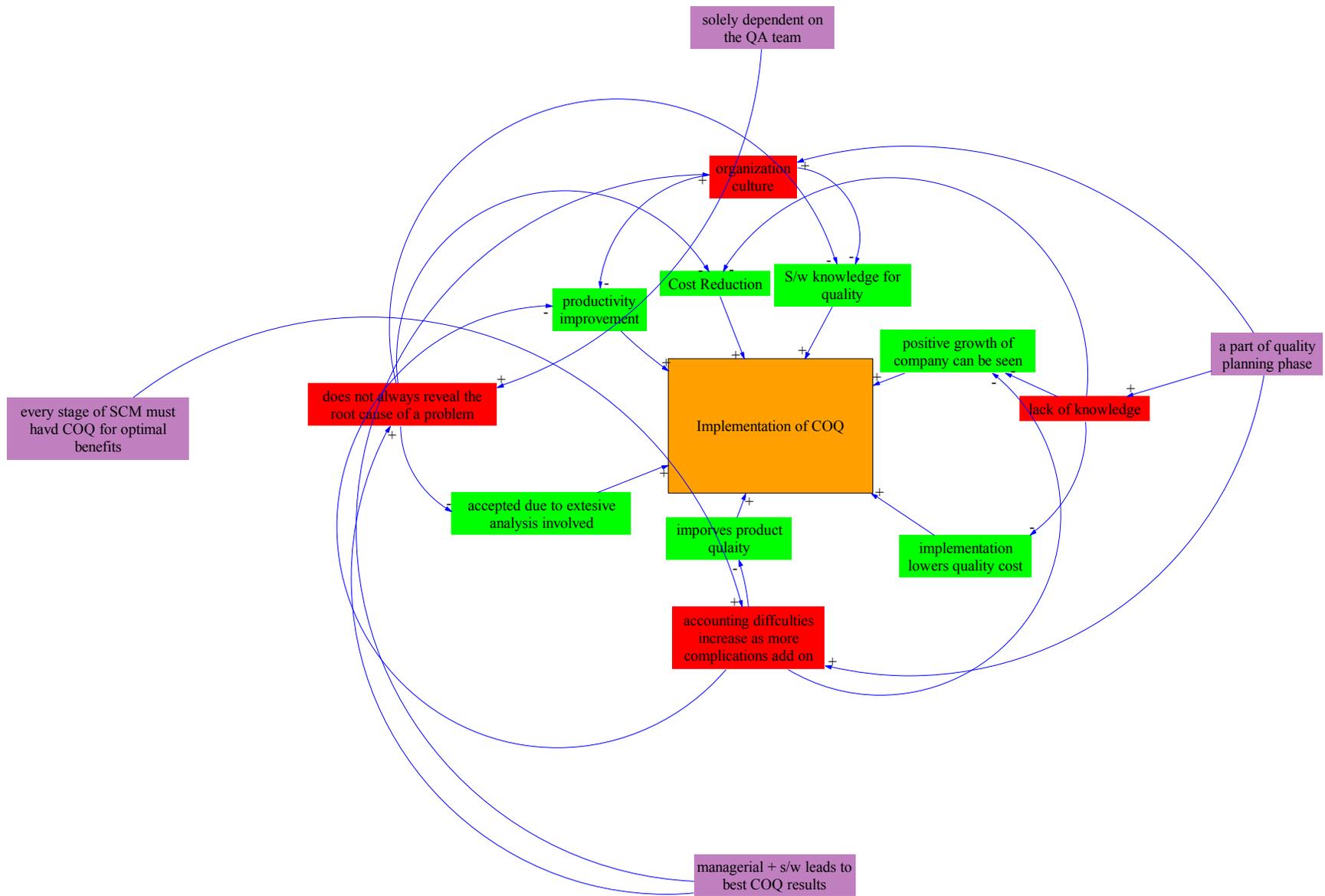
**Figure 46 . 51-99 employees**



**Figure 47. 100-249 employees**

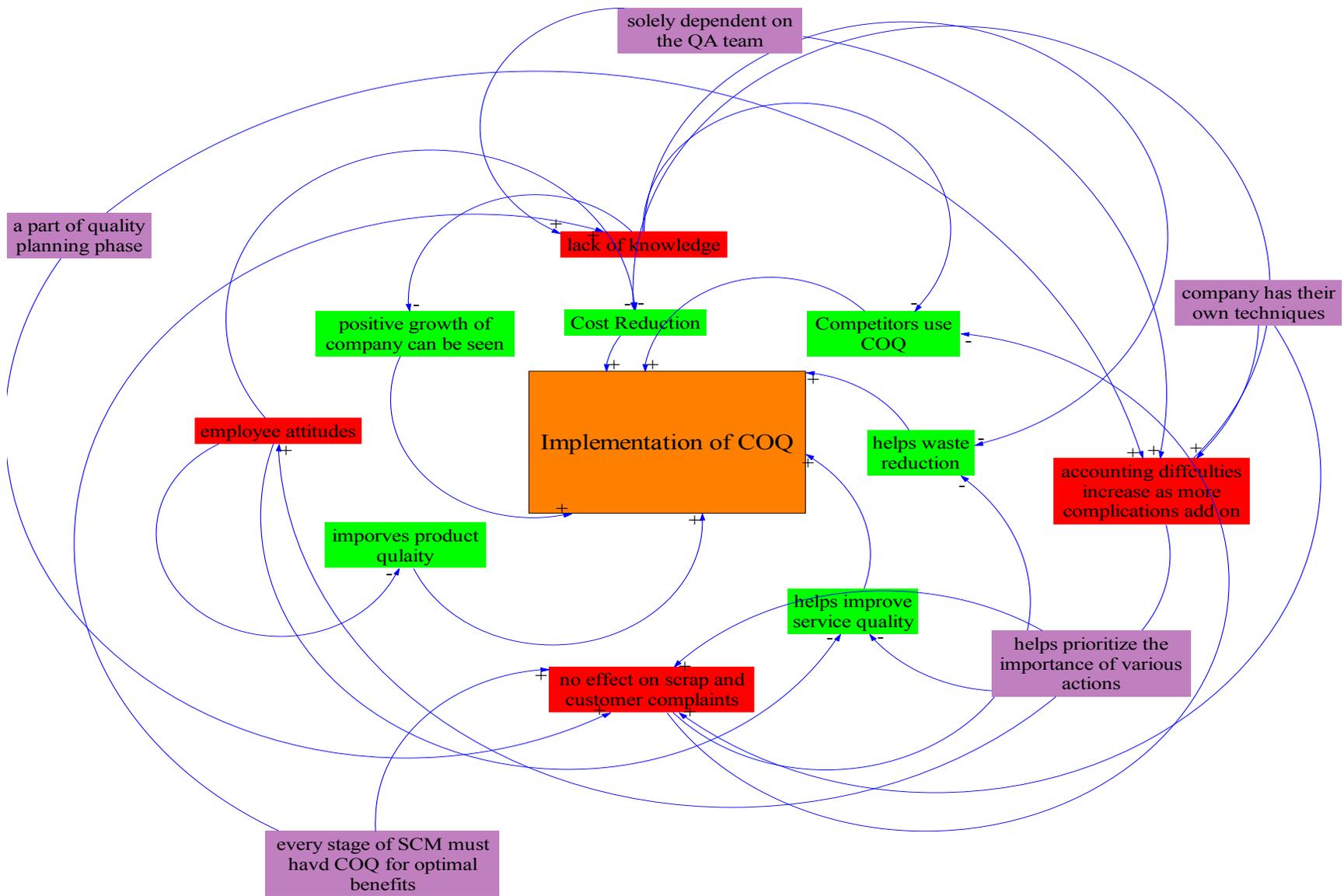






**Figure 50 .1000-2499 employees**





**Figure 52. 5000 and above employees**

**Appendix C:[questionnaire]**

Link for the questionnaire:

<https://docs.google.com/spreadsheets/viewform?formkey=dG5WZFBFfUktWXE5UVhLenBnZ1F2dXc6MQ>

**COQ Questionnaire General Opinion**

**COQ: Cost of Quality**

COQ includes the costs spent on the prevention of poor quality, the quality appraisal (*e.g.* inspections) and the costs resulting from product or service failure (*e.g.* rework and returns)

Scoring is based on a scale from 1 to 5. **1 means Strongly Disagree**, and **5 means Strongly Agree**.

**Demographic Information**

<b>Organization Unit:</b>	Mechanical	Manufacturing
	Industrial	Information Technology
	Bio-technology/Bio-Medical	Medical/Pharmaceutical
	Mining	Construction
	Chemical	Communication
	Electronics/Electrical	Others → Please Specify
		-----

<b>Your Department:</b>	Accounting HR Engineering Finance	Marketing Sales R&D Others → Please Specify -----
<b>Your Current Position:</b>	Owner General Manager Manager Supervisor Project Leader	Accounting Related Position Service Related Position Project Manager Others → Please Specify -----
<b>Total years of related experience:</b>	Less than 1 year 1 to 3 years 4 to 6 years 7 to 10 years 11 years and above	

<b>Years of Experience in Current Position:</b>	Less than 1 year 1 to 3 years 4 to 6 years 7 to 10 years 11 years and above.	
<b>Your Organization is located in:</b>	Please Specify Country: Province (or) State:	
<b>Number of Employees in your Organization:</b>	Less than 50 51 – 99 100 – 249 250 – 499 500 – 999	1000 – 2499 2500 – 4999 5000 and above
<b>Annual Sales of your Organization(In US Dollars):</b>	Less than \$1 Million \$1 – \$5 Million \$6 - \$25 Million \$26 – \$50 Million	51 – 249 Million 250 – 499 Million 500 and above

**Questions Based on COQ Advantages:**

No.	Question	1 Strongly Disagree	2	3	4	5 Strongly Agree
1.	Does your company implement COQ?	<input type="checkbox"/> Yes  Decides the type of Questionnaire to answer.  <input type="checkbox"/> No				
2.	COQ helps a great deal in cost reduction					
3.	There are other quality management techniques better than COQ.					
	Could you please name them:					
4.	Do you know any software for the management of quality?"					
	Could you please mention one Software:					
5.	Do your competitors use COQ techniques effectively?					
	Could you please mention the					

	competitors name:					
6.	COQ implementation leads to a positive growth.					
7.	Implementing COQ helps create an edge over competitors.					
8.	COQ is useful for monitoring quality of the product.					
9.	Organizations use COQ technique results as benchmark against other companies.					
10.	The COQ technique is an effective cost saving technique.					
11.	The whole organization [or every department of the organization] needs to understand COQ technique.					
12.	The whole organization has a positive feeling towards COQ techniques.					
13.	There are practical solutions that are found only due to COQ implementation.					
14.	Usage of COQ leads to higher savings than the expenses needed to implement					

	it.					
15.	COQ affects the following positively:					
	<b>1) Waste reduction</b>					
	<b>2) Supplier cost control</b>					
	<b>3) Productivity improvement</b>					
	<b>4) Technological advancement</b>					
16.	The COQ implementation needs specialists to obtain results and analyze them.					
17.	COQ is used to identify high-cost problem areas.					
18.	COQ helps in evaluating the effectiveness of a quality system.					
19.	COQ helps to motivate employees towards quality goals.					
20.	COQ helps employees achieve quality goals <b>EASILY</b>					

21.	COQ helps to measure progress.***					
22.	<p>Your opinion towards <b>adopting COQ:***</b></p> <p>a) COQ Improves value added activities.</p> <p>b) COQ Improves Product Quality.</p> <p>c) COQ improves service quality.</p> <p>d) COQ reduces failure rates.</p> <p>e) COQ generates significant cost benefits.</p> <p>f) COQ is used as a budgeting tool.</p> <p>g) COQ implementation has low risk.</p>					

23.	<p>Your opinion towards <b>the advantages of implementing COQ</b>:</p> <p>1) COQ system helps justify investments in prevention activities, which lower total quality costs</p> <p>2) The results of COQ are easily accepted due to the extensive analysis involved.</p> <p>3) Implementation of COQ techniques helps in optimizing capital investment.</p> <p>4) COQ helps obtain advanced performance measure.</p>					
24.	COQ helps to set cost reduction targets.					

**Questions Based on COQ Disadvantages:**

25.	There are other better processes than COQ					
Could you please name them:						
26.	COQ reveals the reasons that cause problems in a system.					
Could you please specify some problems:						
27.	COQ highlights the problems that occur in a system more easily.					
28.	The implementation of COQ leads to the increase of:****					

	<b>Customer complaints</b>					
	<b>Rework and scrap</b>					
	<b>Warranty expenditure</b>					
	<b>Prevention plus appraisal costs</b>					
	<b>Failure costs</b>					
	<b>Total quality cost</b>					
	<b>Sales volume</b>					
29.	COQ implementation leads to increase in project completion time					
30.	The implementation of COQ is not					

	easy					
	Could you please mention why					
31.	<p><b>The reasons behind the failure of COQ</b> after implementing it:</p> <p>a) Lack of interest from employees.</p> <p>b) Low ROI.</p> <p>c) Un-necessary expenditure.</p>					
32.	<p><b>The difficulties behind the implementation</b> of COQ?</p> <p>1) Lack of information.</p> <p>2) Employee attitudes.</p> <p>3) Organization culture.</p> <p>4) Lack of accountability.</p>					

	5) Difficulty in collecting COQ data.					
	6) Incompatibility of existing accounting system.					
	7) Lack of senior management commitment.					
	8) Existence of other easier quality control methods.					
	9) Need for continuous reporting and documentation.					
33.	Implementing COQ is a waste of time and money.					
34.	COQ is not implemented because of :					
	a) Lack of knowledge about COQ					
	b) High costs					
	c) Insufficient benefits					

**Questions Based on COQ Practicalities:**

35.	Implementation of COQ is practical					
	Could you please tell why					
36.	COQ aids cost reduction and maintain high quality					
37.	Using Pareto Analysis along with COQ is helpful:	Yes	No	I don't Know		
	Pareto analysis + COQ brings:					
	1) More efficiency					
	2) Ease of use/analysis					
	3) Other benefits [Could you please mention]					
38.	COQ is a part of quality planning phase					
39.	COQ is used to determine the					

	products/processes overall quality					
40.	The costs due to COQ are considered as an important component while estimating the budget of the project.					
41.	COQ helps quantify overall quality improvement.					
42.	COQ helps sustain quality of activities/processes.					
43.	COQ helps improve control of quality activities.					
44.	COQ aids in strategic quality planning and budgeting.					
45.	COQ helps to estimate the monetary worth of individual quality activities					
46.	The prime responsibility of the implementation of quality control methods lies with:  1) Accounting/finance department  2) Sales/Marketing department					

	3) Quality department					
	4) Production control department					
	5) Engineering department					
	6) Production department					
47.	<b>The practical reasons behind the usage of COQ</b>					
	a) Helps prioritize improvement actions					
	b) Creates a more comprehensive quality system					
	c) Helps increase competitiveness					
	d) Helps establish marketing strategy.					
	e) Helps control cost.					
48.	To reduce the prevention cost a company should start with the reductions on					
	a) On equipment					

	b) On facility c) On personnel					
<b>General Questions:</b>						
49.	Which techniques do you think help more in quality improvement	a) COQ techniques.		b) Company Specific Techniques		
50.	The savings in COQ are best achieved through:	Managerial techniques <input type="checkbox"/> Yes <input type="checkbox"/> No		Software techniques <input type="checkbox"/> Yes <input type="checkbox"/> No		
51.	One must pay most attention to:	Prevention cost	Appraisal cost	Internal cost	External cost	
52.	Are the activities performed for quality management reviewed with senior management on a periodic basis?  <b>If yes how often:</b>	<input type="checkbox"/> Yes <input type="checkbox"/> No  -Weekly -Monthly -Every 4 months				

		-Every 6 months			
		-Every year			
53.	The most important feature in the use of COQ techniques is their	Functionality	Reliability	Both	
	Could you please tell why:				
54.	The accounting department has the best knowledge on COQ.				
55.	The accounting department is responsible for COQ statistics.				
56.	The accounting department is responsible for COQ and its overall maintenance.				
57.	The accounting department knows the COQ policies best.				
58.	The accounting department knows best, as to assign cost to activities based on their use of resources				

59.	<p>COQ affects the following :</p> <p>a) Profit percentage <input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>b) Cost per product <input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>c) Total expenditure <input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>d) Annual/monthly sales <input type="checkbox"/> Yes <input type="checkbox"/> No</p>	<p>Please rank the following in terms of importance:</p> <p>Rank It between 1 – 4</p> <p>1-Lowest 4- Highest</p> <p>a) Profit percentage →</p> <p>b) Cost per product →</p> <p>c) Total expenditure →</p> <p>d) Annual sales or monthly sales →</p>				
60.	COQ solves occurrence of repetitive problems					
61.	Implementation cost for COQ is considered a part of budget planning.					
62.	Implementation cost for COQ is considered a part of contingency					

	planning.					
<b>SCM based Questions:</b>						
63.	COQ techniques in Supply chain(SC)concentrate on	Prevention cost	Appraisal cost	Internal cost	External cost	
64.	Implementing COQ in every stage of the SC Management is vital					
65.	Using COQ in every stage at SC is the same as using it any one of the stages					
66.	COQ is most important in	Pull production		Push production		
67.	Which is the best place to implement COQ in an SC	<input type="checkbox"/> Up stream <input type="checkbox"/> Down stream <input type="checkbox"/> Both				

Comments if any:

**Signatures for Approval:**

Interviewee Name:

Date:

Sign:

Interviewee's Managers Sign: [optional]

**Appendix D: [Relationship aiding causal Analysis]**

**1) Table1 - Revenue based relations:**

Advantages:	Disadvantages:	Practicalities:	Advantages:	Disadvantages:	Practicalities:
Cost Reduction	lack of knowledge	solely dependent on the QA team	Cost Reduction	lack of knowledge high costs of implementation increase in project completion time	establish the marketing strategy SCM upstream
S/w knowledge for quality	employee attitudes	establish the marketing strategy	S/w knowledge for quality	employee attitudes accounting difficulties increase as more complications add on	solely dependent on the QA team
Competitors use COQ	organization culture	helps in controlling cost on the long run	Competitors use COQ	organization culture high costs of implementation	used more like revenue builder helps estimate monetary changes
positive growth of company can be seen	accounting difficulties increase as more complications add on	company has their own techniques	positive growth of company can be seen	lack of knowledge high costs of implementation increase in project completion time	helps in controlling cost on the long run managerial + s/w leads to best COQ results
used for budgeting as a tool	high costs of implementation	has to be done/reassessed/analyzed/t weaked every 4 months	used for budgeting as a tool	organization culture accounting difficulties increase as more complications add on	company has their own techniques managerial + s/w leads to best COQ results
monitoring quality	needs specialists	helps employees assess and know where to concentrate on to increase revenue	monitoring quality	employee attitudes accounting difficulties increase as more complications add on	establish the marketing strategy managerial + s/w leads to best COQ results

helps in value added activities --> investment increase, share value, customer satisfaction, Global exposure	increase in project completion time	used more like revenue builder	helps in value added activities --> investment increase, share value, customer satisfaction, Global exposure	lack of knowledge high costs of implementation increase in project completion time	has to be done/reassessed/analyzed/tweaked every 4 months company has their own techniques
improves product quality		a part of quality planning phase	improves product quality	accounting difficulties increase as more complications add on	solely dependent on the QA team company has their own techniques
helps improve service quality		aids in strategic quality planning and budgeting	helps improve service quality	lack of knowledge needs specialists increase in project completion time	company has their own techniques establish the marketing strategy
optimizes capital investment		helps estimate monetary changes	optimizes capital investment	accounting difficulties increase as more complications add on	a part of quality planning phase establish the marketing strategy
accepted due to extensive analysis involved		SCM upstream	accepted due to extensive analysis involved	employee attitudes needs specialists increase in project completion time	aids in strategic quality planning and budgeting every stage of SCM must have COQ for optimal benefits
helps waste reduction		every stage of SCM must have COQ for optimal benefits	helps waste reduction	lack of knowledge accounting difficulties increase as more complications add on	helps estimate monetary changes SCM upstream

productivity improvement	COQ analysis + COQ implementation helps understand the ease of use/analysis/collection of data	productivity improvement	employee attitudes needs specialists increase in project completion time	COQ analysis + COQ implementation helps understand the ease of use/analysis/collection of data increase comprehensive quality system
	increase comprehensive quality system			
	managerial + s/w leads to best COQ results			

2) **Table 2 - Years of experience based relationships:**

Advantages:	Disadvantages:	Practicalities:
Cost Reduction	<b>lack of knowledge accounting difficulties increase as more complications add on high loads of documentation</b>	solely dependent on the QA team <b>a part of quality planning phase</b>
S/w knowledge for quality	<b>employee attitudes no effect on scrap and customer complaints</b>	establish the marketing strategy <b>aids in strategic quality planning and budgeting</b>
positive growth of company can be seen	<b>accounting difficulties increase as more complications add on needs specialists increase in project</b>	should be implemented on personnel and facilities <b>Accounting department is 50% involved the other 50% is top management and departmental decision</b>

	<b>completion time</b>	
used for budgeting as a tool	<b>employee attitudes high loads of documentation</b>	company has their own techniques <b>Pull + push production</b>
monitoring quality	<b>lack of knowledge no effect on scrap and customer complaints</b>	more concentrated on external failure(contingency) and prevention(primary goal) <b>Accounting department is 50% involved the other 50% is top management and departmental decision</b>
helps in value added activities --> investment increase, share value, customer satisfaction, Global exposure	<b>needs specialists no effect on scrap and customer complaints</b>	solely dependent on the QA team <b>helps prioritize the importance of various actions</b>
improves product quality	<b>high loads of documentation increase in project completion time</b>	has to be done/reassessed/analyzed/tweaked every 4 months <b>reliability is a key point of note</b>
helps improve service quality	<b>lack of knowledge high loads of documentation increase in project completion time</b>	used more like revenue builder <b>every stage of SCM must have COQ for optimal benefits</b>
optimizes capital investment	<b>employee attitudes needs specialists increase in project completion time</b>	establish the marketing strategy <b>increase comprehensive quality system</b>
accepted due to extensive analysis involved	<b>accounting difficulties increase as more complications add on needs specialists</b>	should be implemented on personnel and facilities <b>managerial + s/w leads to best COQ results</b>
optimizes results obtained for showcasing the importance of the various COQ activities	<b>employee attitudes needs specialists increase in project completion time</b>	company has their own techniques <b>Pull + push production reliability is a key point of note</b>

Advantages:	Disadvantages:	Practicalities:
Cost Reduction	lack of knowledge	solely dependent on the QA team
S/w knowledge for quality	employee attitudes	establish the marketing strategy
positive growth of company can be seen	accounting difficulties increase as more complications add on	should be implemented on personnel and facilities
used for budgeting as a tool	high loads of documentation	company has their own techniques
monitoring quality	needs specialists	more concentrated on external failure(contingency) and

		prevention(primary goal)
helps in value added activities --> investment increase, share value, customer satisfaction, Global exposure	no effect on scrap and customer complaints	has to be done/reassessed/analyzed/tweaked every 4 months
improves product quality	increase in project completion time	used more like revenue builder
helps improve service quality		a part of quality planning phase
optimizes capital investment		aids in strategic quality planning and budgeting
accepted due to extensive analysis involved		Pull + push production
optimizes results obtained for showcasing the importance of the various COQ activities		every stage of SCM must have COQ for optimal benefits
		helps prioritize the importance of various actions
		increase comprehensive quality system
		managerial + s/w leads to best COQ results
		reliability is a key point of note
		Accounting department is 50% involved the other 50% is top management and departmental decision

3) **Table – 3 Job title based relationships:**

Advantages:	Disadvantages:	Practicalities:
Cost Reduction	lack of knowledge, employee attitudes incompatibility with existing systems	should be implemented on personnel and facilities
S/w knowledge for quality	lack of knowledge incompatibility with existing systems	managerial + s/w leads to best COQ results
Competitors use COQ	organization culture incompatibility with existing systems high costs of implementation	solely dependent on the QA team increase comprehensive quality system
positive growth of company can be seen	lack of knowledge, employee attitudes no effect on scrap and customer complaints	reliability is a key point of note
used for budgeting as a tool	organization culture incompatibility with existing	has to be done/reassessed/analyzed/tweaked every 4

	systems high costs of implementation	months
implementation lowers quality cost	,employee attitudes incompatibility with existing systems high costs of implementation	should be implemented on personnel and facilities
monitoring quality	lack of knowledge high costs of implementation	solely dependent on the QA team helps employees assess and know where to concentrate on to increase revenue
generates significant cost benefits	employee attitudes organization culture accounting difficulties increase as more complications add on	aids in strategic quality planning and budgeting
helps improve service quality	incompatibility with existing systems no effect on scrap and customer complaints	SCM upstream Pull + push production every stage of SCM must have COQ for optimal benefits
optimizes capital investment	organization culture accounting difficulties increase as more complications add on	has to be done/reassessed/analyzed/tweaked every 4 months
accepted due to extensive analysis involved	lack of knowledge, employee attitudes organization culture no effect on scrap and customer complaints	solely dependent on the QA team helps employees assess and know where to concentrate on to increase revenue
helps waste reduction	incompatibility with existing systems high costs of implementation	solely dependent on the QA team helps employees assess and know where to concentrate on to increase revenue
optimizes results obtained for showcasing the importance of the various COQ activities	lack of knowledge organization culture incompatibility with existing systems high costs of implementation	helps prioritize the importance of various actions increase comprehensive quality system

**4) Table 4 - Industry based relationships:**

Advantages:	Disadvantages:	Practicalities:
Cost Reduction [high costs of implementation] [needs specialists] [helps in controlling cost on the long run] [used more like revenue builder] [helps estimate monetary changes] [implementation is practical and possible for every project based on budget decision]	lack of knowledge	solely dependent on the QA team

S/w knowledge for quality [lack of knowledge] [solely dependent on the QA team]	employee attitudes	establish the marketing strategy
Competitors use COQ [organization culture] high costs of implementation[aids in strategic quality planning and budgeting] [SCM upstream] [managerial + s/w leads to best COQ results]	organization culture	helps in controlling cost on the long run
positive growth of company can be seen [employee attitudes] [high loads of documentation] [helps in controlling cost on the long run] [helps employees assess and know where to concentrate on to increase revenue]	incompatibility with existing systems	should be implemented on personnel and facilities
Help create an edge over competitors [lack of knowledge] [company has their own techniques]	accounting difficulties increase as more complications add on	company has their own techniques
used for budgeting as a tool [accounting difficulties increase as more complications add on]	high loads of documentation	more concentrated on external failure(contingency) and prevention(primary goal)

<p>implementation lowers quality cost [incompatibility with existing systems] [high loads of documentation] [more concentrated on external failure(contingency) and prevention(primary goal)]</p>	<p>high costs of implementation</p>	<p>has to be done/reassessed/analyzed/tweaked every 4 months</p>
<p>monitoring quality [accounting difficulties increase as more complications add on] [solely dependent on the QA team] [has to be done/reassessed/analyzed/tweaked every 4 months] [a part of quality planning phase]</p>	<p>needs specialists</p>	<p>helps employees assess and know where to concentrate on to increase revenue</p>
<p>helps in value added activities --&gt; investment increase, share value, customer satisfaction, Global exposure [high costs of implementation] [solely dependent on the QA team]</p>	<p>does not always reveal the root cause of a problem</p>	<p>used more like revenue builder</p>

<p>improves product quality [high loads of documentation] high costs of implementation[helps in controlling cost on the long run] [aids in strategic quality planning and budgeting] [SCM upstream] [every stage of SCM must have COQ for optimal benefits] [increase comprehensive quality system]</p>	<p>no effect on scrap and customer complaints</p>	<p>a part of quality planning phase</p>
<p>generates significant cost benefits [high costs of implementation] [high loads of documentation] [SCM upstream] [COQ analysis + COQ implementation helps understand the ease of use/analysis/collection of data]</p>	<p>increase in project completion time</p>	<p>aids in strategic quality planning and budgeting</p>
<p>helps improve service quality [high loads of documentation] [no effect on scrap and customer complaints] [solely dependent on the QA team] [SCM upstream]</p>		<p>helps estimate monetary changes</p>
<p>optimizes capital investment [establish the marketing strategy] [accounting difficulties increase as more complications add on]</p>		<p>SCM upstream</p>

<p>accepted due to extensive analysis involved [lack of knowledge] [needs specialists] [should be implemented on personnel and facilities]  [Accounting department is 50% involved the other 50% is top management and departmental decision]</p>		<p>Pull + push production</p>
<p>helps waste reduction [incompatibility with existing systems] [helps in controlling cost on the long run]</p>		<p>every stage of SCM must have COQ for optimal benefits</p>
<p>supplier cost control [incompatibility with existing systems] [has to be done/reassessed/analyzed/tweaked every 4 months]  [Pull + push production] [SCM upstream]</p>		<p>implementation is practical and possible for every project based on budget decision</p>
<p>productivity improvement [incompatibility with existing systems] [lack of knowledge] [more concentrated on external failure(contingency) and prevention(primary goal)] [aids in strategic quality planning and budgeting] [reliability is a key point of note]</p>		<p>COQ analysis + COQ implementation helps understand the ease of use/analysis/collection of data</p>

<p>optimizes results obtained for showcasing the importance of the various COQ activities [lack of knowledge] [solely dependent on the QA team] [aids in strategic quality planning and budgeting] [Pull + push production]</p>		<p>helps prioritize the importance of various actions</p>
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5) **Table – 5 Relationship between number of employees:**

Advantages:	Disadvantages:	Practicalities:
<p>*Cost Reduction knowledge increase as more complications add on implemented on personnel and facilities</p>	<p>*lack of *accounting difficulties *should be</p> <p>lack of knowledge</p>	<p>solely dependent on the QA team</p>
<p>*S/w knowledge for quality attitudes *COQ analysis + COQ implementation helps understand the ease of use/analysis/collection of data</p>	<p>*employee *needs specialists</p> <p>employee attitudes</p>	<p>should be implemented on personnel and facilities</p>

<ul style="list-style-type: none"> <li>*Competitors use COQ</li> <li>*accounting difficulties increase as more complications add on</li> <li>*solely dependent on the QA team</li> <li>*managerial + s/w leads to best COQ results</li> </ul>	organization culture	company has their own techniques
<ul style="list-style-type: none"> <li>*positive growth of company can be seen</li> <li>*lack of knowledge</li> <li>*needs specialists</li> <li>*helps employees assess and know where to concentrate on to increase revenue</li> </ul>	Incompatibility with existing systems	helps employees assess and know where to concentrate on to increase revenue
<ul style="list-style-type: none"> <li>*implementation lowers quality cost</li> <li>*organization culture</li> <li>*does not always reveal the root cause of a problem</li> <li>a part of quality planning phase</li> </ul>	accounting difficulties increase as more complications add on	a part of quality planning phase
<ul style="list-style-type: none"> <li>*monitoring quality</li> <li>*needs specialists</li> <li>company has their own techniques</li> </ul>	needs specialists	SCM upstream
<ul style="list-style-type: none"> <li>*improves product quality</li> <li>*employee attitudes</li> <li>*helps prioritize the importance of various actions</li> <li>managerial + s/w leads to best COQ results</li> </ul>	does not always reveal the root cause of a problem	every stage of SCM must have COQ for optimal benefits

<p>*helps improve service quality    *Incompatibility with existing systems          *COQ analysis + COQ implementation helps understand the ease of use/analysis/collection of data</p>	<p>no effect on scrap and customer complaints</p>	<p>COQ analysis + COQ implementation helps understand the ease of use/analysis/collection of data</p>
<p>*accepted due to extensive analysis involved          *lack of knowledge                      *no effect on scrap and customer complaints                      helps prioritize the importance of various actions</p>		<p>helps prioritize the importance of various actions</p>

**6) Table – 6 Relationship based on number of employees:**

Advantages:	Disadvantages:	Practicalities:
<p>Cost Reduction +organization culture +incompatibility with existing systems + solely dependent on the QA team + helps estimate monetary changes + increase comprehensive quality system</p>	<p>employee attitudes</p>	<p>solely dependent on the QA team</p>
<p>S/w knowledge for quality + employee attitudes + high loads of documentation + needs specialists + should be implemented on personnel and facilities + helps estimate monetary changes</p>	<p>organization culture</p>	<p>should be implemented on personnel and facilities</p>
<p>Competitors use COQ + accounting difficulties increase as more complications add on + solely dependent on the QA team + helps prioritize the importance of various actions</p>	<p>incompatibility with existing systems</p>	<p>company has their own techniques</p>

positive growth of company can be seen + employee attitudes+organization culture + high loads of documentation + helps prioritize the importance of various actions	accounting difficulties increase as more complications add on	has to be done/reassessed/analyzed/tweaked every 4 months
Help create an edge over competitors + accounting difficulties increase as more complications add on	high loads of documentation	helps employees assess and know where to concentrate on to increase revenue
implementation lowers quality cost+does not always reveal the root cause of a problem + has to be done/reassessed/analyzed/tweaked every 4 months	needs specialists	a part of quality planning phase
monitoring quality + employee attitudes needs specialists + helps employees assess and know where to concentrate on to increase revenue + reliability is a key point of note	does not always reveal the root cause of a problem	aids in strategic quality planning and budgeting
improves product quality + needs specialists + no effect on scrap and customer complaints + aids in strategic quality planning and budgeting + reliability is a key point of note	no effect on scrap and customer complaints	helps estimate monetary changes
generates significant cost benefits+organization culture+incompatibility with existing systems + COQ analysis + COQ implementation helps understand the ease of use/analysis/collection of data + reliability is a key point of note		COQ analysis + COQ implementation helps understand the ease of use/analysis/collection of data
helps improve service quality + employee attitudes + high loads of documentation + no effect on scrap and customer complaints + increase comprehensive quality system + reliability is a key point of note		helps prioritize the importance of various actions
accepted due to extensive analysis involved + accounting difficulties increase as more complications add on + high loads of documentation +managerial + s/w leads to best COQ results		increase comprehensive quality system

helps waste reduction + incompatibility with existing systems + should be implemented on personnel and facilities + a part of quality planning phase + managerial + s/w leads to best COQ results

supplier cost control + organization culture + does not always reveal the root cause of a problem + company has their own techniques + helps estimate monetary changes + COQ analysis + COQ implementation helps understand the ease of use/analysis/collection of data

productivity improvement + incompatibility with existing systems + high loads of documentation + needs specialists + has to be done/reassessed/analyzed/tweaked every 4 months

managerial + s/w leads to best COQ results

reliability is a key point of note