TOTAL COST OF OWNERSHIP IN SALES AND MARKETING

Demonstrating Value beyond the Price at Axis Communications AB

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PREFACE

This master thesis represents the final step on our journey to achieve a Master of Science in Industrial Engineering and Management. Consequently, the thesis does not only represent a semester worth of work, it also represents the end of five years at university. During this last semester we have gained a lot of knowledge, experienced about project management and especially had a chance to translate our theoretical academic knowledge into practice.

Writing the master thesis at Axis Communications AB has been a pleasure. Throughout the project, there has been a strong support and a great interest. All employees have been helpful and the company culture has inspired us to maximise our efforts. We would like to show our appreciation to the whole PIM-team, who has been taking care of us during the project. We would like thank Joakim Palmqvist in particular, our supervisor at Axis, who has been helping us forward throughout the project, always been there to answer our questions and always showed a great enthusiasm and commitment. Other people at Axis who have been very supportive are Guillermo Quintanilla, Stefan Sandor and Jeremy Deage. We would also like to express our gratitude to Jens Andersen, who voluntarily has spent hours helping us out. In addition to this we would like to thank all the people at Axis and the company partners who have shared their knowledge with us, helped us with the data collection and bringing the project forward.

From Lund University, Faculty of Engineering, we would like to thank our supervisor Lars Bengtsson for valuable advice as well as Erik Friberg, Susanna Christensen and Hanna Lilja for critically evaluating the final report.

Last but not least we would like to send our appreciation to our families and friends who have been supporting us during this master thesis and during the time enrolled at the university.

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ABSTRACT

Title:	Total Cost of Ownership in Sales and Marketing - Demonstrating Value beyond the Price at Axis Communications AB
Authors:	Axel Eriksson Ville Orlander Arvola
Supervisors:	Lars Bengtsson, Faculty of Engineering, Lund University Joakim Palmqvist, Axis Communications AB
Background:	There is an internal belief within Axis that despite their products' relatively high initial price, the total cost of ownership (TCO) of an Axis camera solution is lower than that of other brands. However, there is no internal research or tools to verify if it is true. Without this, Axis is unable to communicate their belief in an educated and quantifiable way, which is desired in sales and marketing situations.
Purpose:	The purpose of this master thesis is to create a TCO analysis framework for a network based video surveillance solution from a seller perspective. The framework is then to be applied on Axis's solutions to identify and weigh the most important parameters that affect the TCO. Based on this, a TCO analysis model that can be used by Axis's sales force is to be developed.
Methodology:	The overall methodology used in the project is action research in combination with descriptive, exploratory and problem-solving approaches depending on the specific research question. The theoretical methodologies have been integrated with a TCO development and implementation framework, which has formed the research process.
Conclusions:	Existing literature offers a range of TCO frameworks, but little research has been done regarding TCO from a seller perspective. A TCO analysis is very case specific, why generic models are not appropriate. A new framework for the development of a TCO sales tool is therefore proposed, which is adapted and provides detailed guidelines to the network camera surveillance industry. Using this framework, more than 50 cost factors that affect the TCO of a camera solution have been identified and categorised. These were then implemented into a sales tool that can be used to analyse and demonstrate costs and benefits. The significance of the cost factors affecting the TCO for a camera solution varies a lot. For sales and marketing purposes, the parameters that the company can influence and that differentiate a product from another should be emphasised. The benefits for companies to utilise TCO in sales and marketing are several, even though there are some distinct barriers to overcome. For Axis, the developed TCO sales tool can be a strategic resource to help convince its customers to shift their focus from a low-price mind-set to a pursuit of low-cost solutions.
Keywords:	TCO, total cost of ownership, sales, marketing, framework, cost factors, seller perspective, network based video surveillance, Axis.

SAMMANFATTNING

Titel: Totalkostnadsanalys i försäljning och marknadsföring
- Att påvisa värde utöver pris på Axis Communications AB

Författare: Axel Eriksson
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Joakim Palmqvist, Axis Communications AB

Bakgrund: Det finns en intern tro inom Axis att trots deras produkters initialt höga pris så är totalkostnaden för Axis kameralösningar lägre än konkurrenternas. Trots det finns det inga interna undersökningar eller verktyg för att verifiera om det är sant. Utan dessa kan inte Axis kommunicera sin tro på det kvalificerade och kvantitativa sätt som hade varit önskvärt i försäljnings- och marknadsföringssammanhang.

Syfte: Syftet med examensarbetet är att skapa ett totalkostnadsanalysramverk utifrån ett säljperspektiv för en nätverksbaserad kameralösning. Ramverket ska sedan appliceras på Axis lösningar för att identifiera och vikta de viktigaste parametrarna som påverkar totalkostnaden. Baserat på detta ska en totalkostnadsmodell utvecklas som ska användas av Axis försäljnings- och marknadsföringsorganisation.

Metodik: Den generella metodiken som används i projektet är aktionsforskning i kombination med beskrivande, utforskande och problemlösande ansatser beroende på den specifika forskningsfrågan. Ett ramverk för att utveckla och implementera en totalkostnadsanalys har integrerats med den teoretiska metodiken för att tillsammans skapa forskningsprocessen.

Slutsatser: Befintlig litteratur innehåller många olika ramverk som stödjer totalkostnadsanalyser, men forskningen av totalkostnadsanalys från ett säljperspektiv är nästintill obefintlig. En totalkostnadsanalys är väldigt fallspecifikt och det är därmed inte lämpligt att använda sig av generiska modeller. Därför har ett nytt ramverk föreslagits för att ta fram ett totalkostnadsanalysverktyg som kan användas inom försäljning för den nätverksbaserade kameraindustrin. Genom ramverket har mer än 50 kostnadsfaktorer identifierats och kategoriserats. Dessa implementerades sedan i ett säljverktyg för att kunna analysera och påvisa kostnader och fördelar.

Betydelsen av kostnadsfaktorerna som påverkar totalkostnaden för en kameralösning varierar stort. Ur sälj- och marknadsföringssynpunkt bör ett företag lyfta fram de kostnadsfaktorerna som de kan påverka och som skiljer sig mellan olika produkter. Det finns flera fördelar med att använda ett totalkostnadsperspektiv inom försäljning och marknadsföring, men samtidigt finns det även hinder som behöver övervinnas. För Axis kan det utvecklade säljverktyget vara en strategisk resurs för att övertyga sina kunder om att köpa produkter med låg totalkostnad snarare än låg inköpskostnad.

Sökord: Totalkostnadsanalys, försäljning, marknadsföring, ramverk, kostnadsfaktorer, säljperspektiv, nätverksbaserad kameraövervakning, Axis.

TERMINOLOGY AND ABBREVIATIONS

Terminology

Axis	Axis Communications AB.
Cost factors	A factor affecting the cost. Used interchangeably with parameters and cost parameters.
Distributor	An Axis customer that distributes the products to resellers and system integrators.
Fixed dome camera	A camera with a fixed viewing direction covered by a transparent dome.
Fixed network camera	A box shaped camera with a fixed viewing direction.
Integrator	See "System integrator".
Lifespan	The lifetime or service life of a product.
Network camera	Digital camera that uses IP protocol to transmit data over LANs and Internet.
Reseller	A reseller of Axis's products.
Service life	The expected lifetime of a product.
System integrator	A provider of complete surveillance solutions, from system design to installation and maintenance.
Vertical	Industry segment.

Abbreviations

ABC	Activity-Based Costing
DOA	Dead On Arrival
EMEA	Europe, the Middle East and Africa
LAN	Local Area Network
LCC	Life Cycle Costing
MSRP	Manufacturer's Suggested Retail Price
NAS	Network Attached Storage
PIM	Product Introduction Management, a department at Axis Communications AB
PTZ	Pan-Tilt-Zoom, a camera functionality
R&D	Research and Development
RMA	Return Merchandise Authorisation
RQ	Research Question
TCA	Total Cost of Acquisition
TCO	Total Cost of Ownership
TDC	Total Decommissioning Costs
TOC	Total Operating Costs
VMS	Video Management System

CONTENTS

1. INTRODUCTION

The chapter aims to provide the reader with an understanding of the project. The chapter will start by a general introduction of Axis and the camera surveillance industry followed by the problem description for this project. This leads to the formulation of the project purpose and the research questions. The end of the chapter presents an overview of the report structure.

1.1 Background

Axis Communications AB, hereafter denoted Axis, is a provider of intelligent security solutions, with their main business area being network cameras. Axis's product portfolio includes network cameras, video encoders, access control, accessories and application software. The company launched the world's first network camera in 1996, and has ever since been driving the shift from analogue to digital video surveillance technology (Axis, 2015a). A network camera is a digital camera that can use the standardised IP protocol to transmit data over a local area network (LAN) or the Internet (Axis, 2015b).

What used to be a competition between the analogue and digital video technology is now changing into a competition between numerous digital camera surveillance options. Although the analogue camera still has a majority of the market share (Axis, 2015c), the digital technology is being widely adopted and is becoming the standard technology when installing new video surveillance systems.[1] Axis is the market leader in the network camera industry (Axis, 2015a), but the competition is intensifying. The company is mainly manufacturing premium high quality cameras that often are more expensive than those of other vendors. Today there are several actors that offer low-cost solutions. The biggest actor is the Chinese camera manufacturer Hikvision, which recently has been gaining market shares. In 2013, the company had the highest market share for surveillance cameras, when including both analogue and network cameras (IHS, cited by Axis, 2015g).

Axis has predominantly been operating in the high-end enterprise market, but new internal directives state that Axis is to increase their presence in the medium and the small business segment (Axis, 2015g). Furthermore, the emergence of low-cost providers is putting pressure on Axis to justify the relatively high initial investment that an Axis solution often implies. Until recently, it has been sufficient to refer to datasheets to differentiate Axis's products from others', but as the network camera industry is maturing rapidly with many components becoming commodities, other means of differentiation are needed.[1] This includes focusing on other values as well as finding new ways of selling cameras and solutions.

1.2 Problem Description

There is a belief within Axis that despite their high initial product price, the total cost of ownership (TCO) of an Axis camera is lower than that of most other brands.[2] This belief is partly based on factors such as product quality, ease of use, ease of installation, generous return merchandise authorisation (RMA) policies and warranties, high service and industry expertise level. All these factors ultimately affect the TCO of a surveillance system, which examines all the costs that can be associated with a product over its product life cycle. When making a purchase, the TCO should be considered rather than just the initial price (van Weele, 2010). There is currently insufficient information to verify whether the TCO of an Axis camera actually is lower than that of its competitors. To enable efficient creation of marketing and sales material, there is a need

[1] Frännlid, 2015. *Personal communication.*
[2] Quintanilla, 2015. *Personal communication.*

for a better understanding of what parameters that affect the TCO. Without this information, Axis is unable to communicate their belief in an educated and quantifiable way.

Total cost of ownership is an established concept, especially in the context of procurement (Ellram & Siferd, 1993). TCO frameworks have been introduced by Ellram (1993), Prabhakar and Sandborn (2012) as well as Smith, Schuff and Louis (2002) among others, but their applicability for network video surveillance solutions is limited. The frameworks are either on a very high level of abstraction (such as Ellram, 1993) or they have been tailored to suit a specific industry, for instance the IT industry (Smith et al., 2002). Furthermore, they adopt a buyer perspective. The benefits of utilising a TCO analysis from a seller perspective is a subject not very explored, except for the research done by Piscopo, Johnston and Bellenger (2008). Due to the inadequacy of existing frameworks and the low amount of research within the area, Axis would benefit from a framework adapted to their needs as well as have the rationale for utilising a TCO analysis from a seller perspective clarified.

1.3 Purpose

The purpose of this master thesis is to create a TCO analysis framework for a network based video surveillance solution from a seller perspective. The framework is then to be applied on Axis's solutions to identify and weigh the most important parameters that affect the TCO. Based on this, a TCO analysis model that can be used by Axis's sales force and marketing department is to be developed.

1.4 Research Questions

Based on the purpose, the following research questions have been formulated:

RQ 1. How can already existing TCO analysis frameworks be translated to fit a network based video surveillance solution?
RQ 2. Which are the most important cost parameters to consider in a TCO analysis for network based video surveillance?
RQ 3. What is the rationale for utilising a TCO analysis from a seller perspective?
RQ 4. How can the results of the TCO analysis be used in Axis's sales and marketing strategy?

1.5 Delimitations

The project is limited to the network based video surveillance industry, which means that the analogue technology is not considered.

1.6 Target Audience

The main target audience for this report includes the project supervisors and the employees at Axis, in particular the Product Introduction Management (PIM) team, the sales organisation and the marketing department. Secondary target audiences include students and professors at the Faculty of Engineering, Lund University, with an interest in the network based video surveillance industry and TCO in sales and marketing.

1.7 Structure of the Report

This report contains of seven chapters, which is presented visually in Figure 1. Chapter 1 describes the purpose of the project, a short background and the problem description. The next chapter, chapter 2, presents the methodology used in the project and chapter 3 presents a literature study where the relevant theoretical frameworks and models that are used in the results and analyses are explained in detail. Chapter 4 is a company description where Axis's business model, Axis's products and the industry segments are summarised. Chapter 5 provides the results of the project, which consists of a comprehensive cost factor categorisation, a sales tool, a sales tool development framework, two identified reference systems and the quantifications of these when inserted into the sales tool. The results from chapter 5 and how these are to be used by Axis is then analysed in chapter 6. The report is concluded with a summary of the findings, recommendations to Axis and recommendations for further research in chapter 7.

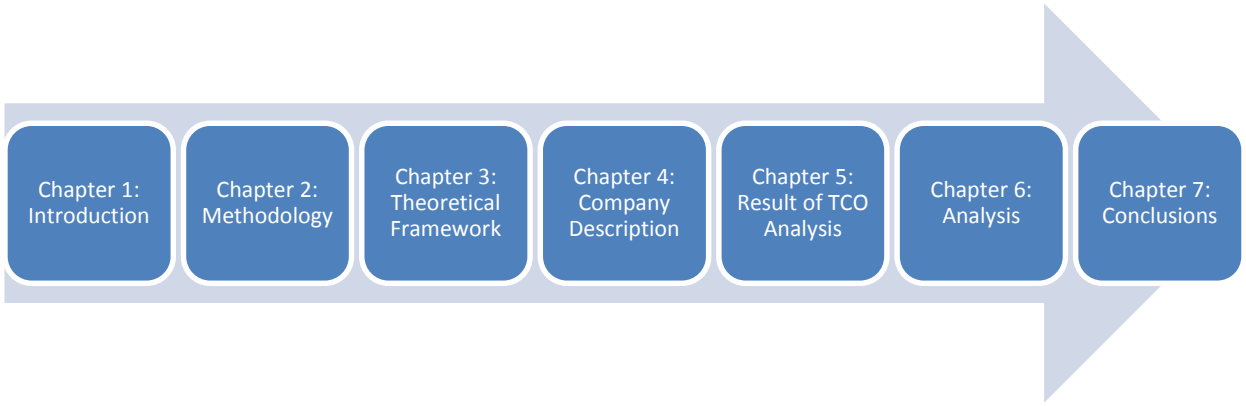

Figure 1. Structure of the report.

2. METHODOLOGY

In this chapter, the methodology used for the project is presented. The research approaches connected to the overall process and the different research questions are described as well as the data collection methods. The different phases of the research method are then described in detail. The chapter ends with a critical evaluation of the methodology and literature used.

2.1 Methodology Purpose

The methodology outlines the project approach. It is a description of the frameworks and principles that are used to guide the project execution (Höst, Regnell & Runeson, 2011). The methodology also determines the validity of the study. It is good practice to show how a study has been carried out, as this allows the reader to make an assessment of the methodology and the reliability of the results.

2.2 Scientific Approach

2.2.1 Overall Research Approaches

Within applied science there are four common methods, which are described by Höst et al. (2011). These include surveys, case studies, experiments and action research. A survey is often used to map a broader issue, whereas a case study is an in-depth analysis of a specific case. Experiments are conducted to compare several alternatives, while trying to isolate and manipulate the input parameters. Action research is concerned with an activity that aims to solve a problem. The latter one is used as the main method for this project.

2.2.2 Action Research

What distinguishes action research is that it emphasises the application of the research results rather than just developing an understanding of a particular problem (Denscombe, 2009). Bryman (2012, p.397) defines it as "an approach in which the action researchers and members of a social setting collaborate in the diagnosis of a problem and in the development of solution based on the diagnosis". The process can be divided into four stages (adapted from Höst et al., 2011):

1. Observation
2. Solution
3. Implementation
4. Evaluation

The first stage begins with observation of a phenomenon, where a problem is mapped and identified. The purpose of this stage is to get a good understanding of the problem that is to be solved. Surveys and case studies may be used to facilitate this process. The next step involves the development of a solution to the problem. When a satisfactory solution has been found it can be implemented. The last stage is the evaluation of the solution. Although it is an important stage, Höst et al. (2011) note that this part often is neglected.

Many research methods aim to observe and analyse a phenomenon without interference, since any impact the observer has on the system may jeopardise the validity of the study. Action research, however, aims to influence the situation while observing and evaluating it simultaneously (Höst et al., 2011). The results may therefore be biased, caused by a lack of objectivity. Höst et al. (2011) suggest that predefined evaluation criteria can be used to increase the objectivity, as well as including external reviewers. Other critique is presented by Bryman (2012, p.397), who states that action research sometimes is "dismissed by academics for lacking rigour and for being too partisan in approach". The master thesis students are external to Axis, which

increases the possibility of adopting an objective approach. The issue of bias is further minimised by including external reviewers such as the Lund University master thesis supervisor and the master thesis opponents. To prevent the project from suffering from lack of rigour, a well-defined methodology is used.

2.2.3 Research Question Approaches

Which methodology to apply depends on the purpose of the study (Höst et al., 2011). Robson (2002) distinguishes between four types of purposes for a project: exploratory, descriptive, explanatory and emancipatory. Although a study may address several types of purposes, it is common that one of them is predominant. Höst et al. (2011) suggest that the last type, emancipatory, is replaced with problem-solving. As the names suggest, an exploratory study intends to understand a phenomenon in depth, a descriptive study describes a phenomenon, an explanatory study tries to identify causalities and explain a phenomenon, and a problem-solving study aims to find a solution to a problem (Höst et al., 2011).

The underlying purpose varies with each research question. The nature of RQ 1, how to utilise existing TCO analysis frameworks, is mainly descriptive. It aims to investigate what research has been done in the field of TCO, what frameworks exist and finally how these can be applied on Axis. Literature review is used as the main mean of addressing RQ 1. RQ 2, identify the most important cost parameters, is mainly exploratory. Here, an in-depth analysis of what factors affect the TCO and how the factors interrelate will be investigated. Qualitative methods such as interviews and quantitative methods to calculate the costs are used to address RQ 2. RQ 3, the rationale for utilising a TCO analysis from a seller perspective, is mainly exploratory since it is a new area with limited previous research. To address RQ 3, findings from the literature are validated throughout the project and combined with a qualitative analysis of the insights that are gathered. RQ 4, how the TCO analysis results can be used in Axis's sales and marketing strategy, is mainly problem-solving. The purpose is not to describe or explain a phenomenon, but rather to come up with solutions of how to utilise the new knowledge that has been produced in the previous steps. To address RQ 4, a qualitative analysis is made, which is discussed and evaluated together with Axis.

2.2.4 Incorporation of the Theory in the Research

The research approach for a project can be deductive or inductive and concerns the relationship between theory and research. A deductive study is conducted with reference to existing theory, while an inductive study uses the research to generate new theory (Robson, 2002). An abductive approach is adopted when these two approaches are used in combination (Wallén, 1996). If developing a framework, it means that it is progressively modified as theoretical and empirical findings are made (Dubois and Gadde, 2002). In this project, an abductive approach is used.

Robson (2002) describes two other approaches to the role of theory in research; fixed and flexible design. The fixed design is a theory-driven research method, which usually is based on quantitative data. The data collection method, and what data to collect, is specified in the beginning of the project, and the analysis does not begin until all the data has been gathered. In contrast, the flexible research method uses mainly qualitative data. It is a method that is evolved throughout the data collection. This project uses a combined strategy design, which Robson (2002) explains as a research with an initial flexible qualitative phase followed by a fixed quantitative phase.

2.3 Research Validation

There are several criteria to keep in mind when evaluating social research. Rosengren and Arvidson (2002) suggest that reliability, validity and the representativity should be considered. Other classifications include

reliability, replication and validity (Bryman, 2012) or validity and generalizability (Robson, 2002). Höst et al. (2011) expand on the categorisation by Rosengren and Arvidson (2002) and describe reliability as the accuracy of the data collection and analysis of data with regard to stochastic variation. Validity is about coherence between the intentions of a measurement and what actually is measured. Representativity is concerned with the extent to which the results can be generalised. The methodology should address each of these issues. The criteria presented by Höst et al. (2011) will be used to determine the validity of the study.

A commonly used strategy to validate the research is to use triangulation (Robson, 2002). Triangulation is about using multiple methods and multiple sources of data to ensure that the results are consistent with each other (Bryman, 2012). Denzin (2009) identifies four types of triangulation; data triangulation, observer triangulation, methodological triangulation and theory triangulation. Data triangulation is used when data is collected from multiple sources, observer triangulation is used when more than one observer is observing the study, methodological triangulation is used when the study combines quantitative and qualitative data and theory triangulation is used when multiple theories and perspectives are utilized (Robson, 2002).

To ensure project reliability, a systematic approach is adopted. The reliability of the research is maintained through data triangulation, by including several independent sources throughout the project; interviews, literature and secondary sources. To confirm important findings, interview summaries are provided to the interviewees to allow them to correct any misunderstandings and ensure that no vital information is left out. The reliability is also ensured through methodological triangulation, since the results will be confirmed with both qualitative and quantitative analyses, and theory triangulation, through literature reviews including multiple sources and multiple search strategies.

To retain the validity of the result, each research method used is scrutinised in regard to what the method measures and the purpose of the measurement. Since two observers always will be present during the project and most issues will be discussed with the project supervisors, observer triangulation is applied. Moreover, close communication with both the Axis supervisor and the Lund University supervisor is ensuring that the project is heading in the right direction and that issues that surface are discussed at an early stage.

The last criterion for the research validity is representativity of the research, which is limited. This is often the case with case studies and action research (Höst et al., 2011). The results of the project can only be validated for the particular circumstances specified in this report. Some generalisations will however be discussed.

2.4 Data Collection Methods

2.4.1 Overview

In this project, data has been collected from multiple sources using different methods. Both qualitative and quantitative data has been gathered using mainly three methods; interviews, literature review and secondary sources. The theory behind the data collection methods will be presented below and chapter 2.5 will describe how the data collection methods are used in this project.

2.4.2 Interviews

A common way to collect qualitative information is through interviews. Robson (2002) identifies three different kind of interviews; fully structured interviews, semi-structured interviews and unstructured interviews. A fully structured interview has the same predetermined fixed questions and fixed questioning order for all the interviews. A semi-structured interview also has predetermined questions. However, the set of questions can be adjusted to the interviewee and be modified during the interview. An unstructured

interview can be a conversation or discussion about a general topic and does not require predetermined questions. The unstructured interview can be either formal or informal.

An interview can be recorded through notes or sound recording. If sound recording is used, the recording should be transcribed, which is very time-consuming and normally takes eight to ten hours per hour recorded (Höst et al., 2011). If notes are used, these can be sent to the interviewee to confirm that the interviewers understood the interviewee correctly (Höst et al., 2011).

2.4.3 Literature Review

The literature used for scientific purposes should have a high validity. The literature should either be reviewed by experts or verified by the researchers to make sure that the choice of methodology, the results and the overall quality of the work is satisfactory (Höst et al., 2011). Höst et al. (2011) presents five forums where it is possible to find scientifically reviewed articles; journals, proceedings from conferences, articles from workshops, posters and short papers. The articles and findings in reputable journals is usually the literature that is most verified by qualified scientists (Höst et al., 2011).

2.4.4 Secondary Sources

Secondary data sources can be used for secondary analyses, which are analyses of data by researchers who were not involved in the collection of the data (Bryman, 2012). Commonly used secondary sources are quantitative data archives, official statistics, written media documents and non-written media documents (Robson, 2002 and Bryman, 2012). If the researcher can confirm that the data can be integrated with the new research, secondary sources may save time and make it possible to process greater amounts of data (Robson, 2002).

2.5 Research Process

The action research method was used as the basis for this project. Consequently, the process could be divided into four stages; observation, solution, implementation and evaluation, as described earlier. Ellram (1993) proposes an eight step process of how to develop and implement a TCO model, which is further described in chapter 3.3.2. The action research and Ellram's (1993) TCO framework combined constituted the foundation of the research process for this project. To be able to answer the research questions, some additional steps had to be included. The research process is described in Figure 2.

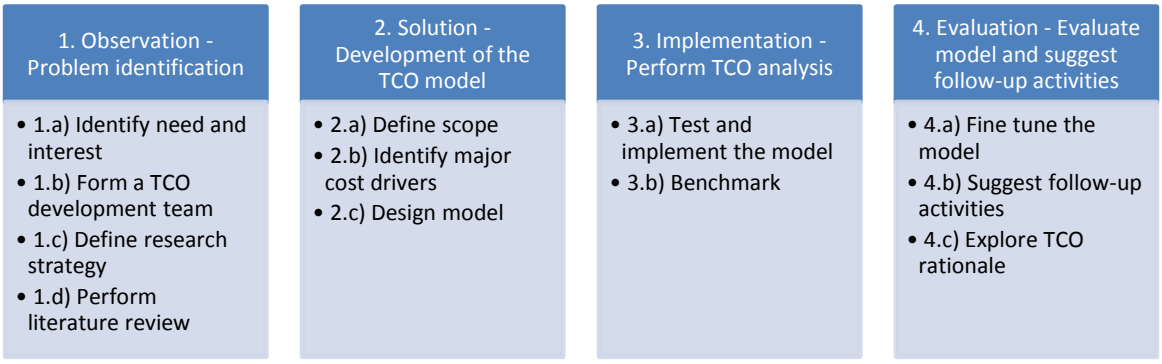

Figure 2. Research process used in the project.

As noted by Höst et al. (2011), action research is an iterative process. Furthermore, the process is not strictly linear. Several steps may overlap and can be executed in parallel. The process above does however provide an overview.

2.5.1 Observation - Problem Identification

The first stage of the research process concerned the identification and isolation of the problem. Parts of this had already been performed by Axis, which led to the initiation of this master thesis. Each step of the observation stage is described in detail below.

1.a Identify Need and Interest

To begin with, the needs and interests for the project had to be identified. Axis had already identified a problem, but it had to be isolated and verified. By conducting unstructured interviews with different stakeholders at Axis, a better understanding of the needs and interests was established. Axis provided a list with key people to interview that was used as a starting point. Throughout the interviews, new people of interest were identified and interviewed.

1.b Form a TCO Development Team

The second step concerns the TCO development team. The core team had been determined in advance and it consists of two master thesis students supported by an internal and an external supervisor. Ellram (1993) suggests that a cross-functional team should be utilised, but the nature of the project and the limited amount of resources restricted the size of the team. To get a cross-functional perspective, both internal and external stakeholders were invited to contribute to the project through meetings and interviews.

1.c Define Research Strategy

The purpose of the project, the research questions and delimitations had to be well defined. A research strategy was then developed to assure that these criteria were met with sufficient validity and reliability. Help and guidance was obtained from social research literature such as Höst et al. (2011), Bryman (2012) and Robson (2002).

1.d Perform Literature Review

A literature review was performed to acquire knowledge within the field of total cost of ownership and other related areas that were required to successfully execute the project. The search process is described in chapter 2.6.

2.5.2 Solution - Development of the TCO Model

The second stage of the research process concerns the development of the TCO model. It was divided into three phases.

2.a Define Scope

The first step in developing the TCO model was to specify what kind of product or solution that the TCO would address. When this had been established, the focus was narrowed down to only one industry segment and a geographical market was selected. This made it possible to identify different cost owners within the segment and finally select one of them. These steps formed the pre-requisites to be able to start the mapping and identification of cost factors that affect the TCO.

2.b Identify Major Cost Drivers

The cost driver identification phase started by conducting unstructured interviews to get an overview. The cost factors were then mapped using a top-down approach. The point of departure was three main activities from where all the costs could be derived. These activities were then broken down into sub activities, to eventually identify cost factors for each activity. When it was not sensible to group the cost factors based on the corresponding activities, an alternative categorisation was used.

The cost factor foundation was based on the literature review. Once the theoretical foundation had been established, the qualitative research process started. An initial brainstorming session was held to map all the factors that affect the TCO. The factors were then categorised according to their inter-relationships and corresponding activities, while factors that were considered insignificant were discarded. The categorisation was used to guide the semi-structured interviews that subsequently were carried out. These interviews were initially carried out with representatives from different departments that were working closely to the customers. Based on recommendations from the interviewees and depending on the expertise needed at the moment, the following interviewees were selected. Some people were interviewed multiple times due to their high expertise and their ability to help bringing the project forward. All the interviewees are presented in Appendix C. Through several iterations, where the list of cost factors gradually was modified, the final cost factor categorisation was developed. This was then sent out for final confirmation to a reference group of selected experienced interviewees representing different company departments.

2.c Design Model

The design of the TCO model started as soon as all the important TCO parameters had been identified. The first step was to categorise all the parameters and determine the structure of the model. The second step aimed at determining how to communicate the results. When these steps had been accomplished, the model was implemented on a spreadsheet.

2.5.3 Implementation - Perform TCO Analysis

The implementation stage aimed at applying the model that was developed in the previous stage on Axis and also to also do some benchmarking.

3.a Test and Implement the Model

Two representative Axis solutions were identified and relevant data was gathered. The TCO model was then applied on these solutions to produce two results. The plausibility of the parameters, the results and the model were then verified through interviews, a workshop and relevant secondary sources, such as old invoices and industry statistics.

3.b Benchmark

In this step, general cost factor data was gathered to create an industry average system. The costs for the created system were then compared with an Axis solution to identify similarities and differences.

2.5.4 Evaluation - Evaluate model and suggest follow-up activities

The evaluation stage aimed at evaluating the whole project. The TCO model was fine-tuned and the results were analysed.

4.a Fine-tune the Model

Although the plausibility of the developed TCO model was verified in previous steps, the model had to be fine-tuned. This included a deeper analysis of the accuracy of the data and how it affected the results.

Sensitivity analyses were conducted with regard to selected cost factors. Follow-up interviews were conducted to get feedback on the model, including the intended users.

4.b Suggest Follow-up Activities

This step focused on how to utilise the knowledge that had been attained throughout the project. By analysing the TCO analysis and the results of the model, follow-up activities were suggested.

4.c Explore TCO Rationale

The exploration of the rationale of doing a TCO analysis from a seller perspective aimed at reviewing what findings that could be generalised and put into a larger context. This was based both on the literature review and the advantages and drawbacks that were identified during the course of the project.

Additional Steps

Two additional steps, "Link TCO to other systems" and "Continue to update, monitor and maintain system", are suggested by Ellram (1993, p. 53) but have not been included in this project. Due to the limited time frame of this project, these steps are to be performed by Axis.

The Final Framework

In the end of the project, the initial TCO analysis framework that had been developed was further improved according to the experiences from the project, into the framework presented in chapter 5.6.

2.6 Literature Review Process

LUBSearch has been used in the search for relevant literature, which is an online service that provides access to the index catalogues of the Lund University libraries and all the databases to which the university subscribes. In addition to this, Google and Google Scholar have been used. The searches have been based on keywords such as "total cost of ownership", "TCO", "total cost", "life cycle costing", "product life cycle costs", "activity based costing", "framework" and "model" in different combinations. Since the TCO concept originates from the purchasing discipline, journals such as "Journal of Business Logistics" and "Journal of Supply Chain Management" have been useful. There is an abundance of articles published about TCO, but their use have been limited due to many of them being very industry or case specific. Whenever a relevant article was found, its bibliography was examined to discover new sources.

2.7 Critical Evaluation

2.7.1 Methodology

The developed cost categorisation and TCO sales tool has to some extent been tested and verified with sales people, but the sales tool has not been used in a real sales situations. This is shortcoming, since the action research method requires implementation and evaluation of the solution. Axis will have the possibility of completing these steps, but this will be outside the scope of this project. This does however only apply to the sales tool. The cost factors have been developed through several iterations.

When mapping the cost factors, the interviewees were provided with a cost factor categorisation that was used as the basis for the discussions. This may have limited their creativity and had them overlook certain aspects, as there is a risk of them getting influenced by the pattern of thought introduced by the interviewers. Having several people agreeing on a result may also create a false sense of validity. To avoid this, the interviewees where questioned about the basic assumptions of the categorisation and the end result was compared to another categorisation developed by an independent team. Many of the people were given the

opportunity to some extent prepare in advance, but only a few had the possibility of doing so because of their ordinary duties.

Most of the interviewed peopled were Axis employees. More interviews with system integrators and end customers would have been desirable, but it was difficult arranging meetings and including them in the process. Firstly, it was time consuming to find the people at Axis who had the contact information to the system integrators and end customers and to have them mediate the connections. Secondly, it was time consuming to find the right people within these organisations who were interested in TCO and willing to spare their time. Another obstacle in the project was that Axis had commitments to some stakeholders that made it untimely to include them in the process.

2.7.2 Sources and Literature

Few printed books that discuss TCO or related topics have been found, why online journals have been used as the main source of information. Furthermore, several articles were found to refer to the same sources, which suggests that the field is influenced by a few scholars only. The works of Ellram (1993, 1994 and 1995) as well as Ellram and Siferd (1993, 1998) seem to have been particularly influential and have laid the theoretical foundation for TCO within purchasing. It is interesting to note that these articles date back to twenty years ago. When reviewing TCO form a seller perspective, only one article has been found, which suggests that the area is not very explored by scholars. There is also TCO research that has been conducted by companies such as Gartner Inc. who specialises in information technology research and advisory, and provides an industry standard for assessing IT costs. However, this information is only available against a fee.

A possible explanation for the limited availability of relevant literature is that a TCO analysis is very case specific. This is further explored in chapter 3. The implications for this project is that the quality of some of the theoretical framework used can be questioned, as not enough research has been done to verify the findings. The frameworks used most in this project are therefore the ones that have been most validated through others' research. In general, more inductive studies are needed to strengthen the theoretical foundation within the field of TCO.

3. THEORETICAL FRAMEWORK

The chapter presents the theoretical frameworks that are utilised in this project. The chapter begins with a general overview of the TCO concept and how it is used today. This is followed by descriptions of several TCO development frameworks and the theory behind some of the relevant TCO model attributes. The chapter concludes with some theory about TCO in sales and marketing as well as benefits and barriers for implementation of the TCO concept.

3.1 Total Cost of Ownership

3.1.1 Background

The concept of considering more than the price when selecting a supplier has been noted to date back to 1928 (Ellram & Siferd, 1993). Today, there are several related terms such as total cost, life cycle costing, product life cycle costs and total cost of ownership that address the issue (Ferrin & Plank, 2002 and Zachariassen & Arlbjørn, 2011). These concepts are all proposing a long-term perspective rather than just looking at the initial price when assessing potential purchases (Ferrin & Plank, 2002). In this project, the total cost of ownership concept is used as the point of departure.

3.1.2 TCO Definition

As stated by Ellram (1993, p.164), "The TCO implies that all costs associated with the acquisition, use, and maintenance of an item be considered in evaluating that item and not just the purchase". Degraeve, Labro and Roodhooft (1999) instead define that "The TCO quantifies all costs associated with the purchasing process throughout the entire value chain of the firm". Garfamy (2006, p. 663) offers a more comprehensive definition, suggesting that TCO "focuses on the true costs associated with the entire purchasing cycle, thus it considers all costs related to the acquisition, usage, maintenance and follow-up of purchased goods or service as well as purchasing price". While many definitions seem to exist, Zachariassen and Arlbjørn (2011) observe that a common characteristic is that the TCO concept highlights the indirect costs and lifecycle costs that a purchase may imply.

3.1.3 Related Terms

There are many theories and concepts that are closely linked to the TCO concept. Some key theories and concepts are presented below.

Activity-based Costing

The TCO approach is an activity-based method and the activity-based costing (ABC) theories are used to understand and analyse the costs (Ellram & Siferd, 1993). It is therefore necessary to understand the theory behind ABC.

ABC emerged in the 1980s as a new way to obtain more precise information about the costs and the underlying causes. ABC was developed for allocation of the costs within manufacturing, but does also have other fields of application. The traditional way of allocating indirect costs, or overhead costs, was to arbitrarily find a cost base, which the costs then were to be proportionally allocated after. The ABC system instead links the general costs through identified cost drivers (Kapić, 2014). The costs are primarily linked to activities and processes and secondly to the products (Kaplan & Cooper, 1998). The activities are linked to the consumed resources and provide an accurate cost allocation.

Kaplan and Cooper (1998) present four stages of developing an ABC system. The first step is to develop the activity dictionary, where the activities are identified. The second step is to find out the costs for each of these activities. The third step is a valuation of the activities performed, to evaluate if the activities are value adding. The fourth step is to link the activities to the cost objectives.

Life Cycle Costing

The TCO concept is closely linked to life cycle costing (LCC) theories and the two concepts have many similarities. LCC was systematically used already in the early 1930s and was mandatory to use in the US during the 1970s for weapon system procurement (Hunkeler, Lichtenvort & Rebitzer, 2008). Hunkeler et al. (2008, p. 4) describe a conventional LCC as "the assessment of all costs associated with the life cycle of a product that are directly covered by the main producer or user in the product life cycle". The LCC considers costs related to R&D, production, sales, the usage of the item and the disposal. Which specific parameters to include vary depending on the purpose of the analysis. The objective of LCC is similar to that of the TCO; to gain a deeper understanding of the sources from where the costs derive.

The difference between LCC and TCO is what areas of cost parameters they include. Whereas the LCC includes all the aspects from design to disposal, the TCO excludes the costs associated with the design and focuses on the costs incurred by the user. The TCO costs are the most relevant costs for a customer and therefore the TCO concept is more suitable for this project.

3.2 The Use of TCO

3.2.1 TCO Adoption Extent

According to Drury (2003) there is a wide knowledge among purchasing agents that the purchasing price can be low compared to other costs incurred by a certain system. The statement is supported by Ellram and Siferd (1993) whose result of a survey, among purchasing directors, shows that 85 per cent of the respondents were familiar with the TCO approach. Despite this fact, TCO is rarely used and generally does not have a big impact on the purchasing decisions (Drury, 2003). Ferrin and Plank (2002) further investigated these statements and surveyed more than 140 purchasing managers about their opinions and usages of TCO. The surveyed managers represented companies that were of various sizes and operating in different industries, however with a high concentration of medium sized manufacturing companies. The results showed that an average of one third of the purchasing decision made were based on a TCO valuation, but less than ten per cent of the companies based more than 80 per cent of their decisions on TCO. The top three categories of goods purchased using a TCO valuation were, in descending order; capital goods, manufacturing parts and raw material.

Ellram and Siferd (1993) conducted research among purchasing managers and also carried out a study at a convention about purchasing cost savings. Of the purchasing managers, only one out of 120 claimed that their firm used a TCO model. At the purchasing convention, less than one fifth of the 100 respondents had a formal TCO approach and approximately 60 per cent claimed they had an informal TCO approach. Ferrin and Plank (2002), through their research, conclude that the reason there is a low number of companies using a TCO approach is due to its complexity, although the TCO is well worth the effort if it is correctly applied.

3.2.2 TCO within Purchasing

Though the TCO approach can be used in many different contexts, it is most commonly used in purchasing. Ellram and Siferd (1998) investigated how TCO was used in companies, and their case study identified many usages that were categorised into five major usage areas. These are supplier selection, communication,

ongoing supplier improvement, drive improvement and create understanding. The usages within each major area, as described by Ellram and Siferd (1998), are specified below.

Supplier selection: The usages are mainly concerning the evaluation and selection of suppliers in early stages, when the supplier is not yet selected. The decisions may also concern outsourcing and how to allocate the business between the different suppliers.

Communication: TCO is used for communication of ideas, both internally and to external suppliers. The communication may be education, marketing or to be able to share ideas and visions.

Ongoing supplier management: Includes the performance evaluation of current suppliers as well as to find potential improvement opportunities. The TCO is also helpful to provide a fair supplier evaluation tool.

Drive improvement: TCO helps decreasing costs through better cost evaluations of equipment and facilitates in the process of identifying on which areas the company resources can make the greatest improvement.

Create understanding: Makes it possible to better understand processes and how costs are created. It also helps in quantifying cost reductions and in understanding the cost factors that are critical for the commodities.

3.2.3 TCO within IT

Within the IT industry, TCO is a significant concept. As McKeen and Smith (2010) as well as Drury (2003) state, most IT purchasers are aware that the purchase price is relatively small compared to the annual operating costs. However, the research also shows that not many purchasers within IT consider the TCO when purchasing new technology and most of them do not follow up the total cost (Drury, 2003). McKeen and Smith (2010) identify two main usages in the IT industry. The first is to optimise the budget allocation and to enable better decisions making on how to invest the money. The second is to provide important input for IT planning and asset management, which helps in making better choices on how to minimize the future costs of the assets. To be able to use TCO, it is important to be able to collect a comprehensive data set with correct and relevant data. With the right applications, the already collected data in most companies can easily be modified to support a TCO model (McKeen & Smith, 2010). McKeen and Smith (2010) further explains several advantages for IT companies to use TCO; to manage the IT costs, to justify certain strategic technology choices, to capture the actual project costs and for communication to the organisation.

In their research, McKeen and Smith (2010) establish that there are multiple obstacles for a company when implementing TCO, both in the cost factor identification phase and in the resource allocation phase. In the identification phase, there are difficulties mainly due to the high number of cost factors that affects a system. Identified typical cost factors that are included in an IT application are listed in Table 1. In the allocation phase, the main issue is the difficulty to tie the maintenance and operating costs to a specific system. McKeen and Smith (2010) state that "striving for perfection with TCO is folly". The statement is followed by an explanation that the TCO will always be a trade-off between accuracy, granularity and control.

Table 1. Typical application costs of an IT system. Source: McKeen & Smith, 2010, p.633.

Life-cycle stage	Typical costs
Acquisition and procurement	Administrative costs Evaluation Contract management Hardware Backup Software licenses
Operations and maintenance	Administrative costs Training IT staff Supporting users Technical support Retooling to accommodate new hardware and software Software and hardware versioning Fixed allocations Internet and other network access costs Energy costs Informal self-support Down time due to hardware/software malfunctions and/or user errors
End-of-life management	Administrative costs Staging Sanitizing hard drive and other storage media Testing and/or preparing for reuse Providing follow-on support to employees or others purchasing used equipment Recycling/disposal fee and/or outsourcing fee Physical shipping and delivery Value of sold products and materials

To succeed with TCO in IT industries, McKeen and Smith (2010) suggest four strategies. The first strategy is to focus the TCO to areas where the benefits are superior the costs and efforts. The second strategy is to assign the TCO ownership to a specific department as well as to work on the internal acceptance. The third is to work with the TCO data gathering regularly during the whole product life-cycle, not only the development phase of the product. The final strategy is to allocate sufficient resources for the TCO, both human resources and capital for tools. TCO has a very high potential in the IT industry, but if the companies fail to allocate enough resources for implementation it will not be successful (McKeen & Smith, 2010).

3.3 TCO Frameworks

There exist several TCO frameworks and models, but none that is fully compatible for a network video surveillance solution. To get thorough support and guidance throughout a TCO analysis, more profound models are required. The differing natures of each case, suggest that TCO models have to be tailored for each situation. This is supported by Ferrin and Plank (2002), who consider generic TCO frameworks as inappropriate. Different TCO frameworks may also have different purposes. Some frameworks focus on the TCO development and implementation process (e.g. Ellram, 1993 and Piscopo et al., 2008), some focus on

how to identify the cost factors (e.g. Ellram & Siferd, 1993) whereas others may focus on the mathematical modelling (e.g. Degraeve, Roodhooft & van Doveren, 2005).

3.3.1 Cost Factor Identification

The framework developed by Ellram and Siferd (1993) is helpful to identify the activities that affect the TCO. The model, presented in Figure 3, consists of an overview of six categories of purchasing activities that affect the TCO. These are management, delivery, service, communications, price and quality. In each of these categories, there are several relevant activities listed that can be included in a TCO analysis. However, all these factors are optional to include and may not be relevant in all situations. There is no comprehensive specification on how to calculate the activity costs or identifying the underlying cost factors.

Management	Delivery	Service	Communication	Price	Quality
• Determination of purchasing strategy in conjuncion with corporate strategy • Hire, evaluate, promote, fire purchasing personnel • Coordinate with other functions • Training of purchasing personnel • Initial orientation • Ongoing procedure changes • Professional development	• Accept delivery • Accept partial shipment • Expedite late orders • Arrange for correction of incorrect orders	• Oversee installation of equipment • Oversee maintenance • Order parts for warranty repairs • Involvement in customer training • Maintain spare parts inventory for nonwarranty repairs • Supply service manuals • Conduct product recalls • Respond to complaints • General trouble shooting	• Update forecasts and communicate to suppliers • Prepare and send purchase orders by mail, phone, fax and electronic data intercharge • Maintenance of purchasing information system • Match purchase orders with receipts • Make invoice adjustments	• Negotiate terms of contract with respect to: • Quantity • Quality • Delivery conditions • Freight costs • Purchase discounts • Contract length • Degree of coordination and cooperation	• Select and approve suppliers • Assess supplier performance • Understand suppliers' processes • Maintain supplier relations • Acquire parts for rework • Return rejected parts • Inspect incoming materials • Dispose of scrap

Figure 3. Purchasing activities affecting the TCO. Source: Ellram & Siferd, 1993, p. 166.

According to Ellram and Siferd (1993) there are four aspects to determine after the activities are identified. These four aspects are:

1. To identify which activities are consuming most time
2. To identify the costs associated with the activities
3. To identify the drivers for the costs
4. To identify for which costs information is already available

After all the costs are understood and the four aspects are identified, the implementation of the TCO concept can be followed through.

A study by Ferrin and Plank (2002) has another approach. Instead of creating a framework for which cost parameters that should be included in a TCO analysis, the research explores which factors that actually are

used by organisations. Through a survey sent to targeted companies within a supply management association the research identified more than 130 unique key cost factors, where each respondent specified no more than six factors each. These factors were then categorized into 13 major categories, as shown in Table 2. This research suggests that the cost factors for TCO analyses have a high variation depending on the situation and purpose. Since the cost factors are very diverse, the conclusion of the research is that it is not possible to create an adequate generic TCO model and that tailored models should be used instead.

The cost factors can be classified based on the activities that generate the cost. Anderson, Narus and Narayandas (2004) suggest that there are three activities that generate costs; acquisition expenses, conversion costs and disposal costs. Acquisition expenses include the search, processing and delivery costs. Conversion costs relate to the use of the product or service, such as installation, maintenance, repairs and downtime. Disposal is the cost of disposing of the product after its service life. Another classification that is proposed by Elliot (2011) states that the TCO includes the total cost of acquisition costs and the total operating costs.

Table 2. TCO cost drivers. Source: Ferrin & Plank, 2002, p.25.

Operations cost • Manufacturing • Machine efficiency • Production to schedule • Labour savings • Assembly cost • Operating supplies • Long-term operating costs • Capacity utilisation • Increase in production output • Equipment speed • Cost in use • Line speed	**Quality** • Durability • Replacement • Field failure • Customer downtime • Inspection • Cost of quality • Calibration cost • Rework • Scrap • Customer returns • Rejection cost • Quality of improvement • Unplanned downtime • Out-of-service costs	**Logistics** • Freight • Packaging • Customer service • Availability • Handling • Instability in freight rates • Outbound cost • Tariffs • Leadtime • On-time delivery • Supplier-managed inventory • Time to schedule • Warehousing • Duties • Area of the country customer must order from • Import fees • Entry and harbour maintenance fees	**Technological Advantage** • Design obsolescence • Suitability for intended use • Flexibility for new use • Technology • Changing technology • Long-term advantage • Supplier ability to change technology **Supplier reliability and capability** • Partnering costs • Team costs • Trust • Supplier capabilities • Payment terms • Supplier R&D capability • Supplier ability to grow • Supplier support • Service by supplier • Stocking at supplier (quantity availability) • Familiarity with supplier
Maintenance • Supplies • Training • Downtime • Costs • Labour • Repair costs • Parts • Spare parts • Long-term maintenance costs • Repair frequency • Reliability • Preventive maintenance schedule	**Inventory cost** • Safety stock • Design/procurement for inventory reduction • Storage • Perishability • Turnover **Transaction cost** • Administration of post-purchase agreements • Ease of transaction • Supplier conversion cost (cost to change supplier) • Small orders • Procurement • Transactional activity • Long-term savings	**Life cycle** • Long-term usage • Projected life cycle • Life of product • Life cycle stability • Cost savings over life of product • Useful life • Redesign cost • Life cycle obsolescence cost	**Initial price** • Unit cost • Initial purchase price • Long-term price stability • Initial capital expenditure **Customer-related** • User satisfaction • Customer perceptions • Customer specifications **Opportunity cost** • Cost of money • Overhead
Miscellaneous • Taxes • Value chain • Warranty • Product design • Availability from a supplier • Disposal costs • Liability and indemnification • Obsolescence cost	• Salary, benefits • Indirect labour • Product use • Depreciation • Lease or buy • Supplier cost drivers (from requisition to receipt) • Safety • Support costs • Utility costs	• Installation • Ease of operation • Noise level • Technical support • Validation/registration cost • Overall competition • Service costs • Disposal value • Currency exchange rates	• Direct labour • Total installed price • Lease rate factors • Flexibility of the supplier • Tooling and fixtures • Environmental issues

3.3.2 TCO Development and Implementation Framework

There are multiple ways of creating a TCO model that fits a specific purpose or a specific company. Ellram (1993) proposes a framework to help developing and implementing TCO models, which was developed by conducting case interviews with companies that successfully had implemented the TCO concept. The framework consists of eight steps. The first three steps are a pre-phase while the next five steps are the core of the model development. The process is iterative and is presented in Figure 4.

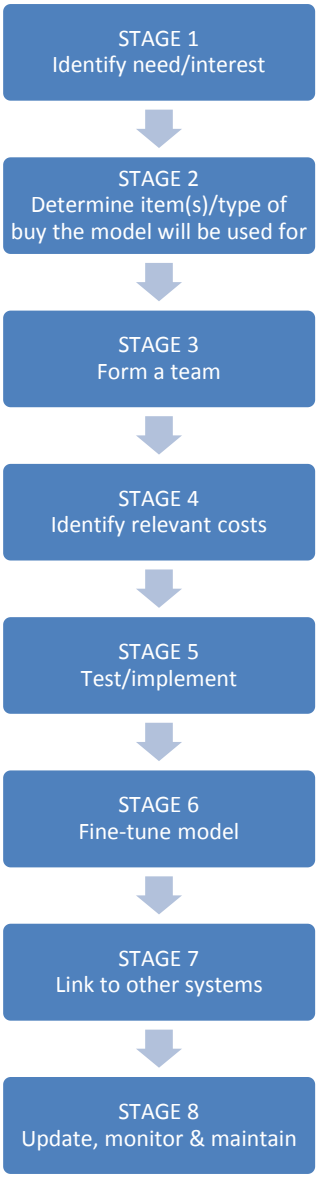

Figure 4. Framework for TCO model development. Source: Ellram, 1993, p. 53.

1. Identify need and interest

The first step is to identify and specify why the TCO should be developed. This is either driven by internal or external demands.

2. Determine the purchases of interest

The second step is to determine which items to consider in the TCO model. The items that are considered in the model should either be directly related to the need and interest, or it can be important items for the company. The importance of the items is ranked from a monetary perspective, which means that the items with high values should be included in the model.

3. Form a TCO development team

The next step is to create mixed teams with different expertise and networks. The utilisation of expertise from people with different backgrounds and from different functional areas can increase the awareness of the project, the ease of data collection and help in getting a broader perspective.

4. Identify major costs

The first step of the actual model development is to identify and select which cost parameters to include. The first part is to identify as many cost parameters as possible that are affecting the TCO. The second part is to narrow these cost parameters down to only include the major and the most critical costs. After the cost parameters have been determined, the relevant data needs to be collected. During the data collection all aspect such as information about the data, how the data is modified and how it is used should be documented.

5. Test and implement the model

After the cost parameters have been gathered, the next step is to enter the parameters into a model and verify that the parameters are appropriate. If necessary, formulas in the model should be modified to fit the input data.

6. Fine tune the model

The next step is to verify the results from the model to make sure that the result is correct. A recommendation is to make a sensitivity analysis of the data. This step also includes documentation of the process and lessons learned.

7. Link TCO to other systems

The next step is to link the TCO model to other system to improve strategic and operational decisions. The model can be linked to training and education systems, supplier monitoring systems and computer systems.

8. Continue to update, monitor and maintain system

The last step is to monitor, maintain and update the model regularly. This step is a continuous process to make sure the model is relevant and correct.

3.3.3 TCO Matrix

The methodology framework presented by Degraeve et al. (2005) is a generic methodology for using a matrix to identify and analyse cost parameters as well as a mathematical programming model to calculate these costs. The framework enables the user to create a managerial decision model to evaluate the supplier performance.

The TCO matrix presented by Degraeve et al. (2005) is a matrix with three dimensions. The matrix is used as a foundation for collecting data, to organize the data and to communicate the data. The first dimension of the matrix is related to when in the life cycle of the product the cost incurs. There are five defined stages: acquisition, reception, possession, utilization and elimination. The second dimension of the matrix is represented by the level of the cost. There are five levels identified: supplier level, product level, order level, product order level and unit level. The third dimension concerns if the cost of the resource is of a flexible or

committed nature. The committed costs are costs that still incur regardless if the resource is used, while the flexible costs do not incur if the resource is not used. The model is presented in Table 3.

		Acquisition	Reception	Possession	Utilization	Elimination	Total cost
Supplier level	Cash Non cash						slc
Product level	Cash Non cash						plc
Order level	Cash Non cash						olc
Product order level	Cash Non cash						polc
Unit level	Cash Non cash						ulc

Table 3. The TCO matrix. Source: adapted from Degraeve, Roodhooft & van Doveren, 2005. p. 52.

Once the costs are organized in the TCO matrix, Degraeve et al. (2005) suggest a mathematical model to calculate the optimal procurement strategy. The target with the model is to minimize the total cost of ownership, with the objective function below. The model also includes a number of constraints which can be modified depending on the prerequisites for the situation where the model is applied.

$$Min\ TCO = slc + plc + olc + polc + ulc$$

Where:
slc = total supplier level costs
plc = total product level costs
olc = total order level costs
polc = total product order level costs
ulc = total unit level costs

3.3.4 Seller TCO Process

The TCO process framework presented by Piscopo et al. (2008) is similar to other frameworks but with a distinct difference; the framework is developed to be used for selling purposes. This process is developed as a guidance for a seller, an external analyst or to investigate a customer's TCO of an offering. Even though an external party conducts the TCO analysis, the TCO analysis will create more value if the seller and the customer can collaborate as much as possible. The framework consists of eight steps, presented in Figure 5, where the steps can be categorised into five phases. The first phase, which includes the first three steps, is to analyse the current situation and identify the cost drivers. The second phase, step four and five, is data collection and to create a solution. The third phase, step six and seven, is to calculate the financial consequences of both the new improved scenario as well as the status quo scenario. The final step is to present the results of the process to the customer.

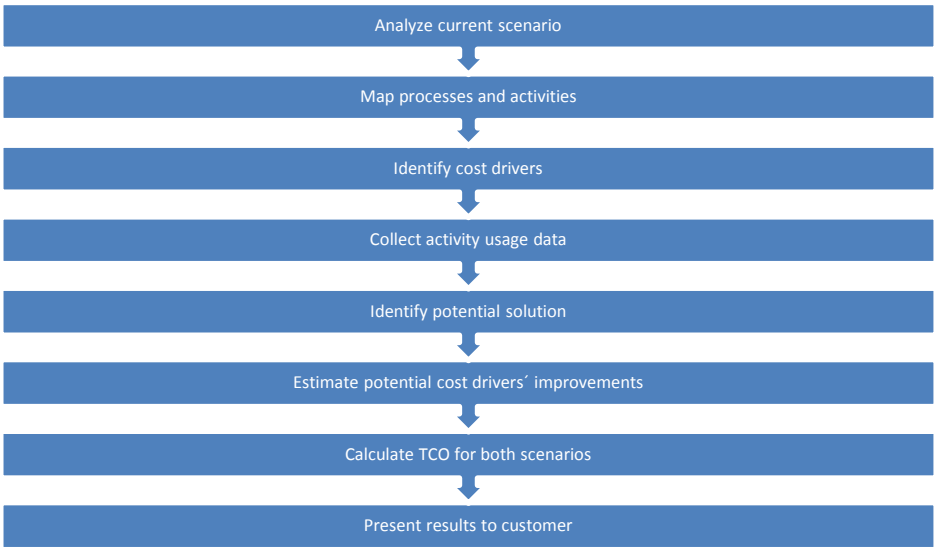

Figure 5. The seller TCO process. Source: Piscopo et al., 2008. p 216.

3.4 TCO Model Attributes

3.4.1 Overview

The TCO model attributes provide theory that will support the development of the TCO model. When creating a TCO model, there are several choices that need to be made to create an appropriate model; if a unique or standard model should be created, how the factors in the model should be valuated and which parameters to include. Other aspects include the cost of downtime and the cost of capital. These attributes are described in the following section.

3.4.2 Standard versus Unique Model

There are two types of models for a company to use when implementing a TCO model; either a standard model or a unique model. Ellram (1994) describes the standard model as a general model framework that is established in the literature. The standard model is applicable when there are no or little requirements of data modifications and the purchases are repetitive with the same cost parameters (Ellram, 1994, 1995). The unique model is a model that is developed for a specific item and where the cost factors differ a lot (Ellram, 1994). The unique model is favourable when there is a high flexibility required and the critical cost parameters are unique for the specific item (Ellram, 1995). Ferrin and Plank (2002) oppose the notion of standard and unique models. They suggest that there is no such thing as a standard model, although a model can evolve into a standardised model. They further conclude that even though the models are unique, there are many cost parameters that are more commonly used than others.

3.4.3 Valuation Approaches

The valuation of the factors in a TCO model can be done in various ways. Ellram (1995) identifies two approaches which are used in organizations; the dollar-based approach and the value-based approach. A dollar-based approach is measuring, through actual costs or allocated costs, the TCO in monetary terms. This approach is easy to understand and easy to explain to external stakeholders. The analysis to gather and screen the information can be time-consuming. The non-monetary elements in the dollar-based approach, like quality and downtime costs, are given an estimated value. Ellram (1995) also presents a variation to the dollar-based approach, which uses formulas to allocate the costs. This approach uses activity-based costing (ABC) to allocate indirect costs to the products.

A value-based approach is used when measuring factors that are hard to monetize. Instead of assigning a dollar value to each factor, the factors are categorised and given value points. These points may be transferred into monetary values in the end. Ellram (1995) suggests that three or four cost categories should be included to avoid making the study too complex. This model enables the user to change the weight and variables without having to re-build the model.

3.4.4 Deciding on Cost Parameters

The strategy of how to decide which cost parameters to include in the TCO analysis is very important for the end result. However, the cost factors are often difficult to identify and there may be many cost factors to consider (Ferrin & Plank, 2002). The most correct, and comprehensive, way is to include all cost factors that can be traced to the items analysed. Even though this analysis provides the best possible result, the process might be very time consuming and it might not be possible to get sufficient data for all the parameters. The alternative way is to only consider the most important parameters. Ellram (1994) suggests the use of Pareto's law when identifying the parameters. This law states that 20 per cent of the parameters account for 80 per cent of the costs. Pareto's law is more of a concept than a rule and the numbers do not have to be strictly 20 and 80 per cent. The point is that a few cost factors often are responsible for a high percentage of the total costs, as seen in Figure 6.

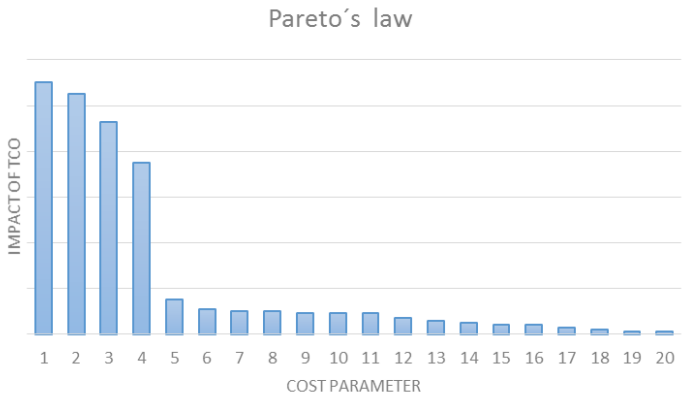

Figure 6. Example of a case when the cost parameters are aligned with Pareto's law.

3.4.5 Cost of Downtime

The cost of downtime can represent a very high cost for items in industries where the operation is dependent on the functionality of the specific item. In other industries, the cost of downtime may be close to zero for the same item because the item might not be necessary for the operation. The cost of downtime is complex and influenced by many different cost factors. Vegunta and Milanovic (2011) categorises the cost factors into three main groups, of which two categories are applicable to the network camera surveillance industry; direct costs and hidden costs. Among others, the direct costs include costs for lost business opportunities, financial penalties, overhead costs and unused labour. The hidden costs include customer dissatisfaction and decreased brand reputation.

3.4.6 Cost of Capital

The cost of capital to a firm can be defined as "the return investors receive on their investments" (Porras, 2011, p. 6). It can also be regarded as an opportunity cost for a given investment, which is the return on investment the capital could generate if employed in another investment. The cost of capital makes future

cash flows less valuable than cash flows today. To be able compare cash flows that occur at different times they should be adjusted for the cost of capital. By discounting future cash flows, a present value of the cash flows can be calculated to make them comparable. The discount rate is commonly defined as an annual rate.

3.5 The Purchasing Process

Costs that affect the TCO may appear throughout the whole purchasing process. van Weele (2010) provides a model of the purchasing process that distinguishes six different stages, which is visualised in Figure 7. Although the stages may be intertwined, the model provides an overview of the purchasing process and shows how the different stages interrelate. The first stage of the process is to determine and specify the need. When an understanding for the need has been established, the search for suitable suppliers can begin. The available suppliers are mapped, assessed and finally a supplier is selected. The contract is then negotiated and drawn up. When the contract has been finalised the order can be placed. This step may in coincide with the contracting stage. The ordering phase also includes establishing order routines. The next step concerns the expediting, which is about securing that the contracted agreement is fulfilled. The final step of the purchase process is follow-up and evaluation. At this stage the whole process and the performance of the supplier is evaluated.

Figure 7. The purchasing process. Source: adapted from van Weele, 2010.

3.6 TCO from a Marketing Perspective

The notion of TCO has mainly been used in the context of purchasing, but it can also be a powerful tool for sales and marketing purposes. Piscopo et al. (2008) present five uses of TCO models for sellers, which are described below:

- Understanding the customer's value function
- Documenting and demonstrating the customer's value
- Consultative selling tool and discovery of joint profitability opportunities
- Supporting value-based pricing decisions
- Improving communication and strengthening relationships

When engaging in a TCO analysis from a customer perspective, a comprehensive analysis of the customer's activities and cost drivers is required. This allows the seller to gain a better understanding of the costs and the value of a specific offering. This can be used to improve the offering and adjust it to fit the customer's needs and requirements. The quantification of the offer value can also be used as a strong marketing tool.

A TCO analysis is an effective way of documenting and demonstrating the customer's value. Figure 8 presents how TCO relates to the perceived customer value. To be able to benefit from the provision of superior value, the value has to be demonstrated to the customer. This can be achieved by comparing the TCO of different alternatives.

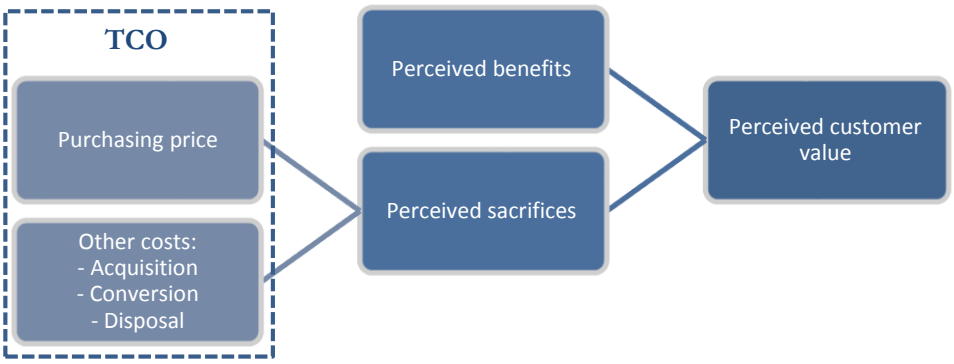

Figure 8. How TCO relates to the perceived customer value. Source: adapted from Piscopo et al., 2008.

Rather than just selling a product, the supplier can take on a consultative selling approach and provide a solution. A TCO model is then an effective tool to illuminate what is value adding and what is non-value adding. By collaborating with the customer, two different sets of knowledge and experience are utilised. Joint profitability opportunities may then be identified that otherwise would not have been discovered.

Value-based pricing decisions can be supported by TCO analyses. There may be a discrepancy between an offering's perceived value and the objective value, but the TCO provides a tool to objectively influence the customer's perceived value.

TCO models may facilitate in the process of improving communication and strengthening customer relationships. If the supplier and the customer collaborate in the process of developing a value measurement model, an understanding for each other's businesses can be established. The TCO can help in demonstrating superior value to the customer, convincing the customer to invest in the relationship. Strong mutual commitment from both the supplier and the customer allows each part to lower the search costs while promoting long-term relationships.

3.7 Benefits and Barriers of TCO

Existing literature focuses on the buyer perspective when conducting TCO analyses. This implies that little research about benefits and barriers of TCO from a seller perspective has been conducted. Piscopo et al. (2008) specifically address the benefits from a seller perspective, which were discussed in chapter 3.6. A major difference when doing a TCO analysis from a customer's perspective rather than a buyer perspective is what party is responsible for conducting it. The TCO results should however be the same. This suggests that benefits and barriers may be similar for the two approaches.

Ellram (1994) has explored the benefits and barriers of adopting a TCO approach for purchasing by conducting nine case studies. Most of the companies included in the study were high technology firms. The study resulted in five major benefit categories being identified as well as three barrier categories. These are shown in Table 4.

Table 4. Benefits and barriers of TCO for purchasing. Source: Ellram, 1994.

Benefits	Barriers
• Performance measurement • Decision making • Communication • Insight/understanding • Supports continuous improvement	• Cultural issues • Education/training issues • Resource issues

For each of the categories, Ellram (1994) lists some examples. Performance measurement benefits include the provision of a framework to evaluate suppliers and a way to measure the results of quality improvement efforts. It can also be used as a tool for benchmarking. Decision making is enhanced by forcing a quantification of the trade-offs, good bias, creating a structured problem solving environment and promoting informed decision making. The communication is improved by providing a vehicle for communication between the firm and the supplier, as well as involving several functions in the purchasing decision. Insight and understanding is increased by letting the TCO analysis provide data for cost trend analyses, supplier performance comparisons, negotiations and target pricing. It also encourages purchasing to identify important non-price factors and adopting a long-term orientation. Finally, a TCO analysis supports continuous improvement. It helps in identifying cost saving opportunities and where to focus improvement efforts. Internal issues such as how costs derive from their own specifications may be discovered and the purchasing personnel are encouraged to broaden their perspectives.

For the barriers, Ellram (1994) highlights the following examples. Cultural issues include the notion of costs not being important for the users, the not-invented-here syndrome, the custom of price orientation and resistance to change. Education and training issues concern the image of inflexibility of the TCO approach, a need for tools and training and a perception of TCO being too theoretical. It also includes the difficulty of quantifying soft issues, lack of expertise or confidence, problems with defining the TCO scope and identifying relevant costs and benefits. The last category is resources issues, which was regarded as the greatest barrier by seven of the nine case companies. These issues derived from a lack of systems and data availability, the labour required to develop and support the TCO analysis as well as other resources to develop, implement and maintain it.

3.8 The Seller-Buyer Relationship and TCO

When using a TCO analysis in marketing, negotiations or in general communication with suppliers or customers, it is necessary that the analysis is correct and that the results are presentable. However, this might not be sufficient to give the party an advantage. If the analysis is not perceived well by the other party, it can even be a disadvantage to use the TCO analysis. The situation is even more complex, since the perception might be more related to the relationship and the situation than the actual analysis.

Zachariassen and Arlbjørn (2011) present a model on how to most efficiently communicate TCO data depending on two inter-organisational aspects; the type of relationship between the firms and the complexity of the cost drivers. The communication channels which the model is developed for are general communication and in negotiation situations between suppliers and buyers. In the model, the relationship is either considered to be a partnership or to be on an arm's length and the complexity of the costs is either high or low. These two dimensions create four possible combinations that are shown in Figure 9; over-engineering, learning, manipulation and confirmation. For each of these combinations, the TCO data will be

perceived differently, which can be either an advantage or a disadvantage for the presenting actor. Therefore, each case should be handled differently. The purpose of the model is to be able to categorize the suppliers in order to know how to prioritize the resources and what to consider when presenting TCO data. The model is developed for buyers, but the reasoning is presented in a general way and is applicable in other contexts. The model is also constructed to be generic to all TCO data analysis models.

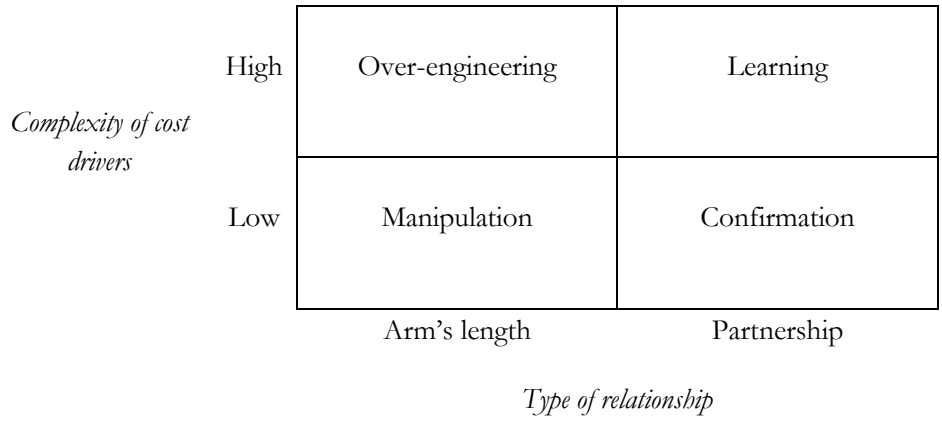

Figure 9. Implications of the relationship between buyers and sellers when using TCO. Source: Zachariassen and Arlbjørn, 2011, p. 459.

The combination of a high complexity of the cost drivers and an arm's length relationship is described by Zachariassen and Arlbjørn (2011) as over-engineering. Since the TCO data is derived from complex cost factors, it is hard to quantify the costs truthfully. The TCO data will therefore be perceived differently depending on how these are communicated. If the main party uses speculative and estimated numbers and claims the data to be very close to the true numbers, the credibility will be low. However if the main party instead claims that the data are meant to be rough estimations, the TCO data will not be considered as misleading.

Learning, as described by Zachariassen and Arlbjørn (2011), is the combination of high complexity of cost drivers and a partnership relationship. In these cases, TCO data is good and useful to identify and learn about the cost drivers. In a supplier-buyer relationship, the information can be used for both parties to collaboratively find areas for cost minimisation.

Zachariassen and Arlbjørn (2011) describe the combination of low complexity of the cost drivers and an arm's length relationship for manipulation. When using TCO data the other party becomes defensive and tries to provide own data. This data can either be manipulated or distorted to give an advantage. Not only is there a high risk of false data, but the communication between the stakeholders may also be more time-consuming and consequently more costly. The risk of increased expenses should be evaluated against the potential of benefits.

A low complexity of the cost drivers combined with a partnership relationship is described by Zachariassen and Arlbjørn (2011) as confirmation. Due to the low complexity of the cost drivers, TCO is a way to confirm the partnership between the parties. If the trust is already high, the TCO will strengthen the partnership. In contrast, when the trust is low, the TCO will weaken the partnership. In these situations, a TCO should only be used when necessary.

4. COMPANY DESCRIPTION

The chapter provides a company presentation of Axis, its business model and some key sales information. There is also a description of the general business industry environment, the different market segments where Axis operates and the company's products. In the end, there is a brief description of previous TCO research at Axis.

4.1 Background

In 1983, Mikael Karlsson and Martin Gren formed the company Gren & Karlsson Firmware. The business was mainly focused on IT consultancy. The year after, they founded Axis Communications together with Keith Bloodworth. The company's first product was a print server that enabled printing on IBM mainframe networks, but the company soon realised the possibilities of TCP/IP protocols. They therefore entered the TCP/IP network printing market and also launched a network storage solution. The business was successful and offices were soon opened in the US, Europe and in Asia. (Axis, 2015d)

Axis has explored several applications of TCP/IP, but what distinguishes Axis today is their success in the video surveillance industry. The journey was initiated in 1996, by introducing the world's first network camera (Axis, 2015d). The camera was intended for remote monitoring, but the use at the time was limited. It was not ready to compete with the existing analogue surveillance cameras. However, as the network camera evolved, it has come to change the whole video surveillance industry.

4.2 Business Model

At the core of Axis's business model is a two-tiered sales model. Axis supplies their products to selected distributors, who in turn supply resellers and system integrators (see Figure 10). A reseller is solely selling the products, whereas a system integrator can provide their customers with a complete surveillance solution, from system design to installation and maintenance. The indirect sales model allows Axis to scale up the business while having specialist competence at each stage of the value chain. The business model is one of Axis's critical success factors, and the distribution chain is strictly followed (Axis, 2015g). As stated on Axis's partner webpage for integrators, resellers and installers; "We'll never compete with you. We are committed to driving business through carefully selected distributors." (Axis, 2015h).

Figure 10. Axis's sales and distribution model. Source: Axis, 2015g.

In each of the stages in the distribution model, Axis has multiple partner companies. This strong partner network is essential for the success of Axis. In the annual report for 2014, the company reported that about

half of the sales are made directly by partners without any involvement from Axis (Axis, 2015g). When Axis is involved in the sales process, it is as a support and guidance for the partners and key accounts. The company representatives are neither involved in the actual purchasing process nor the price negotiations. In addition to the sales partners, Axis has system and architect consultant partners, software partners and hardware partners. To stay competitive and maintain a strong partner network, Axis runs four partner programs. These include the Channel Partner Program for resellers, system integrators and installers, the Application Development Partner Program for software vendors, the Architecture and Engineering Program for system architects and consultants and the Technology Partner Program for hardware vendors. Being a recognised partner has several benefits such as increased margin opportunities, improved support, access to cutting edge technology and a worldwide network.

4.3 Business Environment

Despite the historical growth of the network video surveillance market, the market still has a great growth potential and the market research institutes forecast an annual growth ranging from 12 to 22 per cent (Axis, 2015i). Driving the growth are factors such as increased prosperity, urbanisation and a higher security consciousness. Other factors include stricter legal requirements and new application areas such as inventory management and retail customer behaviour (Axis, 2015i).

The competition in the video surveillance market consists of large global enterprises and small niche companies. It is a fragmented market, with more than 400 competitors that compete for the market shares (Axis, 2015g). In general, the competition is based on features and quality on mature markets, whereas growth markets experience price pressure. In terms of market share, Axis is the market leader for network cameras, followed by Hikvision and Panasonic System Communications (IHS, cited by Axis, 2015g). When considering both analogue and network cameras, Hikvision is the leader, followed by Axis and Panasonic System Communications (IHS, cited by Axis, 2015g). Although network video is becoming the standard technology, the analogue video still has a considerable share of the market. Figure 11 shows the network camera penetration and Figure 12 the projected video surveillance market for 2018.

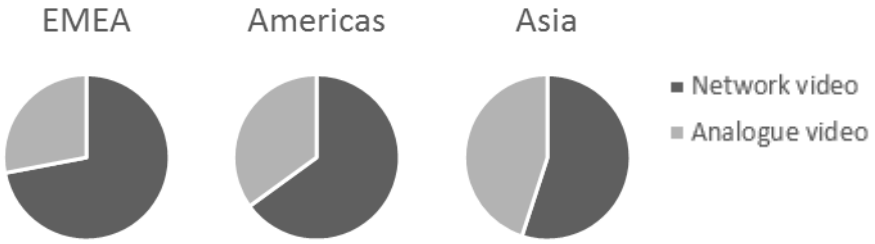

Figure 11. The network camera penetration. Source: adapted from IHS, cited by Axis, 2015g.

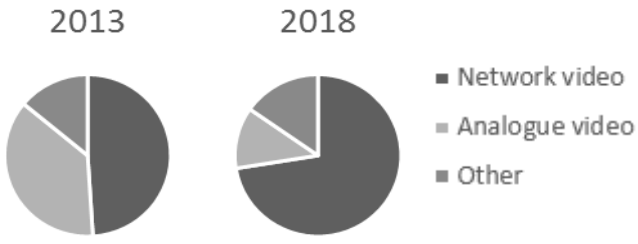

Figure 12. The video surveillance market. Source: adapted from IHS, cited by Axis, 2015g.

The network surveillance market can be divided into three market segments based on system size; small-sized systems, medium-sized systems and enterprise systems. There is no industry standard that defines the system sizes, but an indication is that a small system may include up to 16 cameras, medium systems up to 80 cameras and enterprise systems with more than 80 cameras. Each market segment represents about one third of the video surveillance market (Axis, 2015g). The medium segment has historically not been regarded as an own market segment, but their unique needs have been observed in recent years.

4.4 Axis Today

Axis is the global market leader in network video with a turnover of SEK 5,450 million and a profit margin of 13 per cent in 2014. The company has around 2000 employees from a total of 49 countries, whereof more than 300 employees were employed in 2014. Together with its 75,000 partners, the company reaches 179 countries. The Americas market is the company's biggest market in terms of invoiced sales, 50 per cent, whereas EMEA represents 37 per cent and Asia 13 per cent. (Axis, 2015g)

Most of Axis's revenues are still generated from the enterprise segment (Axis, 2015g), where Axis traditionally has had the biggest focus and therefore succeeded in creating a strong value proposition as well as a strong brand name. This is also the segment where the benefits of network video and high quality products have been most obvious so far, compared to analogue video. The business model and the sales expertise are well adapted to the enterprise segment, but Axis has now expressed a desire to increase their presence in the other segments. In the 2014 annual report (Axis, 2015g), the company states that they have clear internal goals to increase sales in the small and medium segment and has made substantial investments to support the initiative.

4.5 Product and Solution Portfolio

Axis offers a wide range of products and solutions for security and video surveillance (Axis, 2015g). The network cameras are core products, but the product portfolio also includes video encoders, network video recorders, accessories, video management software and software applications. In 2013, the product portfolio was expanded to include physical access control (Axis, 2013). In addition to the products, Axis offers end-to-end security and video surveillance solutions for small, medium and large-scale systems. The company also offers a platform for security as a service, in terms of cloud hosted video solutions.

The network camera portfolio consists of fixed network cameras, fixed dome cameras, on-board cameras, PTZ cameras, thermal cameras, panoramic cameras, HD & megapixel network cameras and outdoor cameras. The fixed network cameras, fixed dome cameras and pan-tilt-zoom (PTZ) cameras are common types, and an example of each type is shown in Figure 13. At Axis, these cameras are divided into three main product lines; the M, P and Q line. In terms of features and quality, the M line represents affordable cameras with basic features, the P line has additional features and a higher quality, whereas the Q line represents the top of the line cameras, with the highest quality and the latest features available.

Figure 13. In pairs of two, from the left: fixed network cameras, fixed dome cameras and PTZ cameras. Source: Axis, 2014.

4.6 Industry Segments

Axis provides camera solutions for several different industries called verticals. Each of the verticals is distinguished by the characteristics of the environment where they operate. Since each environment has specific needs, different cameras have been developed to suit the various conditions. Table 5 provides an overview of the industries where Axis operates and some applications within each segment.

Table 5. The industries or market segments where Axis operates. Source: Axis, 2015e.

Industry	Examples
Retail	Food and grocery stores, big box and discount stores, department and specialty stores, convenience stores and gas stations, fast food and food service, pharmacies.
Transportation	Public transport, airports, railways, maritime, traffic, cargo and logistics.
Banking & finance	Branch offices, cash depots, cash in transit, data centres.
Safe cities	City surveillance, public buildings, parks, streets.
Critical infrastructure	Power plants, water works, telecommunications facilities.
Government	Ministries and city halls, court buildings, customs and immigration offices, museums, transportation hubs and infrastructure, public outdoor areas.
Education	Hallways and corridors, class rooms, computers rooms, canteens, libraries, sports facilities, entrances and exits, parking lots and campus areas.
Healthcare	Hospitals, healthcare facilities.
Industrial	Factories, warehouses, manufacturing facilities.
Casinos	Casino facilities.
Commercial	Commercial buildings, halls, elevators, lobbies, entrances and exits, parking lots.
Hotels & restaurants	Hotels, restaurants.
Prisons & correctional facilities	Prisons, correctional facilities.
Stadiums & venues	Stadiums, convention centres, venues.

4.7 TCO at Axis

Even though there is a high belief that TCO would benefit Axis, there are currently no internal tools to calculate the TCO of their solutions. In general, little research has been done by Axis within the area. Two white papers have been published, where Axis has been the initiator. The first one was published in February 2008 (Axis, 2008) and the following in December 2010 (Axis, 2010). These papers have been comparing the TCO of a network based video surveillance system versus an analogue video surveillance system. However, these papers only include some of the costs up until the system is in operation, such as hardware cost and labour cost for design, installation and training. Since the TCO definition used in this project implies that a TCO analysis should include all costs during the whole lifespan of a system, there is a fundamental difference in the approaches. The white papers only examine costs that would be included in the category total cost of acquisition for this project. From the time when the papers were published, the competition between the network cameras and analogue cameras has declined and instead the competition within the network camera market has intensified. There is therefore a desire at Axis to conduct a comprehensive TCO analysis of the network based video surveillance solutions, which is the reason for the initiation of this project.

5. RESULT OF TCO ANALYSIS

In this chapter, the results of the project are presented. The chapter is initiated by outlining the determined approach of the project, which is followed by a presentation of the cost factors and a compiled categorisation of these. A brief overview of the developed sales tool is also provided. From the project process and the literature, a framework for developing a TCO sales tool is proposed. In the end of the chapter, two identified reference systems are presented as well as the results from the TCO analyses of these systems when calculated through the sales tool.

5.1 Approach

5.1.1 Solution Orientation

TCO theory describes the process of identifying costs for a specific product, but it does not specify what should be considered as the product. In the network camera industry, it would be possible to do a TCO for either only the cameras or for the whole network camera surveillance solution. In this project, the solution approach is used. In Axis's case, the solution approach has several advantages; it is more complete, it provides more opportunities for the sales force and it is in line with the company strategy. Axis's strategy strives to offer the customers full solutions instead of selling the cameras as stand-alone products. The strategy also suits the customers demand; to be able to buy whole solutions with all the components functioning together. In Axis's case, most system components recommended to Axis's cameras are not developed by Axis itself, but tested and verified by Axis. The components are sold in packages with the cameras through the distribution channels.

If only the TCO for cameras was to be considered, a lot of information and costs would be excluded and the analysis could be misleading. Even though the cameras have the same functionality, there can be different types of components required in the system depending on the camera brand and camera model. For instance, the camera has a high impact on the storage needed. If a model or a brand is chosen that enables a high video compression rate, it is possible to lower the storage cost. Other factors which may not be stated in the data sheet but still affect the storage include the frame rate, video resolution and the ability of noise reduction. The camera brand will also directly affect the time required for mounting and configuration during the deployment.

The disadvantage with the solution approach compared with the camera approach is the increased complexity. A complex model can however, if used correctly, highlight the complexity of the network camera purchase and make the customer realise that the initial purchasing price of the camera is not directly related to the total cost.

5.1.2 Retail Focus

Axis operates in 14 different industries and has segmented their business into three market segments. These industries and markets do not only have different cost factors, but the importance of the cost factors can also vary. For instance, a cost factor like downtime may represent a high cost in some industries, while in other industries it should not even be considered. The TCO model created for this project is intended for the retail segment and is applicable to small, medium and enterprise systems with professional solutions.

Retail is the largest market segment globally for video surveillance, and it is an area where Axis has a strong presence and wants to increase its market share.[3] In many cases each surveillance solution is unique, but in the retail segments there are several similarities between the systems. Some parts of the set-ups and ways of operating can be generalised, which may not otherwise be possible. The segment also has similarities with other segments, such as the bank segment, and can therefore be applied on these industries as well. Since the model originally is intended for retail, care has to be taken when applying it on other settings to be able to produce a reliable result.

There is also a segmentation based on the number of cameras in the system and the system sizes are either small, medium or enterprise. Except for the number of cameras, the segments have different key characteristics. Some of these characteristics are presented in Table 6. Since retail installations generally have less than 80 cameras per site, it is usually a small or medium solution per site. However, many retail stores are retail chains with multiple sites. These projects qualify as enterprise solutions too due to the high number of total cameras, along with the projects where there are more than 80 cameras at one site. To make the TCO model usable for multiple purposes, the analysis is focusing on solutions where there are small or medium installations per site, but with the option of scaling the number of sites.

Table 6. Some characteristics of three customer profiles. Source: Axis, 2015j.

	Small business	**Medium business**	**Enterprise business**
Video surveillance knowledge	Little or nothing	Limited	Experienced
System requirements	Basic needs	Robustness and feature needs	Specific needs
Intensity of use	Sporadic use	Active use	Constant use
Financial capacity	Constrained	Constrained	Must fit existing structure and investments
Examples	Convenience stores, small shops, restaurants	Museums, commercial buildings, manufacturing industries	Airports, casinos, city surveillance

The network camera surveillance systems for retail customers can be sold either from a reseller or from a system integrator. These two types of sales channels tend to attract different types of customers. The customers for the system integrator are corporations that desire professional solutions with higher security requirements. These professional customers have a higher tendency to be interested and familiar with the TCO concept and are considered to be a better target of the TCO model. The customers also have a long-term perspective with a high potential of becoming recurring customers. The sales from resellers tend to go to private customers as well as to corporate customers with few cameras, low security requirements and a short-term perspective. Taking this into consideration, the system integrators' customers are more important and will be in focus in this project.

5.1.3 Cost Owner

Figure 14 presents some potential cost owners and the relationships between them. The end customer in this project refers to the business owner who benefits from and is in need of the surveillance system. The system

[3] Filipsson, 2015. *Personal communication.*

administrator, IT manager and the operator are stakeholders within the organisation of the business owner. Depending on the business size, these roles may be the responsibility of one person or there may be departments dedicated for each role.

Figure 14. Different stakeholders in Axis's value chain.

The TCO is dependent on the selected cost owner perspective. This perspective is important since a cost for one actor can denote a cost reduction for another actor. These actors do not have to be external, it is possible to have conflicts of interest between different actors within the organisations. This is especially true for departments with separate budgets, for instance the security department and the IT department. While it is of highest interest for the security department to have a high number of cameras and components, this is likely to be discouraged by the IT department since it means higher costs for them. There are also interesting implications during the purchasing of the camera system. If the security manager has a low budget for the purchase of a camera system, the manager may be forced to buy a system with cheap initial price with a high continuous cost instead of a potential competitor which has higher initial price but lower costs throughout the lifespan.

Another illustration of costs incurring to different actors is dead on arrival (DOA). Since the contract agreement between the customer and system integrator is signed before the deployment starts, all unexpected costs, with some exceptions, cannot be charged extra for. Therefore a high number of DOA cameras can reduce the profit for the system integrator, while no costs will incur for the end customer more than a potential delay.

Most of Axis's customers have individual needs and individual cost structures. It is not obvious that the cost owner also is the system user, which can make it difficult to allocate the costs. For instance, there are several pricing structures for the end customer. The system can be bought upfront, be leased or through a combination of both. There are also service agreements that can be included. These imply a redistribution of the costs and the risks. Customers with all inclusive service agreements will pay a fixed fee, which makes it easy to calculate the TCO. For these cases, it is the system integrator that should be interested in knowing the TCO cost factors for the system. They will then strive to use systems with a low TCO and low risks to be able to guarantee their profit margins.

The costs associated with the system are heavily dependent on the type of system ownership and the pricing structure. Since different actors may incur different costs, the customer perspective needs to be defined before collecting cost factors and the actual values.

5.1.4 System Perspective

This project is not to be case specific, but applicable to multiple projects. To avoid the problem of defining a typical ownership model and hence limiting the usability of the analysis, a system perspective approach is adopted. This means that all the costs that can be derived from the system are considered, instead of defining a specific cost owner for each of the cost factors. As this is a very broad approach, this project will still focus on the system integrator and the end customer who are two major stakeholders. It is common that the system integrator selects the components to include in a system and makes the design, while it is the end customer that ultimately pays for it. All costs that incur upstream of the system integrators are ignored, as these are regarded to be indirectly included in the purchasing price of the components.

5.1.5 Geographical Markets

Axis has divided its operations into three geographical market segments; Americas, Asia and EMEA (Axis, 2015g). In each of these segments, there are multiple smaller markets. All the markets have unique characteristics that need to be addressed, which means that the sales approaches need to be customised to the markets. To show the value through a TCO model is likely to have different effects in each market, due to awareness and receptiveness of the TCO concept. The project conducted have primarily been focusing on the Nordic and North American market and the cost factors have been identified from these markets. However, some input have also been collected from representatives from the South American market and the European market to broaden the perspective.

The North American market is the biggest market for Axis and therefore it is important to maintain a strong market position to maintain and increase the revenues (Axis, 2015g). Since the Nordic market is the market where the headquarter is located and where the company originates from, it is an important market strategically. Both of these markets are mature markets. The business environment in mature markets is more value oriented than the emerging markets which have a higher focus on the price. Another important market is the Asian market, and especially the Chinese, in particular considering the high expected future growth (2015g). The Asian market is however a very price focused market. The business environment in the Asian market tends to have a short-term orientation when doing investments, favouring cheap solutions rather than more expensive and durable solutions.

5.2 TCO Cost Factors

5.2.1 Overview

To create a simple overview of all the costs that affect the TCO of a network video surveillance solution, the cost factors have been categorised. The factors have mainly been categorised according to the activities and the chronological order in which the costs appear throughout the system life cycle. The ownership of a product can be divided into the phases acquisition, operation and decommissioning. Following these phases, the costs are divided into three main categories; total cost of acquisition, total operating costs and total decommissioning costs. These categories are then further divided into sub groups. Table 7 provides an overview of all the cost factors. The costs in each of the main categories are of different natures. While the acquisition cost and the decommissioning cost only incur once, the operating costs incur continuously throughout the system's service life. The size of the operating cost is therefore heavily dependent on the length of the system service time. Two costs, the cost of downtime and the cost of funding, apply to several categories, and are therefore treated separately.

In the following section, a description of the cost factor categorisation is provided. More detailed descriptions of each factor and the costs associated with them can be found in Appendix A.

Table 7. TCO factors for a network video surveillance solution.

Total cost of acquisition	Total operating costs	Total decommissioning costs*
Pre-contract costs	**Overhead costs**	Hardware removal
Defining specifications	Administration	Site restoration
System design	Licencing fees	Residual value
Integrator selection	Insurance costs	Recycling
Contracting	Training of new personnel	Disposal
	Spare parts inventory	
Contract costs	Service agreement	
Hardware	Server room	
Software		
Extended warranty	**System operating costs**	
End customer education	Operators	
Freight	Electricity	
Deployment costs*	**Maintenance costs***	
Preparatory work	Camera maintenance	
Preparatory work	Network / IT maintenance	
Installation	**System failure costs***	
Hardware installation	Hardware failure	
Hardware configuration	Software failure	
Software installation & configuration	Alarm failure	
Testing and validation	Support	
Work tools and equipment		
	System redesign costs*	
Inspection	Change of surveillance objectives	
Inspection	Change of system size	
	System upgrades	
Logistics		
Material handling		
Manpower logistics		
Deviations		**Funding**
Late deliveries		Cost of capital
Dead on arrival		Rental / leasing
Rework		
Support		
Work delays		
Weather related delays		
Overhead		
Project management		
Documentation		
Security		** May imply downtime costs*

5.2.2 Total Cost of Acquisition

Total cost of acquisition (TCA) concerns all costs that incur from the time when the buyer identifies the need for a video surveillance system until the system is fully installed and starts operating. The category has three sub categories; pre-contract costs, contract costs and deployment costs. From an end customer perspective, the deployment costs should also be included in the contract costs. However, the deployment costs are described more in detail partly since these cost factors vary greatly depending on which camera system that is chosen and partly since these costs are the most important costs out of an integrator perspective.

Pre-contract Costs

The costs included in the pre-contract category are all the costs that arise before the signing of the contract. Depending on the pre-contract process, the costs can incur for the end customer, the integrator or an external consultant. Regardless for which party the costs incur, the end customer will be charged most of the costs directly or indirectly. The identified activities in the pre-contract phase are defining the specifications, system design, integrator selection and contracting. Defining the specifications, which is the first phase, is made by the end customer when the need of a surveillance system is discovered. The system design, which is a more specific, detailed design of the system, is done by either the end customer if they have the competence or it can be outsourced to an external part. The external part can be an integrator, if the integrator is already known, or an external consultant. If the integrator is not selected until after the system design phase, there may be a bidding process where different integrators offer solutions to the specified requirements specification. The bidding process represents the integrator selection. The final stage is contracting, when the legal contract is established and other administrative issues are handled.

Contract Costs

The contract costs include all the one-off payments specified in the contract. The costs comprise of the actual price paid for hardware, extended warranties, software, end-user education and, if applicable, freight. For an end customer, the deployment costs are also specified in the contract, but is here described in the next category. The contract costs incur as costs for the owner of the system, where the owner of the system not necessarily has to be the end-user.

Deployment Costs

The costs included in the deployment costs are all the costs associated with the deployment of the system, from preparatory work to inspection and sign-off. At professional deployments, a system integrator is responsible for the deployment phase. The system integrator may in turn hire subcontractors to perform some of the work, for instance when the system integrator is overqualified to do the work themselves. The deployment work is done in three phases; preparatory work, installation and inspection. The activities in the preparatory work phase vary depending on the conditions at the customer site. The preparatory work may include decommissioning of an old surveillance system, ensuring power supply, staging and burn-in. The installation phase concerns both the hardware and the software and the activities during the phase are installation, configuration, testing and validation. Costs for any required work tools, such as skylifts, are also included. The third phase is the inspection phase, where it is verified that the installed system meets the system specification. This may be done between the system integrator and the end customer or it may involve external consultants.

Other costs associated with deployment include logistics costs, deviation costs and overhead costs. The logistics costs cover the transportation, storage and handling of material for the system integrator. The logistics costs also cover manpower logistics, in particular the transportation to the site, but also any necessary

accommodation and on-site amenities. The deviation costs are of particular interest for the system integrator, but may not have any financial impact on the end customer. The deviation costs include costs for late deliveries, dead on arrival, rework, support, work delays and weather related delays. These costs can have a major impact on the system integrator, whose profit margins can drastically decrease if these events occur and result in high costs, usually with limited possibility to charge the customer for the costs. The overhead costs covers project management, documentation of the project and security. Security may refer to a security guard accompanying the installer to access the site.

5.2.3 Total Operating Costs

The total operating costs (TOC) cover all costs from the time when the system is up and running until it is no longer in service. This category has five sub-categories; overhead costs, system operating costs, maintenance costs, system failure costs and system redesign costs.

Overhead Costs

The costs included in the overhead cost are all the operating costs that are related neither to the direct operation nor the costs associated with modifications, changes or failures of the system. The activities included in the category are administration and training of new personnel. The training can refer to both training of operators and administrators and can be led by internal resources or external resources such as integrators. The other costs in the category are service agreement, licensing fees, insurance costs and spare parts inventory. The licensing fees are periodical fees for software licences and the insurance costs are applicable if the system is covered by insurance. The cost for spare parts inventory are only applicable for some end customers that require or desire quick access to spare parts, for instance in case of a breakdown or a store expansion. The spare parts can be stored either by the end customer or the integrator. The service agreement is a periodic fee that the end-user pays to the service agreement issuer. The service agreement may include maintenance, repair service, support, operating services and periodical system checks. This cost can be seen as a redistribution of costs and risks from the end-user to the service agreement issuer.

System Operating Costs

The system operating costs represent the continuous and direct costs that incur during the operation of the system. The system operating cost consists of two cost factors; the operator and the electricity. The operator, if the system has an operator, is the person monitoring the system. The monitoring may include one or multiple systems at the same time, and it can be continuous or intermittent. The electricity costs refer to the energy consumption of the system components, air condition for the servers and electricity for any necessary extra lightning.

Maintenance Costs

Maintenance costs are the periodic costs for servicing the system to keep it in an acceptable condition. The maintenance costs refer to maintenance of the camera, IT and network. For the cameras, the maintenance concerns the cleaning of the protection bubble or, for some cameras, the camera lens. The maintenance for the IT and network, which can be storage maintenance, software maintenance or other hardware maintenance, are costs that the IT department is commonly responsible for.

System Failure Costs

System failure costs are irregular costs that incur when the system fails to meet the system requirements and action is required. The system can have a failure in three ways; hardware failure, software failure and alarm failure. The cost for support is also included in the category, which refers to the activity of finding and getting

support for the failure. If the support is slow and inaccurate, the costs will be higher for the repair due to longer time needed at site, potentially more visits at site and longer downtime.

The hardware failure costs are the costs that incur when a hardware breaks down for any reason. It may be because of tampering, careless manual handling of equipment, product failure or external environmental factors. For the cameras, the consequences may be a need to send the camera for repair or to replace it with a new unit. For the IT and network, costs can commonly incur from hard drive failures. Except the spare parts and the repair cost, the system failures imply labour hours, transportation time and material handling costs. The software failure can be due to transmitting failures or malicious attacks as well as software updates, if the update is due to a non-functioning system. The costs for software failures are the labour hours spent on resolving the issue, as well as financial penalties in some industries.

The last type of system failure concerns the alarms, both for false alarms as well as if the system misses an alarm. The alarm failure costs are applicable if the system is connected to an alarm centre or has real time monitoring. The alarm failures for cameras are in most cases heavily dependent on the quality of any analytics software. The costs that incur due to alarm failures can be the extra working time for the operator monitoring the system, the security sent to site and all costs associated with a missed alarm.

System Redesign Costs

System redesign costs are costs that incur when the system is operating as expected but there are new system requirements, which call for changes or modifications. The costs incur when changing surveillance objectives, changing system size or upgrading the system. The change of surveillance objectives may be due to a new store layout which can require movement and change of current cameras. The change of the system size is made by adding or removing cameras, where other components may have to change accordingly. The upgrade of the system is made if the end user desires new functionalities or just a newer software version. The system redesign costs mainly incur as labour costs and costs for any additional equipment.

5.2.4 Total Decommissioning Costs

The total decommissioning costs (TDC) refer to the costs that incur when the system is no longer in service and needs to be removed and disposed of. The removal costs include labour costs to remove the components and to restore the site. The system components can be reused, recycled or disposed of, where the three processes implicate costs. These costs may include material handling costs and fees for the disposed material.

There is a possibility that the components or the material has a residual value when removed. This is a revenue and not a cost, although the value may decrease by the cost of any reconditioning that may be necessary.

5.2.5 Cost of Funding and Downtime Costs

The cost of funding and the downtime costs affect multiple of the categories and is therefore treated separately. The cost of funding can be either the cost of the capital invested in the system or the costs associated with the rental or leasing of the system. The cost of capital is dependent on the internal rate of return for the investor.

The downtime costs incur when the surveillance system is not fully in operation. In particular, the downtime may result in lost business opportunities when a functioning surveillance system is critical to keep the business in operation. Downtime costs may incur during the deployment, maintenance, system failure, redesign and the decommissioning of the system.

5.2.6 The Cost Factor Categorisation Process

Validity of the Cost Factors

The cost factors and the categorisation have been constructed and developed aligned with the ideas of Ellram (1993). When developing a TCO model, Ellram (1993) highlights the importance of collaborating with people with different expertise and from a variety of functional areas. In this project more than 30 people have been interviewed to fulfil Ellram's criterion, as listed in Appendix C. The interviews have been conducted with system integrators, employees at Axis and an end-user of an Axis system. The employees interviewed at Axis represent a variety of departments, such as product management, product analysts, sales, sales engineering, marketing, operations and competitive intelligence as well as a variety of several markets; Northern Europe, Eastern Europe, North America and South America.

Special consideration has been taken to the interviewed persons' area of expertise when evaluating the statements about certain cost factors or geographical areas. For validation purposes, the final categorisation as well as descriptions of all the cost factors identified has been sent out to a reference group. The reference group consisted of key account managers, product specialists and regional sales managers. These people represented the European and American markets. The feedback from the cost factor categorisation was comprehensive and a belief that all the cost factors were included.

General Development of the Cost Factors

The three main categories TCA, TOC and TDC were inspired by Anderson et al. (2009) and Elliot (2011), but adapted to make the terms more intuitive and easier to communicate. With the three main categories as a starting point, the process for identifying the cost parameters in each category was started. The identification and validation process was conducted in several iteration cycles. Each iteration cycle started with data collection, continued with data review and then the new relevant data was compiled into a new version of the cost categorisation.

In the first iteration cycle, the data collection was based on a combination of brainstorming sessions with the PIM team and the literature review. Especially van Weele (2010), Ferrin and plank (2002) and Ellram and Siferd (1993) inspired the initial categorisation. The cost factors these authors were suggesting were closely reviewed and were either included or rejected depending on the fit to the network video surveillance industry. Several of the factors they suggested are based on costs that may incur for items used in manufacturing. Since this does not apply to Axis's products, many factors could be disregarded instantly. After the initial data collection, the majority of the data collection was based on interviews in combination with internal data, internal documents and the literature. In all the interviews, the current compiled list of cost parameters was used as a basis for the discussion. In this way less resources were needed, as the time of stating already identified costs could be reduced.

At first, the iteration cycles were long with multiple data collection sessions before doing the review and compilation of the cost categorisation. Since the categorisation initially was imprecise and there was a lot of room for improvement, the interview feedback was ambiguous and time-consuming to process. During the initial phase, the categorisation was subject to some major changes to better fit its purpose. As the project progressed, the feedback from the interviewees shifted from a high focus on the changes needed of the cost categorisation to a higher focus on exploring each factor more deeply and to quantify them. Data collection through internal documents and internal data slowly replaced the data collection through interviews. Also, the iteration cycles became shorter after each iteration since there was not as much data to review and validate. In

the end, when the end result was near, there was an iteration cycle after each interview and the interviews were aimed to validate the final categorisation.

Cost Factor Development of Total Cost of Acquisition

The categorisation in the total cost of acquisition part is based on the purchasing process (van Weele, 2010), which originally included all the six stages of the purchasing process. During the process, these stages evolved to explicitly include the three first stages; define specifications, select supplier, contract agreement, and implicitly include the remaining three stages.

The pre-contract cost is a category where the feedback from the interviewees has had the greatest variation and the strongest opinions. This is also the phase when Axis is most involved in the sales process, which can be one reason for the opinions. The factors included in the pre-contract costs are also highly dependent on the project size and the project scope. Some customers do all pre-contract cost activities themselves while some customers hire consultants or system integrators. The cost factors that originally were mapped did not change, but the meaning and the order has been changed numerous times.

The majority of the contract costs were identified from the beginning and the only factor added was spare parts. Some interviewees stated that most customers have spare parts while some interviewees disagreed. The factor was eventually included into the hardware parameter.

The deployment is a complex process and there are a lot of factors to consider. Through interviews with people with previous experience or that currently are working as system integrators, many cost factors have been added during the project process. The process is complex since there are different types of labour working with specific tasks. The process also varies between the projects. A representative from the American market pointed out that the preparatory work, like pre-configuration, staging and burn-in, are very important at projects in the American market since these projects typically are larger than the European projects. Another debated area was the deviation costs. These costs do not necessarily increase the cost for the system buyer, but can have a big impact on the system integrator doing the installation. A cost factor that was discovered late was the inspection parameter, which most interviewees did not consider.

Cost Factor Development of Total Operating Costs

Many of the cost factors were inspired by the costs presented by Ferrin and Plank (2002). The cost parameters presented by McKeen and Smith (2010) were used as a validation for the IT related parameters. The first categorisation separated between expected and unexpected costs, but the categorisation later changed to the current one.

Many of the overhead costs were identified from the beginning, but some costs were refined and some costs were added along the way. Many of the interviewees commented on the service agreement which temporarily was its own category, before it was included in the overhead costs. Except for the service agreement, most interviewees considered the category to be complete already on an early stage.

The system operating costs were identified on an early stage. Notable is that many of the interviewees showed a curiosity about the electricity costs and how it affected the total cost. One interviewee highlighted the cost as an important cost due to the environmental aspects.

The maintenance costs have been modified a lot during the process. Since cameras was an area of expertise for many of the interviewees, they had a lot of comments about how to conduct camera maintenance. Many

maintenance factors were identified, but as a few interviewees established; the customers generally do not conduct maintenance to the recommended extent. The maintenance costs gradually evolved into two cost parameters, since the maintenance mostly is dependent on the amount of labour hours.

The system failure costs was quickly established to be a key area to focus on. Since the belief is that Axis has a competitive advantage in the area, many of the interviewed people showed a strong engagement in the area. As the cameras and a lot of the supporting components are high technology products, there are many possible reasons for component failure, which was pointed out by the interviewees. The alarm failure was also a hot topic, which many of the interviewees considered highly important to highlight.

It has been debated whether the system redesign costs should be included in the analysis or not, but with a predominant opinion that the cost factors should be included. The parameters included have been changed from only including the scalability parameter to include the current ones.

Cost Factor Development of Total Decommissioning Costs

Many of the interviewees have been surprised to see that this category is included, since the decommissioning costs are rarely considered at all. However, the opinion has been to include the parameter but not put too much focus on it. The cost parameters were found on an early stage and have been confirmed by the interviewees.

5.3 The TCO Sales Tool

5.3.1 Overview

To be able to communicate and use the information about the identified cost factors, a TCO model, referred to as a TCO sales tool, has been developed for Axis. The model is primarily a tool to support the TCO communication from Axis to different customers. The intention of the model has been to create a comprehensive model with the possibility of a high accuracy, while at the same time make it simple to use and understand for all involved stakeholders. To minimise any unfamiliarity with the model, it has been created as a spreadsheet model in Microsoft Excel. Having the model as a local excel file enables the user to always have easy access to it.

The target groups for the model are primarily the sales organisation and secondarily the marketing department. In sales, the model is intended to be used as a complementary sales tool. It is solely intended for the salesmen and not to be used by the customers themselves. The purpose is to ease the crafting of sales arguments through estimated costs for the whole lifespan, cost distributions and cost comparisons. For marketing purposes, the results of the model can be used for creating different types of marketing material. With the sales tool, scenarios can either be isolated or be compared with competitive systems.

5.3.2 Model Characteristics

A Customisable Model

The TCO model could have been developed through two different approaches. The first approach would be to create a model with fixed cost parameters already filled out with values representative for either Axis's solutions or representative for industry solutions. The second approach would be to create a model where the user, to a great extent, can modify and enter its own values. The first suggestion, with fixed values and less manual input, would simplify the use for the user but it would also decrease the accuracy. Since each of the network based video solutions is unique and only a few costs are possible to generalise, even for systems in a specific market segment, the model needed to be highly customisable. Both in regards to which cost

parameters to utilise as well as the values for each parameter. The selected approach will prolong the time and complicate the entering of the input values, but the output will be more accurate and useful.

The customisable approach will also enable the user to select the parameters to utilise if less parameters are desired. There is also a feature where the user can decide to highlight the key parameters. The feature is a complement to the actual model and can be applied if the user believes that these parameters are enough to craft convincing sales pitches.

Layout of the Model

The model has three sections. The first section is the result section, the second section is where all the input values are entered and the third section is for the calculations. The calculation section is solely used for background calculations and is not intended for everyone to be viewed. However, for an interested user and for future modifications, the calculation pages will still be accessible.

Result Section

The result section contains several worksheets where each sheet presents the result in a numerical or graphical way. There are two types of results, the first is a system specific presentation of the costs and the second is a comparison between two systems. The comparison result comprises of the whole system over time, the cost per channel over time and a cost comparison between the most significant cost parameters for the cameras. These results have been requested by Axis. The separate results are presented both in a numerical and in a graphical way. The numerical presentation has the cost factors and the time as the axes. The time axis is relevant because some of the factors vary over time; in particular the maintenance, the failure rates and the redesign costs. Also, for some systems the maintenance and redesign costs do not incur every year. The failure rates can potentially vary a lot between each year. The purpose of the graphical presentation is to simplify the message and make it more understandable for an unversed receiver.

Value Input Section

The section where the user enters the values consists of three parts; the first part for general parameters, the second part for the system specific specification of hardware and software components and the third part for all other system specific input parameters. The general parameters include parameters that are the same for both system A and B, like salary parameters, operating hours and cost of capital. The component specification specifies all the components in the system and different key data for each component. The key data can consist of variables such as purchase price, failure rate and deployment time. The system specific input part is where the majority of the input is entered. The layout follows the cost factor categorisation. Each cost factor is divided into a few parameters for the user to enter, for instance the time required or the labour type required. The input parameters were defined to be easy to understand and to allow for the use of existing data without any calculations.

5.3.3 Tool Usability

To validate the model, there were several evaluation sessions with targeted people. The feedback from these people concerned the usability, identified necessary modifications and the likelihood of actually using the model. The initial evaluation was conducted through targeted interviews to be continued with a workshop including people from the sales organization, the marketing department and some related key people. During the feedback sessions, the people were shown the model and then got the opportunity to try it. Oral feedback was continuously collected during the sessions. There was also a presentation of the model for the Nordic sales organization during a sales conference.

The main feedback regarded the complexity of the model. The model is created to allow for a high flexibility and the choice of including the factors that may be applicable in each particular case. Because of this, the model may seem very complex at first sight. Sales people are busy people, and unless the model is easy to use with clear benefits, it may not be used at all. It is therefore important to be familiar with its structure and how it works. The presentation at the sales conference and the workshop aimed at overcoming this barrier. To reduce the perceived complexity, a feature that allowed the user to highlight and only fill out the key parameters was implemented.

5.4 Reference Systems

5.4.1 Purpose

The reference systems are case examples of Axis solutions that are considered to represent typical systems within retail. The use of reference systems has multiple purposes; model validation, increasing the internal acceptance and educational. The first purpose is to validate the TCO model. By using data collected from an actual system, it is possible to verify the functionality of the model. This is also a way to verify whether the required input data matches the data available. If possible, the results should be compared with other estimations to make sure the result is trustworthy. The second purpose is to market the TCO concept internally to sales people and make them realise the value of using a TCO mind-set. Instead of just informing about the possibilities of using TCO in sales discussions, it is an advantage to be able to show some real case examples. The internal acceptance is also important to raise from the whole company, not only the sales and marketing departments. The third purpose is educational. Since the model is to be used by the sales force, to provide examples is one way to easily increase the understanding of the model.

5.4.2 Chosen Systems

Based on real case examples, two systems have been identified to be appropriate as reference systems. The first system is a small system with seven cameras per site and the second system is a medium system with 48 cameras per site. The systems have been chosen because of their representativity of the retail segment in the European and American market. Although it is hard to define an average system, the selected small and medium system covers a large part of the retail segment. Both systems are professional solutions where a system integrator has been involved in the sales and deployment process.

The small solution has cameras from Axis's M-line and the medium system has cameras from the Axis's P-line. Axis's Q-line cameras are generally not used in the retail industry and are therefore not represented in any of the reference systems. A common trait in the retail industry is chain of similar looking stores with separate installations. This trait is true for both of the reference systems. The costs for the systems are highly correlated with the number of sites and the costs per site can therefore be multiplied with the number of sites to estimate the total cost. The selected small and medium systems do not qualify as enterprise solutions when considering each site in isolation, but they do when adding up several sites of a retail chain. The reference systems are not representative for large installations with more than 80 cameras per site. However, the installations with less than 80 cameras are more common in a retail environment. Considering the scalability possibility, the reference systems are representative for a majority of the retail solutions.

Small System

The small reference system contains seven cameras combined with the hardware and software specified in Table 8. The cameras are from Axis's least expensive product line, the M-line. Both of the cameras have a two megapixel resolution and the major difference is that the AXIS M1025 is a box camera and the AXIS M3005-V is a fixed dome camera. The hardware components, the software and many of the other input variables are

mainly based on the information provided by the case customer, but also from various experts in the area. The system is based on a Nordic retail chain.

Table 8. Hardware and software specification for the small reference system.

Component	Quantity
AXIS M3005-V [camera]	3
AXIS M1025 [camera]	4
AXIS Camera Companion, 16 camera base [VMS]	1
HP 2530-24G-PoE+ [switch]	1
CAT5E, incl. Power via PoE (25m per camera) [network cable]	7
R45 connectors [network cable connector]	14
LENOVO Iomega ix2 Network Storage, NAS, 4 TB [storage]	1
Desktop terminal [computer]	1
Mounting utilities	1
Other accessories	1

Medium System

The medium reference system consists of 48 cameras as well as the hardware and software specified in Table 9. The cameras are from Axis's P-line, which is the medium priced product line. The AXIS P3365-V is a fixed dome camera with a two megapixel resolution and the AXIS P3354 6MM has a one megapixel resolution. The hardware components, the software and many of the other input variables are compiled from various experts in the area. The system is based on a North American retail chain.

Table 9. Hardware and software specification for the medium reference system.

Component	Quantity
AXIS P3365-V [camera]	14
AXIS P3354 6MM [camera]	34
AXIS Camera Station, 32 camera base [VMS]	1
AXIS Camera Station, 5 license add on [VMS]	3
AXIS Camera Station, 1 license add on [VMS]	1
HP 2530-24G-PoE+, 24 ports [switch]	1
HP 2530-8G-PoE+, 8 ports [switch]	4
CAT5E, incl. Power via PoE (50m per camera) [network cable]	48
R45 connectors [network cable connector]	96
AXIS S1032-9T, 9 TB [storage]	1
AXIS Camera Station S9001 Desktop Terminal [computer]	1
Other accessories	1

5.5 Quantifications

5.5.1 Small System

The TCO cost distribution for a small retail system is shown in Figure 15, where the right chart includes an annual cost of capital of ten per cent and the left chart does not take cost of capital into account. The figure shows the distribution of the main cost factor categories, as specified in chapter 5.2. Without the cost of capital, the largest costs are the contract cost, the system operating cost and the maintenance cost, which together make up for 62 per cent of the TCO. The contract cost is the dominant factor, which comprises of the hardware purchase cost. Its significance further increases if the cost of capital is taken into account. The

cost of capital may vary for different firms, but ten per cent is used to demonstrate its effects on the cost distribution. It will affect future costs by discounting them and decreasing their present value. This results in a relative increase of the contract cost and the deployment cost, which incur initially, whereas the percentage of future costs such as decommissioning and maintenance costs decrease.

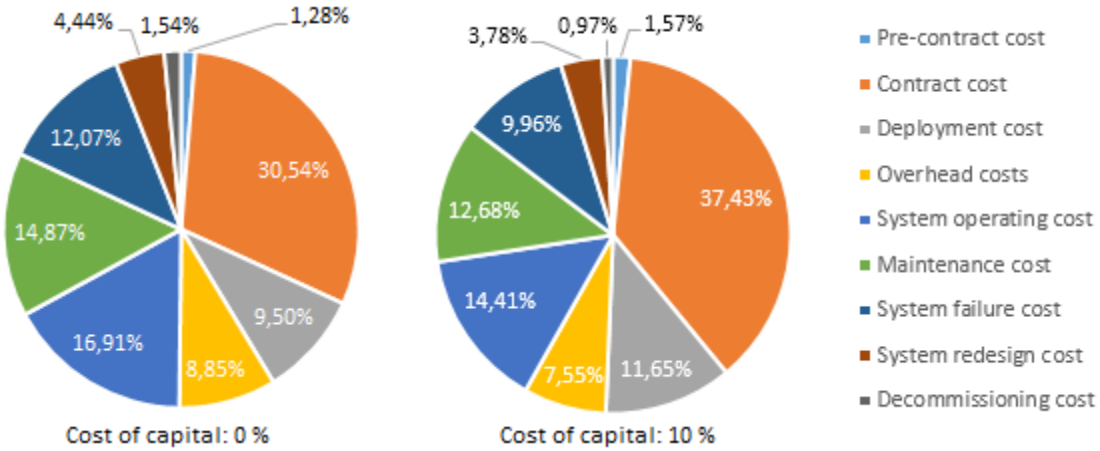

Figure 15. The cost distributions for a small retail system comprising of 7 cameras, with a 0 % and a 10 % annual cost of capital.

While Figure 15 presented a cost distribution between the main cost factor categories, it can be of interest to observe the cost factors in more detail. Figure 16 presents a more detailed cost distribution with the largest individual cost factors. All the cost factors, which are zero in the small reference system, have been excluded. In this system, it is evident that a few cost parameters represent the majority of the total cost.

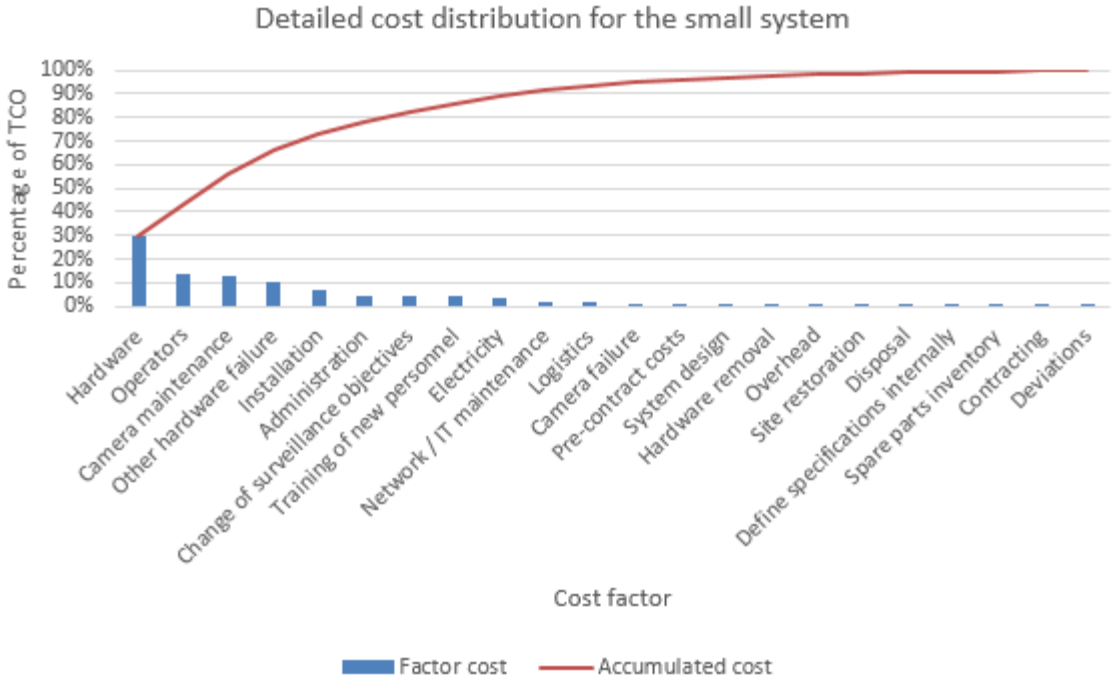

Figure 16. Detailed cost distribution for the small system. Factors that are zero have been excluded from the graph.

Figure 17 presents the annual and accumulated costs of the system. The variation of the annual costs is due to different yearly hardware failure costs, such as camera and hard drive failures.

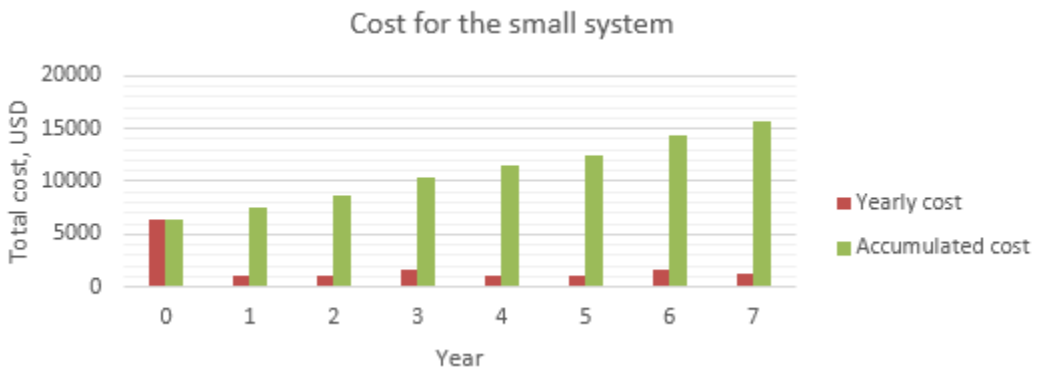

Figure 17. Yearly and accumulated costs for the small system.

5.5.2 Medium System

The TCO cost distribution for the main categories of the medium reference system is shown in Figure 18. The largest costs are the contract cost, the maintenance cost and the deployment cost, which together make up for 86 per cent of the TCO, when not considering the cost of capital. When including the cost of capital, the percentages of the contract costs and the deployment costs increase.

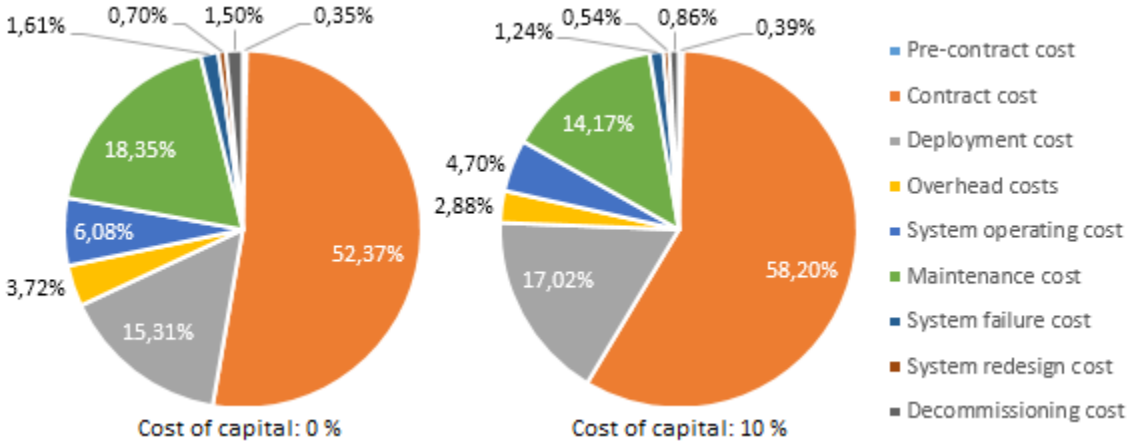

Figure 18. The cost distributions for a medium retail system comprising of 48 cameras, with a 0 % and a 10 % annual cost of capital.

Figure 19 presents a detailed cost distribution for each individual cost factor. Noticeable is that the hardware cost represents more than 50 per cent of the total cost. There are more factors affecting the system than the small system, but there are still several factors, which have been excluded since their value for this specific system is zero.

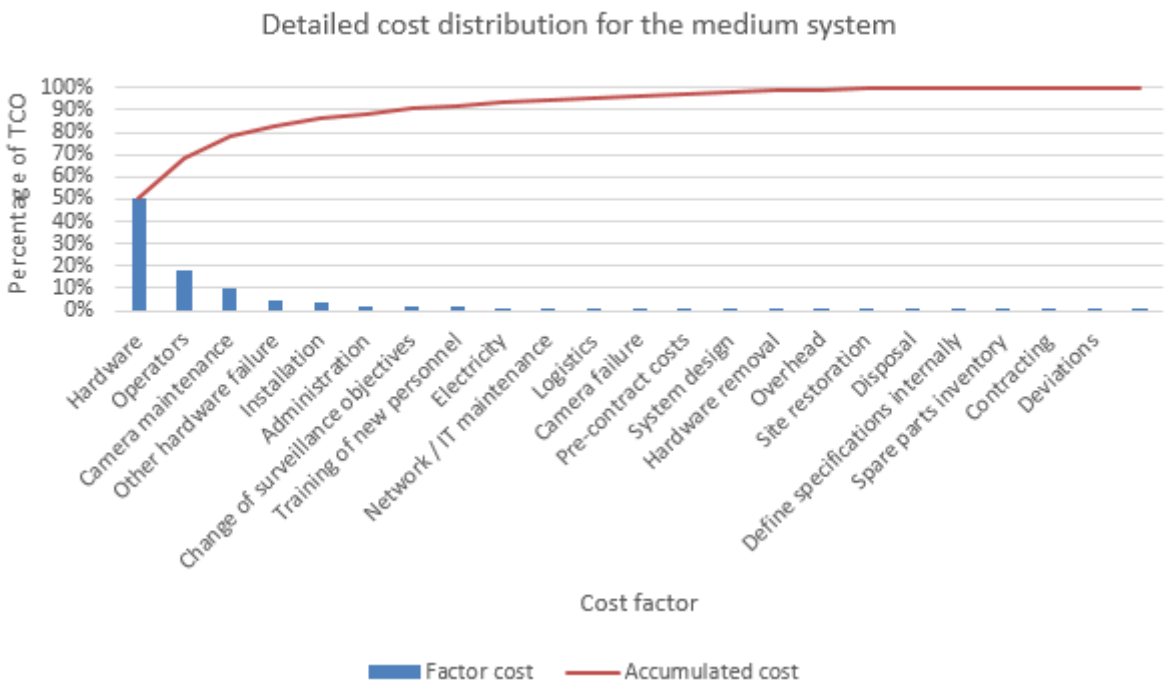

Figure 19. Detailed cost distribution for the medium system. Factors that are zero have been excluded from the graph.

Figure 20 shows the annual and accumulated costs of the system.

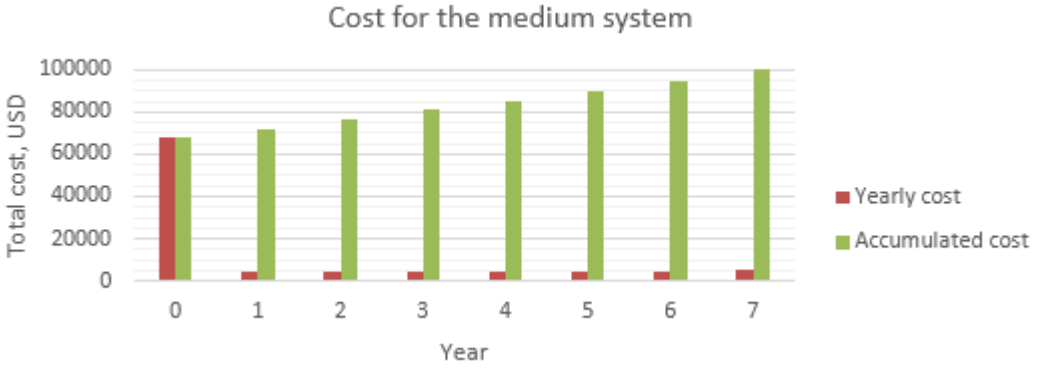

Figure 20. Yearly and accumulated costs for the medium system.

5.5.3 System Comparison

The quantifications of the reference systems have made evident that the cost structure can differ a lot, even though they both operate in the same industry segment. Figure 21 shows a comparison of the small and the medium system. The graph shows the cost per channel, which is the cost divided by the number of cameras in the system.

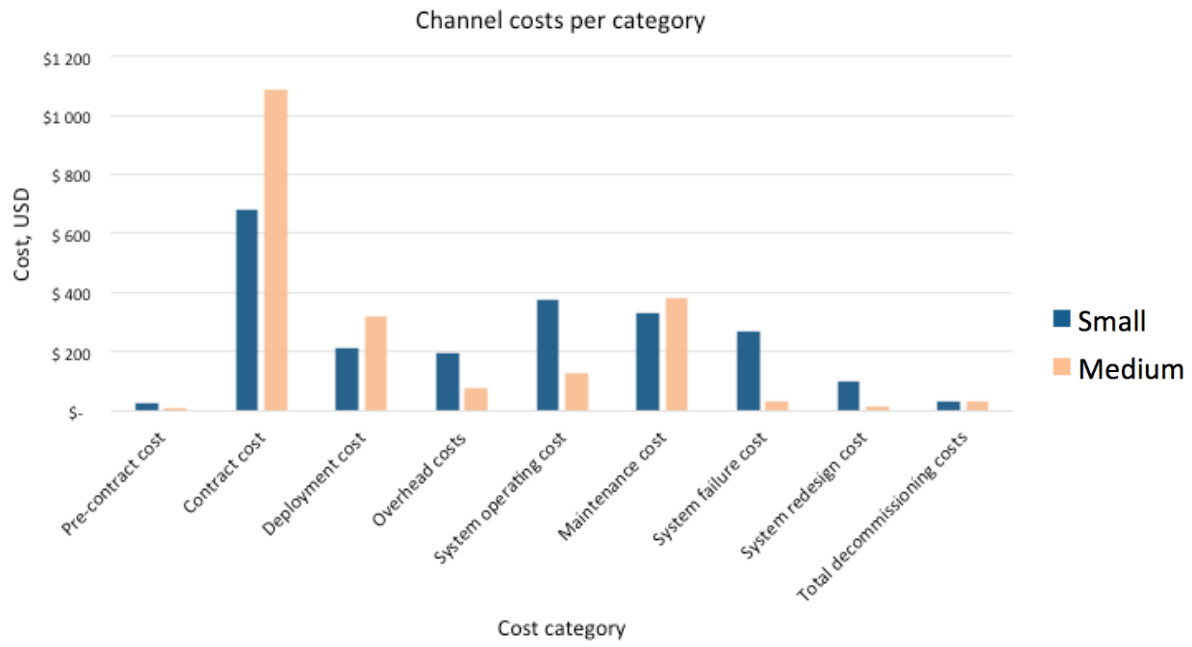

Figure 21. Cost per channel for each category for the small and the medium system.

The hardware cost is much higher for the medium system than the small system, which is caused by more expensive cameras. The cameras in the medium system have a cost that is more than twice as high as for the small system cameras. The remaining hardware cost per channel is about equal. The higher deployment cost for the medium system is mostly due to the cabling work, since each camera has twice as long network cables. The difference in overhead costs is caused by higher costs for administration and training of new personnel for the small system, which also has more operator hours per camera creating a higher system operating cost. The maintenance cost and the decommissioning cost are about equal for both systems, while the difference in system redesign cost is due to estimations made by different people. The difference in system failure costs is mainly due to the small system using a network attached storage (NAS) with a much higher failure rate than for the server that the medium system is using.

5.5.4 Largest Costs

As the Pareto's rule (Ellram, 1994) suggests a small number of parameters are responsible for the majority of the costs. This is true for the medium system in particular, but also for the small system. Hardware is the single largest cost for both systems. This is followed by camera maintenance and installation for the medium system, which together make up for 78 per cent. The small system has a more scattered cost structure. The hardware cost is there followed by operators, camera maintenance, other hardware failures, installation and administration that together represent 78 per cent.

5.5.5 Underlying Data

General Input Parameters

The input parameters that the TCO calculations are based on can be divided into general and system specific parameters. The general parameters that have been used are presented in Table 10, with the salary parameters in Table 11. To make the numbers comprehensible for a larger audience, all the numbers have been converted from SEK to USD using a conversion rate of 1 USD being equal to 8.30 SEK.

The data for the small system has mainly been provided by the case company, whereas the data for the medium system is mostly based on information provided by a system integrator. However, the presented input data is only the general parameters. The reference system specific input data has been requested to not be disclosed to public.

Table 10. General parameters.

General parameters		
TCO time frame (years)		7
Number of sites		1
Cost of capital / internal interest rate (%)		0 / 10
System operating days / week		7
System operating hours / day		24
Time to site, each way (h)		1
Work hours / day		8
Skylift cost / day	$	150
Electricity cost per kWh	$	0.13

Table 11. Salary parameters.

Salary parameters		**Cost per hour**
Camera & network installer	$	60
Camera configurator	$	75
Project manager	$	100
Operator	$	60
Administrator	$	35
System integrator	$	75
Security manager (end customer)	$	50
Sales assistant (end customer)	$	30

Reference System Parameters

The most salary parameters are based on the average price offered by a couple of system integrators, whereas the project manager, administrator and sales assistant salaries are based on estimations. As Appendix B makes evident, several costs factors have resulted in a cost of zero. The reason is that some of the costs do not incur in the reference systems. For instance, the downtime costs have been assumed to be negligible within retail, as the surveillance system is not critical for the business operation and most of the installation and maintenance can be done outside of the business hours.

Lifespan

There is no obvious time frame that can be used when calculating the TCO. The lifespan of a system is not marketed externally and there is no official internally communicated number. The lifespan is complex due to the dependency of several factors such as technological life, economic life and the rate at which the technology becomes obsolete. Through interviews, the compiled estimation of rational time frame for a TCO analysis for Axis's solutions was determined to seven years. While the cameras are designed to last longer than that, there are too many uncertainties that make it difficult to justify a longer time frame. One major uncertainty is the technological development, which historically has been a common argument to update the system. The lifespan is therefore highly dependent on the future development rate of the technology, which is hard to predict.

Camera Failure Rates

An important system specific input parameter is the camera failure rates, which also is one of the major differentiators between the competitors on the video surveillance market. The failure rate is closely related to the lifespan of the system. The rates are related to a unique product and can even be unique for a batch number, which makes it hard to predict future failure rates for new or existing products. The failure rates typically follow the same distribution, as presented in Figure 22. Initially there are a high number of failures caused by problems during the deployment, such as hardware defects, but after some time the failure rate decreases and stabilises. It stays low until the cameras get close to the end of the technological lifespan, where the failure rate increases.

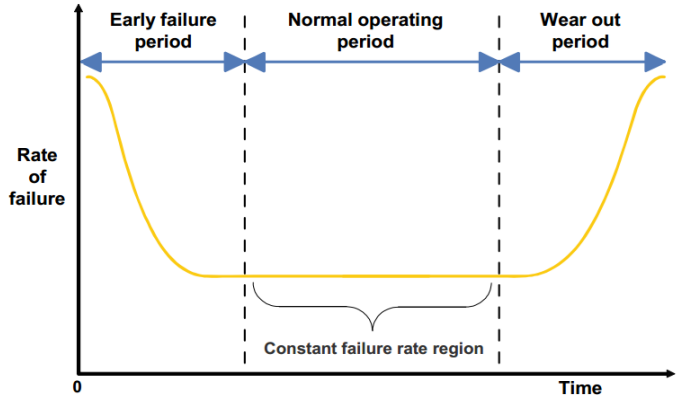

Figure 22. Failure rate distribution. Source: Axis, 2015k.

The camera failure rates used for the quantifications are based on the relevant RMA data. The data is only reliable during the warranty time, since few customers file RMA cases after this period. In the TCO calculations, the failure rate is assumed to be constant from year three and onwards, when Axis's camera warranty has expired. It can be argued that the RMA data does not represent the real failure rate, since not all the failed cameras are sent back for repair. On the other hand, not all RMA cases are due to hardware failures caused by Axis.

5.5.6 Use Case Scenarios

There are several applications of the sales tool. Different solutions can be compared and single parameters can be isolated to see how they affect the end result. To demonstrate how the tool can be used for analyses, two use case scenarios are provided. The first case is a benchmark between the small Axis reference system and a comparable industry average system. This case will show how the model can be used for competitor analysis, which is of major importance in sales and marketing. The second case is a failure rate analysis for two different cameras and is conducted since failure rate and quality are top priority within Axis.

Benchmarking

To be able to get some perspective on the cost distribution and the actual costs, the small reference system has been compared with data from an industry average system. The variables that have been changed are the installation time, the configuration time, the failure rates, the purchasing price for the cameras and the lifespan of the system. The purchasing price has been reduced with 33 per cent and the lifespan determined to five years on average in the industry. The installation time, configuration time and the failure rates have approximately been doubled. All other variables in the system remain the same as for the small reference

system. While it can be argued that also other variables will change, both in advantage and disadvantage for Axis, it will not be included in this specific case. The cost of capital is also assumed to be zero.

Figure 23 shows the cost distribution of the costs for the industry average system. As the figure indicates, the cost distribution looks similar as to the small reference system. The major difference is that the deployment cost has increased from 9,5 per cent for the small reference system to 15,5 per cent for the industry average system. Since the deployment cost category has increased, the other cost categories have decreased. As only a fraction of the variables were changed from the small reference system, the cost distribution was not expected to change much.

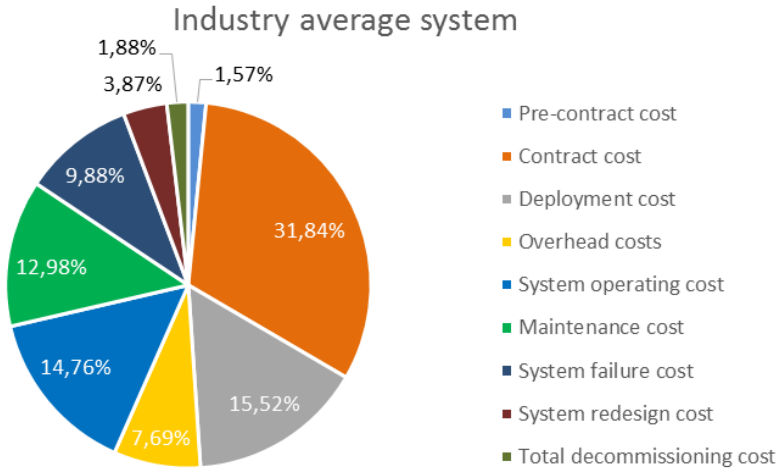

Figure 23. Cost distribution for industry average system.

When looking at a cost comparison of the two different systems, there are some key findings. Table 12 shows the cost relationship, where the costs for Axis's small reference system has been set to 100 per cent and the costs for the industry average system is described in relation to the Axis system. Noticeable is that the industry average system only has a lifespan of five years, which would mean that a new investment would be required after year 5. If the total costs are compared with each other, the industry average system has a slight higher accumulated cost year 5, at the point when its lifespan is over. However, the Axis's system will continue to operate for, on average, two more years. Therefore, a comparison of the total costs divided by the number of lifespan year is more fair and informative. This comparison clearly shows that Axis's reference system is cheaper and that the industry average system is 15 per cent more expensive. These findings are interesting since it marginalises the influence of the purchasing price for the cameras when considering the TCO of a system.

Table 12. Cost comparison between an Axis system and an industry average system.

System	Axis small reference system	Industry average system
Lifespan	7 years	5 years
Accumulated COSTs year 5	100 %	102 %
Total cost / lifespan years	100 %	115 %

Failure Rate Analysis

Some costs that are directly influenced by the choice of camera include the camera purchase price, the installation cost, the configuration cost and the camera failure cost. An interesting aspect is how these costs interrelate and how the camera failure rate affects the TCO when the camera price is higher but the failure rate is lower. To analyse this, a fictitious scenario for two different cameras has been constructed. One of the cameras has a 50 per cent higher purchase price while the other one has a 50 per cent higher installation and configuration time. The aim is then to find a break-even point by altering one of the camera's failure rates.

The purchase price, the installation cost and the configuration cost depend on the camera price and the labour required for the camera deployment. The camera failure cost depends the failure rate and the costs associated with each failure. First, there may be a freight cost for sending the failed camera for repair or receiving a new unit. The repairman, for instance the system integrator, has to be transported to and from the installation site. Labour is required to remove the failed camera, as well as to re-install and re-configure the new one. If the camera is situated on a difficult spot, a skylift or other equipment may be required and if the camera is critical for the business operation, the failure may imply downtime costs.

The data that the given scenario is based on is presented in Table 13, Table 14 and Table 15. It is assumed that a new camera is purchased each time a camera fails except for failures during the warranty period, when a new camera is received for free. The camera repair incurs labour costs in terms of administration, transportation, camera removal, camera installation and camera configuration. The camera installation and configuration time is assumed to be the same as during the initial camera deployment. The freight cost and the downtime cost are assumed to be negligible.

Table 13. The two compared cameras.

	Camera A	**Camera B**
Price (USD)	200	300
Installation time (h)	0.75	0.50
Configuration time (h)	0.75	0.50
Skylift time (h)	0	0
Annual failure rate (%)	Altered	1
Warranty (years)	1	1

Table 14. Costs per camera failure.

	Labour hours	**Cost per hour**	**Cost**
Administration	0.25	50	$ 25
Transportation (repairman)	2	75	$ 150
Camera removal	0.5	75	$ 37.5
Re-installation and re-configuration	Camera specific	75	Camera specific

Table 15. General parameters.

General parameters	
TCO time frame (years)	7
Annual cost of capital	10%
Freight cost per camera failure	$ 0
Downtime cost per hour	$ 0

Camera B is assumed to have a constant failure rate of 1 per cent, whereas the failure rate of camera A is altered. The result was calculated by using the tool described in chapter 5.3. The total cost for camera B for a seven year period is then 392 USD. The break-even point is when Camera A's failure rate reaches 3.96 per cent. The result is shown in Figure 24.

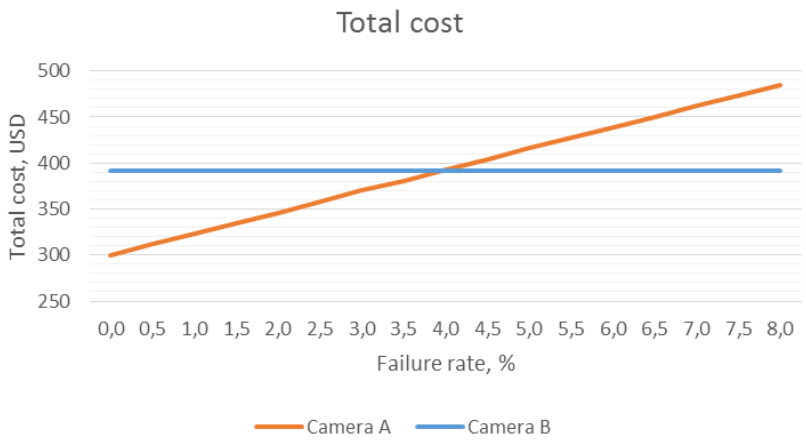

Figure 24. The total cost for camera A and camera B, when altering camera B's failure rate. Break-even at 3.96 per cent.

Using the same set-up, the break-even point has been calculated for different camera A failure rates. These are presented in Table 16. The analysis makes clear that a relatively low difference in failure rates may have a high impact on the total cost. Although it is not a linear function, the difference in failure rates for the investigated range is about three per cent to reach break-even. Similar analyses can also be made to see the effect of the installation and configuration time. For instance, if camera A has a failure rate of 3 per cent and camera B a failure rate of 1 per cent, then the installation and configuration time of camera B has to be 44 per cent shorter than for camera A, if camera B still is to have a lower total cost than camera A.

Table 16. Break-even points for various constant camera B failure rates.

Camera A	3,4%	4,0%	5,1%	6,1%	8,3%	13,8%
Camera B	0,5%	1,0%	2,0%	3,0%	5,0%	10,0%

5.6 Framework for Development of a TCO Sales Tool

5.6.1 Presentation of the Framework

Based on the development and implementation framework by Ellram (1993), the process by Piscopo et al. (2008) and the research conducted, a TCO development framework for sales purposes has been developed. This provides an answer to RQ 1, of how to translate existing TCO frameworks to be applied on a network

based video surveillance solution. This final proposed framework is based on the initial research process, but has been developed and fine-tuned based on findings throughout the project.

The framework consists of five main phases with more detailed steps in each phase and is presented in Figure 25. The first phase is the problem identification and project definition, the second is the TCO cost factor and categorisation development, the third is the sales tool development, the fourth the implementation and the last phase is the continuous work. Some of the activities are directly merged from the framework of Ellram (1993) and the process from Piscopo et al. (2008). The description for these activities will be very similar to the previous descriptions. The processes of the phases are iterative and during the tool development it is possible to iterate back to earlier phases. The third, fourth and fifth phases are also iterative within each phase and these iterations will be required until the result is satisfactory.

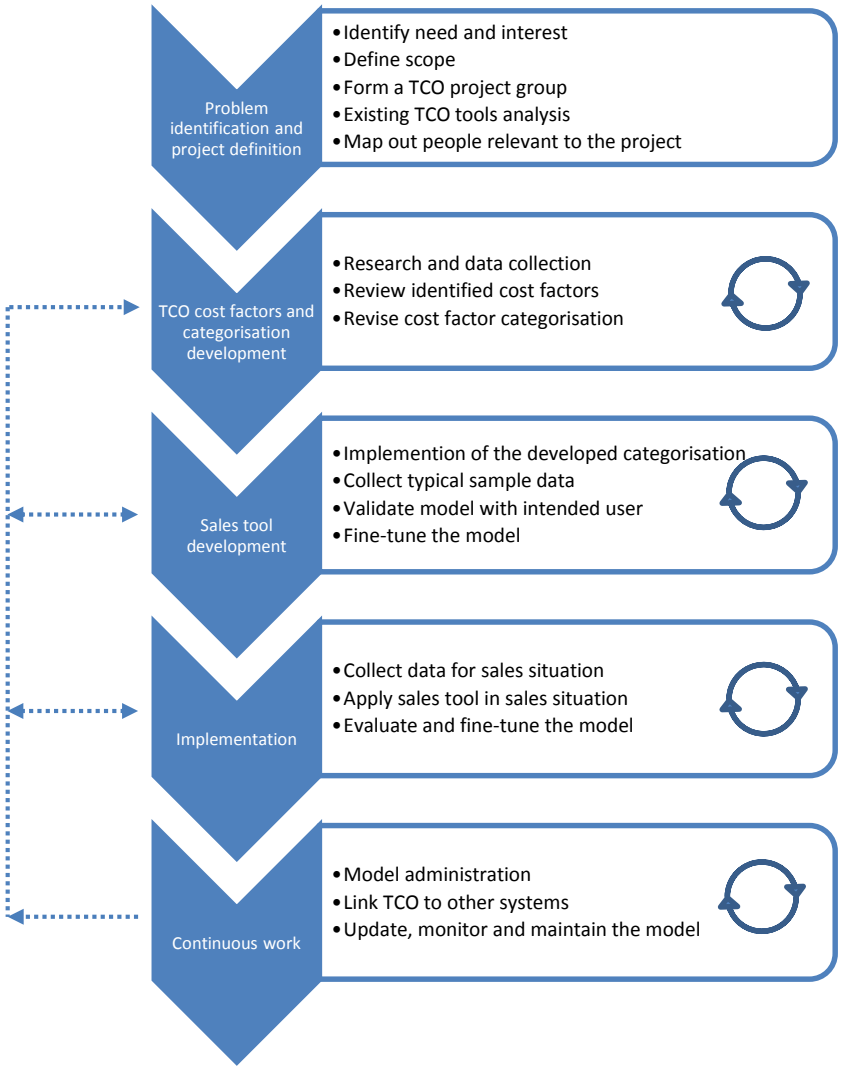

Figure 25. A framework for the development of a TCO sales tool.

There are several similarities of the process with the action research methodology. The first phase in the framework corresponds to the observation phase and the second phase in the framework corresponds to the solution phase. The third and fourth steps in the framework are iterative processes and both phases include

the implementation and evaluation phases. The third phase is an internal implementation and evaluation, while the fourth phase is an external implementation and evaluation. The fifth phase represents continuous work to maintain and improve the developed model, which is outside the scope of the action research methodology.

5.6.2 Phase 1: Problem Identification and Project Definition

1.a Identify need and interest

The initial step is to identify why TCO should be developed and used as a sales tool. This can be driven by an internal or an external demand. If possible, the functionality and the design of the desired final sales tool should be specified.

1.b Define scope

There are four variables that have to be specified; the products of interest, the industry segment, the TCO perspective and the geographical market segment. The determined variables should be aligned with the needs and interest.

Define products of interest; determine which products to include in the TCO. The TCO can be conducted on individual products or on multiple product solutions. If a solution approach is used, the components included in the solution are to be specified. The product or solution considered should be of high importance for the company, due to strategic importance or of a high monetary value.

Define industry segment; define which industry segments to focus on. The segment should have a high importance and be a key segment.

Define the TCO perspective; determine from whose perspective the TCO should be conducted. The perspective can either be a system perspective, to include all the costs that affect the chosen products of interest, or a stakeholder perspective, to include all costs that incur to a specific stakeholder.

Define geographical market segment; define which geographical market segments to focus on. It can either be one or multiple markets that preferable are of high importance.

1.c Form a TCO project group

Form a project group of people with mixed expertise, experience and networks. It is desirable to have a project group with good knowledge within the specified scope. To fulfil the project purpose, sufficient time, support and resources need to be allocated to the group.

1.d Existing TCO tools analysis

Investigate the utilisation of TCO based sales tools of competitors or in comparable industries. The findings can be used to inspire the project or to create a qualitative benchmark. Relevant literature and research can be used to learn more about the TCO concept.

1.e Map out people relevant to the project

The project group should involve and utilise the available expertise from people with different backgrounds and from different functional areas. Their expertise can support the project through easier data collection and to get a broader perspective. They can also be used to increase the awareness of the project and the TCO concept.

5.6.3 Phase 2: TCO Cost Factors and Categorisation Development

2.a Research and data collection

Research needs to be conducted to be able to identify the relevant cost factors. To collect data, research methods based on interviews, literature review and hard facts can be used. The research is divided into three phases; scenario analysis, processes and activity mapping and cost factor identification.

Analyse scenarios; the first step is to identify the current scenarios and how the products of interest are used in the specified environment. These scenarios then need to be understood and analysed.

Map processes and activities; the second step is to map the processes and activities relevant to the products.

Identify cost factors; the third step is to derive the cost factors from the processes and activities.

2.b Review identified cost factors

The identified cost factors should be reviewed within the project group to make sure the cost factors are within the project scope and, if needed, verify them. The parameters must be reviewed to ensure that they have a potentially major or critical impact on the TCO.

2.c Revise cost factor categorisation

The cost factor categorisation should be revised with the identified cost factors.

5.6.4 Phase 3: Sales Tool Development

3.a Implementation of the developed categorisation

The implementation of the developed categorisation into a sales tool.

Identify cost drivers; for each cost factor identified, there are cost drivers that need to be specified. The cost drivers should be easy to understand for an inexperienced user and, if possible, the number of cost drivers to each cost factor should be kept low.

Sales tool implementation; the cost factors and its cost drivers are to be implemented in a sales tool. The implementation should be done in a user friendly and intuitive style. To create a logical structure, the cost factor categorisation can be used as a base.

3.b Collect typical sample data

For validation purposes, typical sample data is to be collected. The data collection process is also a verification of the cost drivers to make sure that they are appropriate and aligned with the data possible to gather.

3.c Validate the model with intended user

The model is to be validated together with its intended users, which are representatives from the sales organisation or the marketing department.

3.d Fine-tune the model

Based on the feedback from intended users and the results of the sample data collection, the model is to be fine-tuned. Sensitivity analysis of the data is recommended.

5.6.5 Phase 4: Implementation

4.a Collect data for sales situation

Cost driver data for an actual sales situation is to be collected and used in the model. The customer's processes and activities need to be identified to find the appropriate quantitative input variables. Preferably, the data collection should be done together with the customer to ensure the input data quality and accuracy.

4.b Apply sales tool in a sales situation

The sales tool is to be used in an actual sales situation. The data collection of the input variables, TCO results and the most important cost factors can be used to support and craft sales arguments.

4.d Evaluate and fine-tune the model

Evaluate the feedback from the sales situation and fine-tune the model.

5.6.6 Phase 5: Continuous Work

5.a Model administration

The development process and the lessons learned are to be well documented. The logic behind the sales tool needs to be explained. The model needs to be distributed to the intended users and education sessions should preferably be held.

5.b Link TCO to other systems

If possible, the TCO model can be linked to other system to improve strategic and operational decisions. The model can be linked to training and education systems, business intelligence systems or customer relationship management systems.

5.c Update, monitor and maintain the model

The model regularly needs to be monitored, maintained and updated to ensure its accuracy. Modifications and updates also need to be documented.

5.6.7 Description of the Framework

The major foundation of the project methodology is Ellram's (1993) ideas of how to develop and implement a TCO model. The methodology for this project combined with Ellram's (1993) framework and the ideas of Piscopo et al. (2008) led to the creation of a framework for the development of a TCO sales tool. In particular, Ellram's (1993) first and last steps are almost identical with the created framework. The major improvements and differences are the cost factor identification, the model development and the application implementation.

Despite the similar topics, the research by Ellram (1993) and Piscopo et al. (2008) has fundamentally different approaches. Ellram (1993) has the perspective of a model developer whereas Piscopo et al. (2008) have a user perspective. For these reasons, Ellram (1993) has been the most relevant for the sales tool framework.

Project Initiation

The first phase of the framework is the problem identification and the project definition. During the phase, the project is mapped out and a rough project plan is created. After the need is identified, the scope should be determined. The scope lays the foundation for all the following steps and with an early defined scope, it will be possible to allocate the resources more efficiently and make deeper analyses. The TCO team should then be formed, which will have an advantage if it has a good knowledge within the scope, the company, the industry and a strong network. A strong team will be able to save a lot of resources. This team will then be

responsible to search for similar TCO sales tools used by competitors or in comparable industries, as well as to map the people and resources needed for the forthcoming project.

Cost Factor Identification and Categorisation

The cost factor identification and categorisation is a key phase in the sales tool development. Sufficient time should be allocated to this phase and the project group should not continue to the next phase until it is ensured that the categorisation is complete and correct. This is ensured through multiple iterations until the feedback of the cost factors and the categorisations are either positive or the critique can be dismissed due to valid counter arguments. Several iterations are in most cases necessary to come to an agreement. The number of iterations is dependent on the initial knowledge and expertise. If the expertise is low, the number of iterations will be much higher. The implications with no or only a few iterations would be the possibility that the cost categorisation is neither correct nor complete.

Two Implementation and Evaluation Phases

The sales tool framework consists of two implementation and evaluation phases, where the first phase is internal and the second phase is external. The first internal phase, sales tool development, focuses on implementing the model into a valid, user-friendly and accurate sales tool. A simple way to overcome unfamiliarity with the tool is to create it in a software that the sales people are already knowledgeable in, for instance Excel. When the tool is developed, the model needs to be validated. For the purpose of testing the model, the data needs to be correct but does not have to be the up to date. The feedback from the intended users is critical. If the user does not feel comfortable with the model, it will most likely not be used. The project group then needs to process the feedback, try to understand the complications with the model and fine-tune it.

The second validation is in real sales situations with the intended users and customers. From the conclusions of the several internal iteration rounds, the external implementation and evaluation will most likely not be similar. This is because the customers probably will value and criticise different aspects of the sales tool than the people internally. The customers will also have a more restrictive mind-set to the new sales tool, since they can be afraid to be manipulated by the results. Aligned with the ideas of Zachariassen and Arlbjørn (2011), the customers who are used for the validation of the sales tool must be selected carefully. The customers should preferably already be in a close relationship with the sales person to gain advantage of existing trust. Close relationship customers tend to be interested in helping out to a greater extent since they understand that the developed sales tool eventually will become an advantage even for them.

The continuous work

The continuous work phase is important to maintain the validity and usability of the model. A continuous future plan to maintain and update the model can be something that is easy to overlook, but this will only shorten the useful life of the model. Another key factor to be able to maintain the model in a usable condition is documentation. The project needs to be well documented, both the process and the end result, to be able to understand what has been done and the reasoning behind the earlier decisions.

6. ANALYSIS

The chapter includes analyses of the project and more specifically the analyses of the results from the research, the takeaways from the process and the project findings in relation to the applied literature. The first section focuses on the analysis of the cost factors. This is then followed by analyses for each of the research questions in a consecutive order.

6.1 Cost Factors

6.1.1 Methodology

The choices of methodology for the cost factor identification and categorisation may have impacted the process in particular and also potentially the outcome. One of the strategic choices was to have several iterations in the identification phase and to provide the existing categorisation to the interviewees, either before the meeting or during the meeting. The reason for this was to create a better and more time efficient discussion. Instead of letting the interviewees state the obvious costs, the interviews focused on leading the interviewees into areas that needed to be further explored. In this way, it was possible to dedicate more time to these unexplored cost factors. The categorisation was also used as an inspiration for the interviewees to come up with related, not yet included costs.

There is a risk that the decision to provide an already compiled list of cost factors may have directed the mind-sets of the interviewees and limited their creativity. Especially the general structure of the categorisation may have been difficult to criticise. If each interviewee would have had the chance to create their own categorisation without any guidance, chances are that the compilation of the final categorisation could have given another end result. The original approach was to let the interviewees start out from a blank paper to identify the costs. During the first interviews, it became clear that this approach would result in discussions where the time would only be enough to discuss a few, often obvious, cost factors. To compensate for the risk of potentially directing the interviewees, a high numbers of interviews were conducted. This had positive implications since each person has its own area of expertise.

What was noticed during the process of collecting the cost factors were the different interpretations of the cost parameters. Therefore, a description of the cost factors and the final categorisation was sent to a reference group including selected knowledgeable people that had been interviewed during the project. The descriptions acted as a confirmation both for the actual cost factors and that the definitions of each cost factor were correct. Another approach could have been to send out the definitions in advance to the interviewees. However, since the project was based on unstructured and semi-structured interviews, it was possible to explain ambiguities during the interviews. In retrospect, to send out a description to the respondents would have been unnecessary work for the interviewees and would most likely not have been read due to a shortage of time.

6.1.2 Data Availability

One of the obstacles that Ellram (1994) identified as a barrier for the TCO was the lack of data availability and general resource issues. An additional issue that has been discovered during the project is the difficulty of finding appropriate data and the time it takes to process the data. Even though the data found was correct, it was a time-consuming process to process and modify it before it could be used in the model. For instance, the camera failure rates were eventually received, but they were categorised in a way that was not applicable for the model. The model could also be adjusted to better reflect the data availability. Since the time consumption is a key factor if the sales people will use the model, the data collection can be a barrier. The

issue with the data is that most data is case specific and therefore only fractions of the data that can be re-used. To overcome the barrier, it is necessary that the sales people learn which data they need from the customers and that the internal data is easily available from Axis.

6.1.3 Generalizability

An interesting finding is that none of the identified cost factors are specific solely for the retail segment. The only cost factors that might not be included in the costs for all segments are the change of surveillance objective and alarm failures. However, these costs can be found in other segments, like banking, airports and casinos as well. This finding proposes that the differences between the industry segments might not be that big. None of the cost factors initially identified, before the scope was determined, had to be excluded due to their absence in the retail segment.

Since the model is developed for the retail segment in the European and American market, the validity is only ensured there. During the project process, there were also indications that there were markets that were very similar to the retail segment, like the bank segment. The model can most likely be successfully applied to this segment as well. An argument against applying the model on other verticals is that there might be some major costs that have been left out during the identification phase. An argument for applying model on other verticals is its flexibility. The cost factors are fixed, but the values of the cost factors are not. Therefore, if it is only the numbers that differ between the verticals, it is possible to apply the model onto other segments.

Despite the fact that the cost factors are similar in different industry segments, it was discovered that there can be large differences between the actual costs. For instance, it is possible to compare the downtime between two extremes; retail industry and casinos. In a retail environment, where the cameras in many cases are non-critical, the impact of camera downtime is low or zero. Contrarily, in a casino, where the cameras can be critical for the business, the cost of a broken camera can be huge. Not only does a broken camera require the gambling to stop at the specific table, which implies lost revenues and dissatisfied customers, it can also lead to large fines. Another comparison can be made for the maintenance cost in the retail segment and the infrastructure segment. While it can be enough for a system integrator to only clean the lens in the retail environment, the same person may have to rent a skylift, temporarily close a road and have a lot of road security to conduct the maintenance in a traffic environment.

6.2 The Created Sales Tool Development Framework

The created framework has similarities with Ellram's (1993) framework, even though Ellram's is applicable to purchasing and supply chain management. Ellram´s (1993) framework leads to a model with fixed cost factors and fixed variables, most likely a model that requires a lot of underlying fixed data. However, while that type of model most likely is usable for its purpose within supply chain management, it became clear during the project that the model would not be as useful for developing a sales tool. A sales tool needs to be more customisable for different situations and it should have the possibility to choose relevant cost factors to a higher extent. There were also some phases in the framework that needed to be modified to fit the network based video surveillance industry.

The fact that the created framework is more detailed than Ellram's (1993) makes it easier to understand and use. To enable Axis to create new TCO models in the future, it was beneficial to provide more in-depth guidelines. Especially Ellram's (1993) fourth phase, identifying relevant costs, has been expanded. During the project it was found that a better description of the cost identification phase would have accelerated the process. Generally, the new framework is constructed to go more in depth on the model development, while

the data collection is not illustrated in detail. This is because it will be up to the user to customise the model for each situation.

To be able to conduct a valid TCO analysis that can be useful, all of the phases and steps have to be carefully performed. It is of special importance that the second, third and fourth phases are not rushed through. These phases should be iterative to make sure that no areas are left unexplored. As there are many phases in the model, it is necessary to allocate sufficient resources to the project. Not only during the framework development, but also continuously to maintain the model. However, if conducting the analysis with the guidelines in the constructed framework, there is a great chance that the outcome will outweigh the required input resources.

A difficult trade-off when developing the sales tool is to balance the complexity of the tool and the user friendliness. While the users tend to favour simple tools, the complexity can be necessary for the accuracy of the results. However, if the model is too complex, the risk is that the model will not be used. As noticed during the project, there were several iterations with multiple stakeholders before the tool was usable and designed as desired. A realisation during the project was also that the different stakeholders have their own agenda and goals with the model. Therefore, it is necessary to focus the testing and validation with the people who will actually use the model, while other people may not have the same opinions as the intended users.

6.3 Identification of Key Cost Parameters

One of the project goals that was specified in a research question, RQ 2, was to identify and weigh the most important parameters that affect the TCO. The research question is relevant when doing a TCO analysis from a buyer perspective. However, its meaning when applied from a seller perspective is found to be different and can be interpreted in various ways. Before identifying the key parameters, the term key parameter from a sales perspective has to be understood.

One approach to determine the key parameters is to consider all the identified cost factors as key parameters. This was the initial approach, before its unsuitability was realised. The motivation to use the approach is that the factors that affect the total cost are key components, regardless of their impact. For the reference systems it would imply a lot of key parameters to consider, even though a lot of the cost factors are ignored due to their low impact, as shown in Appendix B. It is debatable if the number of key parameters should be this high, and for this project it is considered to be an unsuitable way of defining key parameters.

The key parameters can instead be determined by their size, either by including a number of the largest cost factors or by including all the costs bigger than a specific value. The quantification was believed to be a method to find out the key parameters. When analysing the reference systems out of this approach, the number of key parameters was low. By excluding all the cost factors that represent less than five per cent of the TCO, three factors could be identified for the medium system and five factors for the small system, as shown in Figure 16 and Figure 19. The three top factors of the medium system are all represented among the top five factors of the small system. Consequently, based on the quantifications, the five key parameters for the TCO of an Axis retail surveillance solution are the hardware cost, the installation cost, the camera maintenance cost, the operator cost and the other hardware failure costs. Even though there are similarities among the cost top cost factors in the two reference systems, the cost factors are likely to be completely different for other systems and it is not possible to draw any general conclusions from this.

Another strategy is to define the key parameters as the input parameters that will change the result most by a small change of its value. These key parameters can be used in sales and marketing, but also to find areas

where it is valuable to spend resources on further improvements. Many of the input parameters only incur once in the cost factors, which means that the cost change is straightforward. This is especially true for many of the cost factors in the total cost of acquisition category, for instance the project management hours or the pre-contract cost factors. What should be focused on are the parameters that affect many different costs. Some of the most distinguishable input cost parameters that incur in multiple of the cost factors are the failure rates, the installation time, the configuration time and several of the salary parameters. The salary parameters are hard to change by Axis, but the installation and configuration times do have a high focus at Axis in several projects. Since the failure rates parameter also was a distinguished input parameter, these rates were analysed in chapter 5.5.6.

The final approach was to identify the cost parameters that Axis could influence the most, and consider these to be the key parameters. Even though the interviews had been focused on identifying the cost factors, they had also been providing several insights of which costs that differ between the camera manufacturers. The obvious factors include the purchase price and the installation cost in terms of labour hours needed. Other significant factors include the failure rates due to camera quality, the necessity of maintenance, different storage costs depending on compression methods and the costs for compatible VMS software. Since this approach would show itself useful, the developed sales tool was complemented with functionality that supports this interpretation of the key parameters. In the model, the user can choose to highlight the input needed to calculate the key parameters and there is a separate page only showing the key parameter costs. The selected key parameters are the applicable direct costs for the cameras, storage and VMS. These direct cost factors include the purchasing price, installation costs, configuration costs, dead on arrival costs, maintenance costs and the failure costs. This approach is aligned with an efficient sales and marketing strategy. The strategy should have the highest focus on how Axis can differentiate its own value from the competitors' value. Optimally, this will be made with the whole solution included, to also incorporate the small differences, but since this is very complex and time consuming, the key parameter approach will represent a good approximation.

6.4 TCO Rationale

6.4.1 Validation of Previous Research

The TCO rationale aims to discover the general conclusions identified regarding the rationale of using TCO in sales and marketing. Even though the area is not very researched in the past, some connections and general conclusions can be drawn when comparing the literature. The only found research in the area is by Piscopo et al. (2008) who presented several benefits of using TCO in sales and marketing. These conceptual usages that Piscopo et al. (2008) present have also formed the basis for the answers of RQ 3, the rationale of utilising TCO from a seller perspective. Since the usages are conceptual, there was a need identified to investigate if these usages have practical applications as well. It is therefore possible to answer RQ 3 with a combination of the literature and the practical experiences. During the project, it has become apparent that the rationale presented by Piscopo et al. (2008), see chapter 3.6, can be adopted into the network video surveillance industry, even if some of the suggested usages have to be slightly modified, as described below.

6.4.2 Understanding the Customer's Value Function

The first use that Piscopo et al. (2008) brings up is the understanding of the customer's value function. Considering Axis's sales model, the company has limited contact with the end customer compared to companies with a direct sales model. The end customer contact is mainly handled by system integrators and resellers, although Axis is involved in the process for key accounts. This makes the TCO analysis particularly

valuable, as it forces the company to reach out to and understand the customers. Many employees within Axis have relatively good experience about what affects the TCO, but a lot of this knowledge is because the employees have previously worked in the industry. Thus, this is considered to be an area with improvement potential. This was extra evident after the interviews with the system integrators and the end customer. These partners were able to contribute with facts about the cost factors and values for the cost parameters that the people at Axis were more speculative about. Just through this TCO analysis, there is information about the end customers that were previously not known within the company. The possibility to identify strategic key knowledge about the end customers would be even greater if the TCO concept would be used continuously.

6.4.3 Documenting and Demonstrating the Customer's Value

The documentation and demonstration of the customer's value is one of the main reasons for conducting a TCO analysis from a seller perspective. The desire to be able to document and demonstrate the product value in a satisfactory way was also the key reason for the initiation of this project. High quality products and ease of installation are some of the characteristics of Axis products that the company tries to convey to the customers, but little data of the actual customer value exists to support these statements. The TCO analysis is one way of addressing these issues and to be able to demonstrate the value. However, the demonstrated value is purely financial and it is important to also consider the non-financial aspects, for instance the image quality, brand trust and relationships to the sales people and the company in general.

6.4.4 Consultative Selling Tool and Discovery of Joint Profitability Opportunities

The use of TCO as a consultative selling tool and discovery of joint profitability opportunities is suggested by Piscopo et al. (2008). They emphasised how the supplier should take on a consultative selling approach and provide solutions rather than just the products. Axis has recently taken several steps against providing complete solutions. This will require a better understanding of the customer needs and challenges. Piscopo et al. (2008) also state that the TCO analysis should be conducted together with the customer, which has not been the case for this project. A couple of system integrators and an end customer were interviewed, but the result could be improved significantly by starting a TCO project in close collaboration with some system integrators and end customers.

6.4.5 Supporting Value-based Pricing Decisions

TCO supports value-based pricing decisions and is a mean to shift the focus from sales through initial price to value oriented sales. A higher initial price may be justified by pointing out other costs that can be avoided as a result of product quality or features. When the competition intensifies and customers start questioning different costs, the TCO analysis can provide a context when analysing the costs. In the network based video industry, just like in many other industries, the initial price sales orientation is typically favouring companies with low-price and low-quality, while a value based selling strategy typically favours companies with higher quality. These conclusions are supported by Piscopo et al. (2008). The value-based pricing strategies are found to be extra useful in mature and developed markets while in the emerging markets there are other sales arguments that can be stronger. However, this would be a topic to further investigate.

6.4.6 Demonstrating Customer Engagement

An area only briefly mentioned by Piscopo et al. (2008) is the use of TCO as a marketing tool. During the project, it has been found that the act of conducting a TCO analysis can itself be used for marketing purposes. This usage should be emphasised more and should be added as a sixth use to complement the already existing list of five uses by Piscopo et al. (2008). To carry through a TCO analysis demonstrates that the company is engaged in its customers' businesses and puts resources on trying to understand the customer needs, with the

desired outcome to be able to become better at tailoring suitable solutions. This can be used to strengthen the company brand and to create customer loyalty. Another important aspect is that the TCO analysis can be regarded as a service for the customer. Any security manager of a large company has to have some kind of TCO mind-set to be able to make long-term investments. If a company can provide and communicate a credible and accurate TCO analysis for a customer project, this can save a lot of work for the customer as well as minimise the risk of the investment. The work for assessing the investment is facilitated by the TCO analysis provider and the risk can be reduced by being aware of potential costs and take actions to prevent these costs from incurring.

6.4.7 Improving Communication and Strengthening Relationships

Piscopo et al. (2008) suggest that the communication and the relationships may be improved by using TCO, since a TCO analysis requires collaboration between different stakeholders. This is supported by the other benefits, which state that both parties can gain from TCO analyses and deeper collaboration. The fact that both parties have monetary incentives for the collaboration is a key driver. The better data the customer provides, the better solutions and improvement areas the supplier will be able to identify. The increased collaboration is found to be of special importance in the network video industry, where the users of the cameras tend to be far from the camera suppliers. It is also found that the camera suppliers put a lot of resources to create long-term relationships, where the TCO analysis is one part. The long-term relationship through TCO is aligned with what Piscopo et al. (2008) acknowledge. It can also boost short-term relationships and enable the relationship to grow from an arms-length relationship to a partner relationship. Then the TCO analysis can be used for learning, which is a relationship described by Zachariassen and Arlbjørn (2011).

6.4.8 Barriers

The benefits of using TCO are several, but there are also barriers for its usage. Ellram (1994) described three barriers when implementing TCO; educational and training issues, cultural issues and resource issues. In the study it was found that the educational, training and resource issues are more related to the sales people and the cultural issues are more related to the customers. The cultural issues among the customers became apparent in particular on the Asian market. During a TCO workshop that was carried out by the PIM team in China, it became clear that many of the Chinese customers were very price oriented, and therefore the salesmen had a hard time understanding the value of TCO. In the specific case, the cultural issues can be dependent of the maturity of the market. Nevertheless, the cultural issues are observable and have to be taken into consideration. There is no simple way to overcome the issue, and as a single company it is more likely to succeed through adjustment of the TCO model to suit the customer.

The educational, training and resource issues are found to be more related to the sales organisation. Within the Axis organisation it became obvious that there was a high interest in TCO in the sales organisation. However, there seems to be a lack of knowledge and supporting TCO tools. Both of these are ultimately due to a lack of resources prioritised for education and tool development. To make a thorough TCO analysis is a resource demanding process, due to the complexity and the different expertise needed. Then to be able to educate the sales people in using the model is also a time consuming process. For a company to overcome these issues, the TCO has to be given a higher priority. However, just allocating resources will not be enough, the resources also needs to be spent wisely and where it will give the highest impact for the specific company.

6.5 TCO Implications for Axis's Sales and Marketing Strategy

6.5.1 The Contributions

The TCO project has produced three outcomes that can be used by Axis for sales and marketing purposes. How these outcomes should be used in Axis´s sales and marketing strategies answers RQ 4. Since the goal of using TCO from a procurement perspective is to be able to minimize the costs, the tools should be used in cases when Axis can prove that their solutions are cheaper than the competitors (Degraeve et al., 2005). The three contributions include the mapping of cost factors, a supportive sales tool and reference system quantifications. Each of these outcomes can be used for different purposes to different customers.

6.5.2 Target Customer

The implications of TCO in the sales and marketing depend on which customer is the target. The customers are the distributors, system integrators, resellers, and the end customers. Since the direct customers, the distributers, act like finished goods warehouses, these stakeholders are not considered as a target for sales and marketing. The system integrators and the end customers are of particular importance, especially the system integrators. The motivation is that if the system integrators see the advantages of Axis's products, they will be able to convince the end customers to choose an Axis solution. This is also why Axis spends a lot of resources on, for instance, developing the products to be easy to install.

The problematic customer situation also acted as a basis for the decision to have a system approach during the project. In this way, the analysis was not bound to any of the customer types, but could be modified to fit any of them. However, a discovery during the project was that the final sales tool would most likely be used for sales and marketing towards end customers even though there are a lot of interesting usages of the tool for system integrators as well.

6.5.3 Customer Demand for TCO Data

Despite an identified need for a TCO sales tool by Axis, the general customer demand for TCO data for the surveillance solution is limited. As the competition increases and the network camera market is maturing, this is however likely to change. Especially larger customers are increasingly emphasising the notion of total cost over time. Some of the enterprise customers involved in large long-term investments have even specifically asked for the solution TCO. This is not only for competitor comparisons, but also to be able to determine the size of the designated budget. Even though the shift to a higher interest in TCO may take time, it is important that Axis is leading the change. Then Axis will already have acquired a high knowledge and experience with the TCO analyses when the competitors start replicating the same strategy.

6.5.4 The TCO Analysis Itself as a Sales Argument

In sales, trust and relationships between the sales people and the customer have been identified as a way to increase the likelihood for successful sales situations. This is true in the network based video industry, just like several other industries. A way to build trust between the customer and the sales person is to show an interest in the customer and its cost drivers. Through the TCO analysis, Axis is demonstrating the company's strong interest for its customers and its desire to understand them better. The fact that Axis is putting resources on developing this awareness is a value itself that can be used in marketing and as a sales argument. Axis can argue that they do not only have an interest in selling their products, they also have a high interest in understanding all the costs that affect the customer during the lifespan of the system. Since the interest can benefit both Axis and its customers, Axis should highlight itself as a partner to develop long-term relationships together with to find collaborative improvements with joint profitability opportunities.

6.5.5 Usage of the Cost Factor Categorisation

Even if the cost factor mapping was a step in the process to create the sales model, the categorisation also has several usages in sales and marketing. The cost categorisation basically is a way to create a common language when talking about TCO. It points out and acknowledges all cost factors, as well as puts them into a broader context. This is a way to show the customers the complexity of the costs and to challenge them about hidden costs that they may not be aware of. Just the awareness of the costs can be used a competitive advantage and it can build trust by its transparency. It is also a support to the salesman when highlighting cost saving opportunities compared to competitors and when showing improvement areas where Axis is developing its products. For instance, the support cost for system failures can drastically be reduced by the possibility of Axis being able to provide remote support. Another example is the electricity of the cameras, which in the reference systems turned out to represent a low cost. But as one sales person pointed out, it is important to include and be able to quantify the electricity costs since these are of particular importance for customers with a high environmental concern.

A key takeaway that can be used in sales situations is that the purchasing price for the cameras only represents a fraction of the cost factor hardware, which is only one out of the more than 50 cost factors. Even though the purchasing price percentage may be higher for Axis, it can be good to communicate this insight. If a customer believes that the purchasing price for the Axis product is too high compared to a competitor, a skilled sales person can convert this into an argument that there are instead several cost factors that potentially are lower, for instance system failure and installation costs.

6.5.6 Usage of the TCO Sales Tool

With the created sales tool it is possible for the sales people to create TCO sales arguments and have supporting data for it. That Axis's solutions cost less than many of the competitors over time is a strong internal belief, but it is not until supporting data exists that this can be communicated to the customer. Even if the competitors may be less costly in some of the cost factors, the sales person can choose to highlight the cost factors where Axis has a competitive advantage. This can also be supported by the comparison function. Since the result will provide the actual amount between the competitive systems, this is a message that the customer is likely to both understand and be very interested in. For example, how much they can expect to reduce the TCO by using a camera with a low failure and maintenance cost compared to another camera. Another area of use may be how much a customer can save in storage costs by using the newly launched Axis' Zipstream video compression technology.

Similar to the cost factors, the sales tool can be used to educate the customers about the various costs deriving from the solution. The education can both create trust for Axis's sales people while illustrating the advantages of an Axis system. The fact that the salesperson at Axis can provide a value to each cost factor, or at least have a method of how to calculate these costs, will be an advantage.

Some findings that have been made by using the model are presented in this report, but due to the limited scope of the project, several areas have been left unexplored. The model should be used to analyse different business scenarios where significant findings may be published as white papers. Another possible use is to provide TCO calculations as a service to the customer. The service can either be charged for or provided as a free service. Except to be of an advantage for the customer, the analyses can also be advantageous for Axis. Since the model requires data for the specific customer to be accurate, the customer has to provide data for the analysis. This data can include a lot of useful information that can be used when further improving or developing new products. This is also an opportunity to get closer relationships with the end customers.

6.5.7 Usage of the Reference Systems

The reference systems were created to show how the model can be used and to get a rough estimation of the cost distribution. The uses for the reference systems themselves are limited in the sales and marketing. It can be used as an example for the customers to gain an understanding for the concept, but will not be directly applicable to the specific customer. The only time the reference systems can be directly applied is if the customer's solution is very similar. For educational and internal marketing purposes, the reference systems have turned out useful. Especially when demonstrating the sales model for people not working within marketing and sales.

Even though not directly applicable in marketing and sales, the reference systems have provided some useful insights, as previously described. These insights can be used in sales as an indication of how much the costs are affected by certain parameter changes. However, the impact will be more accurate if the input parameters are customised to the specific customer.

6.5.8 Usages Internally at Axis

Except for the usages in sales and marketing, the cost categorisation, the sales tool and the reference systems can be used internally at Axis. Partly to the employees at Axis to learn about the cost drivers for the customers and partly for R&D. In R&D it is of high importance to know about these costs to be able to develop better products. It can be helpful during the allocation of resources. If there are specific cost factors for major customer segments that affect the TCO the most, it would be favourable strategically to spend more resources within this area.

6.5.9 Barriers to Overcome

The outcomes of the projects are useful in many ways for Axis, but there are also barriers to overcome. The major barrier is the customer attitude. The sales people need to be able to convince the customers about the superiority of a TCO approach rather than a price approach, which is an issue of education. Some customers will be very receptive, while other customers will be harder to convince. It may not even be possible to convince some customers in some markets at this time.

Another barrier, as Ellram (1994) brings up, is the resource issue. This is related to the ownership issue of this project. A TCO mind-set is not conveyed to the sales people and the customers solely through this project. The work must continue and the project ownership must be allocated to a department or a person within the organization, just as McKeen and Smith (2010) advocates for. Sufficient resources have to be allocated wisely. In particular, the sales people should be given time to really learn and adopt the TCO concept.

6.5.10 From Low-Price to Low-Cost

One of the TCO fundamentals is that price does not equal cost. This is something that should be incorporated into Axis's sales and marketing strategy. The company should differentiate between low-price providers and low-cost providers. Low-cost providers often refers to companies that compete based on low prices, but as the TCO discussion in this report makes clear, there is a distinct difference between price and cost. A low price product may not have a low cost when taking the total cost into account. Low-cost competitors should therefore be referred to as low-price competitors, whereas Axis aims to provide low-cost solutions.

Another important aspect when considering TCO is that it only takes into account the costs. As Figure 8 makes evident, the costs, or perceived sacrifices, have to be put into relation with the value that is offered.

TCO may be regarded as a mean of demonstrating hard values, but not all values can be quantified. There are several soft values such as loyalty, relationships, reliability and service that are difficult to quantify. It is therefore important to emphasise that TCO should be regarded as a complement to ordinary sales arguments, rather than replacing them.

7. CONCLUSIONS

The chapter concludes the project by stating the key findings during the project and how these are related to the initial purpose and the research questions. There is also section about the limitations. The chapter ends with suggested future actions for Axis as well as recommended further research.

7.1 Findings

Existing literature offers a range of TCO frameworks with different purposes. They provide frameworks for the TCO analysis process, how to identify cost factors and mathematical models. The concept of TCO is well established within purchasing, but the small amount of research regarding TCO analyses from a seller perspective suggests that it is not a common area of application. Only one study has been found that addresses the area.

A TCO analysis is very case specific, why generic models are not appropriate. The existing frameworks can provide some guidelines, but to be able to perform a TCO analysis for a network camera surveillance solution, a new framework has been developed, which is presented in chapter 5.6. It is based on some of the existing frameworks, but has also been influenced by the action research methodology and the experiences from the TCO analysis process of this project. The main benefit of the framework is that it provides detailed guidelines and is tailored to suit the network camera surveillance industry. Previous frameworks have been designed for other industries and have described the model development from a supply chain and purchasing perspective.

The cost factors that affect the TCO can be divided into the three main categories; total cost of acquisition, total operating costs and total decommissioning costs. Each category is in turn divided into sub groups, as specified in Table 7. The categorisation is a definition of what costs that affect the TCO of a network camera surveillance solution. If specific factors within each group are to be selected as key parameters, the meaning of key parameters must be defined. As the analysis demonstrated, there are several ways of defining key parameters. The conventional way is to define it as the parameters that represent the largest costs, but this is not advisable since the costs are very case specific. When doing a TCO analysis from a seller perspective, the company should rather emphasise the parameters that the company can influence and that differentiate a product from another. In Axis's case, these parameters include the purchasing price, the installation and configuration cost, camera dead on arrival cost, maintenance and failure cost for the cameras as well as the corresponding storage cost and VMS cost.

The rationale for doing a TCO from a seller perspective is based on the several benefits that can be gained, while some barriers must be overcome. The benefits include the understanding of the customer's value function, the documentation and demonstration of the customer's value, its use as a consultative selling tool and the discovery of joint profitability opportunities, the support of value-based pricing decisions and the improvement of communication and strengthening of relationships. In addition to this, the act of being engaged in a TCO analysis can itself be used for marketing. Three barriers that have to be overcome include educational and training issues, resource issues and cultural issues, of which the two former barriers mainly relate to the seller and the cultural issue mainly relates to the customer.

The knowledge gained through the TCO project can be used by Axis in several ways. The cost factor categorisation can be used as the company's way of defining the cost of a network camera surveillance solution. By pioneering within the area, Axis has an opportunity to create a common language and set an

industry standard for how the total cost should be measured. The fact that the company is engaged in TCO analyses shows its endeavour to understand and meet the customer needs, where the high engagement can be used as a sales argument.

The identified cost factors were implemented into a TCO sales tool that can be used to analyse and demonstrate costs and benefits. It is an effective way of calculating the TCO and can be used to benchmark and compare different solutions while highlighting cost saving opportunities. The flexible design allows it to be tailored according to each customer's given circumstances. Using the model, further analyses can be made to come up with more sales material and support the production of new white papers. The quantified reference systems showed that the TCO is very case specific, but is still favourable to be used in the context of internal education and how the model can be utilised. While there are several benefits of adopting a TCO approach, it is important to keep in mind that barriers such as customer attitude and education must be handled. The issue of resources also has to be addressed, by allowing relevant people to learn about TCO, providing access to the data needed along with the work it takes to continue the TCO effort.

A TCO analysis does not take soft values into account, and is therefore not suitable to be used in isolation. It has to be used as a complement to ordinary sales arguments. The customer demand for a TCO approach is still limited, but it is expected to grow. This is an opportunity for Axis to lead the change towards a TCO mind-set and use the knowledge to increase the company's competitive advantage. Although it will take time to change the industry landscape, this project may be used to facilitate the move away from a low-price mind-set to a pursuit of low-cost solutions.

7.2 Limitations

A system perspective with a focus on the system integrator and the end customer has been used when mapping the cost factors. Retail was selected as industry segment and only professional systems in the European and American market were considered in the study. The project findings are therefore limited to these settings, although they may be true for other settings too.

Many persons were interviewed during the data collection phase. Due to the qualitative nature of the research and the fact that most of the interviewed persons were Axis employees, the result may be biased. Another aspect is that the mapping of the cost factors was accomplished through interviews, by letting the interviewed persons give feedback on a pre-compiled list of factors and come up with new cost factors based on the list. This may have restricted their creativity, missing costs factors and considerations that may have been discovered if each interviewee was allowed to come up with a cost factor categorisation themselves. The approach to reduce these risks during the project has been to conduct many interviews.

7.3 Further Actions

7.3.1 Suggested Activities for Axis

The project has demonstrated several benefits of using TCO in sales and marketing, along with some barriers. Important contributions include the mapping of cost factors and the TCO calculation sales tool. To ensure that the results have an impact on Axis, the knowledge about TCO has to be communicated, the model has to be maintained and also further developed. To maximise the utility of the findings, an action plan with recommended actions has been developed.

This master thesis is only an initial effort in exploring the field of TCO in the camera surveillance industry. It should be regarded as a pilot project that now needs to be followed up to reap the benefits. In order to do

this, Axis should appoint a team or department responsible for the future development of the TCO concept and the TCO sales tool. Since TCO is an interdisciplinary field, the appointed responsible should be regarded as a driving force for initiating projects and gathering relevant competence, rather than to be executing the projects on its own.

One limitation of the project has been that only a few system integrators and end customers have been involved in the study, although it is their TCO that has been investigated. To make the findings gain further legitimacy, a project team comprising of an influential system integrator and an end customer should be established. In this project the contact with them was mainly through interviews, but by including them in the project team their knowledge can be utilised better. Their task is then to conduct deeper analysis and either confirm the current cost factor categorisation or complement it with new factors. Since the current project has focused on the retail segment, other segments may be included in the study. The project team may also quantify a case scenario for the end customer. By explicitly having the system integrator and the end customer included in the team, it will be possible to get access to the data required to do an accurate TCO analysis. The quantifications made in this project provide hints of what the cost distributions look like, while a thorough quantification can be used for external marketing purposes.

The developed TCO tool has to be validated by sales people in actual sales situations. The tool needs to be evaluated to ensure that it helps the sales people with finding sales arguments. To do this, they first need to be trained in the TCO concept and how the tool can be used. This is a task that preferably can be performed by the PIM team initially. The model also needs to be updated and modified depending on the feedback received and if any cost factor is considered redundant or missing. Another important task is to provide the sales team with data to be used in the TCO comparisons. One of the strengths with the model is that it provides a framework for comparing two solutions, but without reliable input data it may backfire. It is therefore suggested that competitor data is collected to be able to make valuable benchmarks. Apart from spotting strengths, areas of improvement can be identified. The efforts may be synchronised with those of the competitive intelligence team, who in addition can use the cost factor categorisation to identify future areas to investigate.

7.3.2 Recommended Further Research

An early discovery was that there is not much research conducted within the area of TCO relative its long existence. A lot of research is built on the same sources and there are several areas left unexplored. A prominent area where more research would be needed, which this thesis aims to explore, is TCO in sales and marketing. The previous research has focused on its uses and benefits, but it would be interesting to conduct further studies about existing barriers. More case studies are needed to document the effects of suggested benefits and barriers, along with how the benefits can be realised and the barriers overcome in practice.

The proposed development framework for a TCO sales tool is based on the experiences and the process of this project. More research would be necessary to verify its usefulness, for instance by applying it on other industry segments and markets. A perception throughout the project is that the concept of TCO is easier to convey in developed markets, but this has not been further investigated. It would be interesting to explore what impact the culture and the market maturity has on the use of TCO.

An objective approach has been pursued when mapping the cost factors, but there is inevitably a risk that the choice of cost factors is influenced by Axis. Further research on the cost factors by an independent institution would be favourable. Moreover, the cost factors that affect the TCO of a surveillance solution are dependent on the environment where the system operates. Different factors may be applicable for each setting and the

significance of each factor can vary between installations and industry segments. It is likely that there is a set of cost factors that affect the majority of the costs, disregard of industry segment, but since this study has focused on one particular segment no general conclusions are drawn. This could be further explored by conducting research that includes several industry segments.

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APPENDIX A – COST FACTORS

Total Cost of Acquisition

Total cost of acquisition concerns all costs that incur from the instance that a need for a network video surveillance solution has been identified until a system is fully installed and starts operating. The category has three subcategories; pre-contract costs, contract costs and deployment costs.

Pre-contract Costs

Pre-contract costs include all costs that occur before the signing of a contract.

Defining specifications is the activity of defining the video surveillance needs in terms of functionality. It is about identifying a need for video surveillance and the purpose of it. Some general considerations include determining if a camera is to be used for detection, identification or recognition. The cost for this activity is mainly the labour hours spent on the activity, either internally or by external consultants.

System design is the design of a system to meet the specified needs. This includes activities such as site survey, choice of cameras, accessories, network infrastructure, storage and software. This is usually done by consultants or integrators in collaboration with the end customer. Costs incur at each of the involved parties in terms of labour hours.

Integrator selection includes the identification of suitable integrators, the tendering process, the bidding process and ends with the selection of an integrator to be awarded with the job. The labour hours for administering the process create costs for the buyer.

Contracting is the phase of establishing the legal contract. Costs are incurred by the labour hours that are needed to prepare, negotiate and form the contract that ultimately is agreed upon and signed by the parties.

Contract Costs

Contract costs include all the one-off payments. The deployment cost is also part of the contract cost, but is treated as a separate category to highlight all of its components.

Hardware is the cost of all the hardware that is needed for the system. This includes cameras, network infrastructure, storage, accessories, user interface and power supply. In addition to the hardware that is installed, hardware costs may include backup cameras and spare parts that are put on stock.

Software is the cost of all the software that is needed for the system in terms of license fees. Common software includes a video management system (VMS), operating system software and antivirus.

Extended warranty is the cost of extending a warranty of a piece of hardware.

End customer education is the cost of training the end customer to use the surveillance system. Personnel in need of training may include the system operators, the system administrator and the IT department. The cost depends on the number of labour hours needed to conduct the training.

Freight is the cost of delivering the hardware from the distributor to the integrator or the installation site.

Deployment Costs

Deployment costs include all costs associated with the deployment of the system, from preparatory work to inspection and sign-off. This category may imply downtime.

Preparatory Work

Preparatory work may include activities such as the decommissioning of any old system, ensuring power supply, staging and burn-in. The activities depend on the conditions and the environment of each installation, for instance if it is a greenfield or a brownfield installation. Costs mainly incur as labour hours.

Installation

Hardware installation is the cost of installing the hardware. This includes the labour hours spent on physically installing cameras, network infrastructure, storage, accessories, user interface and power supply. The installation process consists of different tasks where different labour types are involved, for example camera installers and network cable installers.

Hardware configuration is the cost of configuring the installed hardware. For the cameras for instance, it may involve adjusting the zoom and focus, assigning IP addresses and configuring any camera intelligence. The cost incurs as labour hours.

Software installation and configuration includes the cost of installation, configuration and set-up of software such as the VMS. The cost consists of the labour hours spent on the activity.

Testing and validation is the cost of the labour hours spent on testing and validating the system performance to make sure that it meets the specified needs. It includes the camera system as well as the integration with any other systems.

Work tools and equipment is the cost of the tools and the equipment required for the installation. In particular, the cost of supplementary equipment such as skylift rentals is to be considered.

Inspection

Inspection is the cost of inspecting the deployment of the camera system. It includes verifying that the deployed system meets the requirements stated in the system specification and to ensure that all the commitments included in the contract have been fulfilled. Costs incur as labour hours, either internally or by external consultants.

Logistics

Material handling is the cost for transporting, storing and handling the material from the point when the system integrator receives the material until it is installed or disposed of. Waste handling is an integral part of the material handling. Costs incur as labour hours and transportation costs.

Manpower logistics is the cost of transporting the manpower to and from the installation site. It also includes the provision of accommodation and any required on-site amenities such as sheds and toilets. The cost incurs as work hours spent travelling, the transportation cost and the cost of providing necessary accommodation and amenities.

Deviations

Late deliveries is the cost caused by late deliveries of material. The costs may stem from several different sources. Some examples are the administration and the expediting of the late deliveries, personnel that cannot be utilised because of missing parts and project delay costs.

Dead on arrival is the cost of handling material that is not functioning upon arrival. The costs may incur as project delays, freight costs or increased labour hours for administration, material handling and installation work.

Rework is the cost of rework due to changed plans and previous faults. These may originate from design errors, other erroneous preparatory work and installation errors. The costs mainly incur as labour hours.

Support is the cost of getting support during the installation. The cost incurs as labour hours spent on finding and getting support as well as any fees for the support.

Work delays is the cost of work taking longer than expected. It may be due to an inexperienced installer or the encounter of unforeseen obstacles. Several different types of costs may incur as a consequence, such as additional labour hours and project delay costs.

Weather related delays is the cost of installation delays caused by the weather. The costs may be because of personnel that cannot be utilised, re-planning of work and project delays.

Overhead

Project management is the cost of administration and management of the project. The cost incurs as labour hours spent on the activity.

Documentation is the activity of documenting the project during the deployment phase. The cost incurs as the labour hours spent on documentation.

Security is the cost of extra security needs during the deployment or the security administration. There may be requirements of having a security guard accompanying the installer to access the site. Workers and the public may have to be protected, for example by having a person watch the ladder while using it. There may also be a process to get access to the site. These requirements can either be enforced by law or be company specific. The cost for security is the on-site security and the security related administration time.

Total Operating Costs

Total operating costs include the costs from the time when the system is up and running until it is no longer in service. The category has five subcategories; overhead costs, system operating costs, maintenance costs, system failure costs and redesign costs.

Overhead Costs

Overhead costs include all the operating costs of the system that neither are related to the direct operation of the system nor the costs associated with modifications, changes or reparations of the system.

Administration is the activity which includes the administration and documentation of the system, as well as invoicing costs. The cost is based on the labour hours.

Service agreement is a periodic fee that the end-user pays to the service agreement issuer. The service agreement may include maintenance, repair service, support, operating services and periodical system checks. This cost can be seen as a re-distribution of the costs and risks from the end-user to the service agreement issuer.

Licensing fees are periodic fees for software licenses, which may include VMS licenses, client software and anti-infringement software.

Insurance costs are periodic fees for insurance coverage of the system.

Training of new personnel is a cost that incurs when operators or administrators need to be trained. The training is led by current operators or administrators, but may also include the integrators. The cost is based on the labour hours spent by the instructor and the new personnel as well as the costs for external trainers, if required.

Spare parts inventory is the cost of having an inventory of spare parts. This cost is applicable to some customers that require quick access to spare parts. The inventory may be hosted by the end-user, the integrator or the distributor. The cost of spare parts inventory consists of warehousing costs and the cost of capital.

System Operating Costs

System operating costs are the continuous and direct costs that incur during the operation of the system.

Operators is the cost of having personnel monitoring the system and is dependent on the number of operators and the time spent on monitoring the system.

Electricity is the cost of the electricity used by the system. Several system components consume energy, such as the cameras, switches, hard drives, server air condition and any extra lighting.

Maintenance Costs

Maintenance costs are the periodic costs for servicing the system, when the system is fully functioning, to keep it in an acceptable condition. The repair costs are separated from this category and instead presented under the category "system failure costs". This category may imply downtime.

Camera maintenance is the periodical cost to maintain the cameras in an acceptable condition. The camera maintenance is mainly the cleaning of the dome bubble or the camera lens. Costs may incur as transportation to site, labour hours, skylift rentals, extra security and other maintenance related costs.

IT and network maintenance is the periodical cost of maintaining the IT and network in an acceptable condition. This includes both hardware and software maintenance. The maintenance is commonly conducted by the IT department and the costs are based on the time spent on this activity. It may also include regular changes of hard drives and firmware updates.

System Failure Costs

System failure costs are costs that incur when the system fails to meet the system requirements and action is required. This category may imply downtime.

Hardware failure includes all the costs that incur when the hardware in the system is not fulfilling the system requirements. For cameras, these failures can occur due to product failure, tampering, careless manual handling or external environmental factors. The consequences can be a need to replace the bubble, change of

hardware, need of recalibration or repair. For the IT and the network, failures may include hard drive failure. The costs incurred are transportation to site, labour hours, material handling, repair costs, spare parts and the freight costs.

Software failure include all the costs that incur when the software in the system is not fulfilling the system requirements. The failure can be transmitting failures or malicious attacks as well as software updates, if the update is due to a non-functioning system. The costs for software failure may be the time spent on resolving the issue, financial penalties or financial losses.

Alarm failures include false alarms as well as if the system fails to alarm. These situations may force the operator to take time monitoring the system and send out security. If the alarm does not go off when it should, there is a risk to miss the alarm situation. The alarm failures for cameras are heavily dependent on the quality of any analytics software. The costs for alarm failure are the extra time spent monitoring, the costs for sending out security or all costs associated with a missed alarm.

Support includes the costs associated with support cases when help or support is required to solve an issue. These costs are based on the resolving time for the support case and the time spent on communication with the support provider.

System Redesign Costs

System redesign costs are costs that incur when the system is operating as expected but there are new system requirements which call for changes or modifications. This category may imply downtime.

Change of surveillance objectives is the cost of moving or re-aiming cameras due to changes of where the recording is desired or other costs due to the change of surveillance objectives. The cost mainly incurs as labour hours.

Change of system size costs incur if cameras need to be added or removed to the system for any reason. The cost factors for increasing the system size are the same as the deployment costs and material costs and the cost factors for decreasing the system size are the same as the decommissioning costs.

System upgrades are made if the user requires newer software versions, often because of new features available. The cost incurs as labour hours.

Total Decommissioning Costs

Total decommissioning costs are the costs of decommissioning and disposal of the system when the system is no longer in service. This category may imply downtime.

Hardware removal is the cost of labour hours and other costs related to the removal of the system.

Site restoration is the cost of labour hours and other costs related to the restoration of the site after the system has been removed.

Residual value is the value of any hardware or its components after the system has been removed. The residual value is a revenue and not a cost, although the value may decrease by the cost of any reconditioning that may be necessary.

Recycling is the cost for recycling system components after the removal. The recycling costs may include the labour hours for the material handling, which in turn is dependent on what materials the components consist of, the number of different materials used and the component assembly methods.

Disposal is the cost for disposal of any material that cannot be recycled.

Funding

Funding concerns the cost of the capital employed by the system.

Cost of capital is the cost of tying capital to an investment. The cost is dependent on the internal rate of return of the investor.

Rental and leasing is the cost associated with the utilisation of a system without owning it.

Downtime

Downtime is the cost that derives from the surveillance system not being fully in operation. In particular, the downtime may result in lost business opportunities when a functioning surveillance system is critical to keep the business in operation. Downtime costs may incur during the installation, maintenance, repair, redesign and the decommissioning of the system.

APPENDIX B – TCO FOR REFERENCE SOLUTIONS

TCO for the small reference system

The costs for the small reference system, which consists of seven Axis cameras, can be found in Table 17.

Table 17. TCO costs for the small reference system.

Total cost of acquisition	**$6 442**
Pre-contract costs	**$200**
Define specifications internally	$50
System design	$125
Integrator selection	$-
Contracting	$25
Contract costs	**$4 761**
Hardware	$4 761
Software	$-
Extended warranty	$-
End customer education	$-
Freight	$-
Deployment costs	**$1 481**
Preparatory work	$-
Installation	$1 084
Inspection	$-
Logistics	$300
Deviations	$23
Overhead	$75
Downtime cost	$-

Total operating costs	**$8 908**
Overhead costs	**$1 380**
Administration	$700
Licencing fees	$-
Insurance costs	$-
Training of new personnel	$630
Spare parts inventory	$50
Service agreement	$-
System operating costs	**$2 636**
Operators	$2 100
Electricity	$536
Maintenance costs	**$2 319**
Camera maintenance	$1 969
Network / IT maintenance	$350
Cost for downtime during maintenance	$-
System failure costs	**$1 882**
Camera failure	$217
Other hardware failure	$1 665
Software failure	$-
Alarm failure	$-
Support	$-
Cost for downtime for system failure	$-
System redesign costs	**$692**
Change of surveillance objectives	$692
Change of system size	$-
System upgrades	$-

Total decommissioning costs	**$240**
Decommissioning costs	**$240**
Hardware removal	$120
Site restoration	$60
Residual value	$-
Recycling	$-

TOTAL TCO	**$15 591**

TCO for the medium reference system

The costs for the medium reference system, which consists of 48 Axis cameras, can be found in Table 18.

Table 18. TCO costs for the medium reference system.

Total cost of acquisition	**$67 954**
Pre-contract costs	**$350**
Define specifications internally	$100
System design	$225
Integrator selection	$-
Contracting	$25
Contract costs	**$52 308**
Hardware	$50 562
Software	$1 596
Extended warranty	$-
End customer education	$150
Freight	$-
Deployment costs	**$15 297**
Preparatory work	$-
Installation	$10 190
Inspection	$-
Logistics	$3 900
Deviations	$57
Overhead	$1 150
Downtime cost	$-

Total operating costs	**$30 430**
Overhead costs	**$3 716**
Administration	$1 960
Licencing fees	$-
Insurance costs	$-
Training of new personnel	$1 225
Spare parts inventory	$531
Service agreement	$-
System operating costs	**$6 076**
Operators	$4 200
Electricity	$1 876
Maintenance costs	$18 325
Camera maintenance	$17 625
Network / IT maintenance	$700
Cost for downtime during maintenance	$-
System failure costs	**$1 613**
Camera failure	$913
Other hardware failure	$700
Software failure	$-
Alarm failure	$-
Support	$-
Cost for downtime for system failure	$-
System redesign costs	**$700**
Change of surveillance objectives	$700
Change of system size	$-
System upgrades	$-

Total decommissioning costs	**$1 500**
Decommissioning costs	**$1 500**
Hardware removal	$1 200
Site restoration	$180
Residual value	$-
Recycling	$-

TOTAL TCO	**$99 884**

APPENDIX C – INTERVIEWED PEOPLE

Axis

Title	Department	Date
Manager	Product Introduction Management	2015-03-16*
Product Introduction Manager	Product Introduction Management	2015-03-16*
Product Introduction Manager	Product Introduction Management	2015-03-16*
Technical Launch Manager	Product Introduction Management	2015-03-16*
Product Manager, fixed cameras	Product Management	2015-03-17
Product Manager, accessories	Product Management	2015-03-19
Product Manager, VMS	Solution Management	2015-03-16
Manager	Product Specialists	2015-03-18
Product Specialist	Product Specialists	8 occasions
Product Specialist	Software Solutions	2015-05-05
Product Specialist	Software Solutions	2015-05-05
Expert Engineer	Core Technologies	2015-03-30
Manager	Product & Solution Marketing	2 occasions
Product Marketing Manager	Product & Solution Marketing	2 occasions
Manager	Global Sales Engineers	2015-03-23
Global Sales Engineer	Global Sales Engineers	2015-03-26
Global Sales Engineer	Global Sales Engineers	2015-03-26
Sales Engineer	Sales Engineering and Training	2015-03-25
Manager	Regional Sales, South America	2015-04-02
Manager	Regional Sales, Russia	2015-04-20
Key Account Manager	Sales, North & Central America	2 occasions
Key Account Manager	Field Sales, Northern Europe	2 occasions
Key Account Manager	Field Sales, Northern Europe	2015-03-26
Product Analyst	Field Sales, Middle Europe	3 occasions
Distribution Manager	Distribution & Inside Sales	2015-03-23
Manager	Global Sales Operations	2015-03-24
Service Manager	Global Technical Services	2015-03-04
Tools Manager Technical Service Tools	Global Technical Services	2015-03-19
Product Analyst	Technical Services, North & Central America	2 occasions
Quality Manager	CLC Quality Control	2015-03-26
Sourcing Manager	Sourcing	2015-03-26
Manager	Competitive Intelligence	2015-03-25
Director	System & Services	2015-04-10
Deputy Director	System & Services	2 occasions
Director	Global Partners & Business Development	2015-03-24
Partner Program Manager	Programs & Partner Marketing	2 occasions
Senior Consultant	Global Consultants	2 occasions

** Brainstorming session*

Partners

Title	Partner Type	Date
Product Manager / Solution Manager	System Integrator A, global company	2015-04-08
Head Solution & Service Portfolio	System Integrator B, global company	2015-04-28
Security Manager	End Customer, Nordic retail chain	2015-04-16

APPENDIX D – TCO SALES TOOL

The developed TCO sales tool consists of three sections. The first section consists of result sheets, where the result is presented in both numerical and graphical ways. Screenshots from two result pages can be found in Figure 26. The second section consists of the input sheets, where there are different sheets for general input parameters and system specific parameters. Figure 27 shows a screenshot from the general parameter input sheet, while Figure 28 shows two screenshots from the system specific input pages. All the values and the results in the screenshots are made up and not related to any real values.

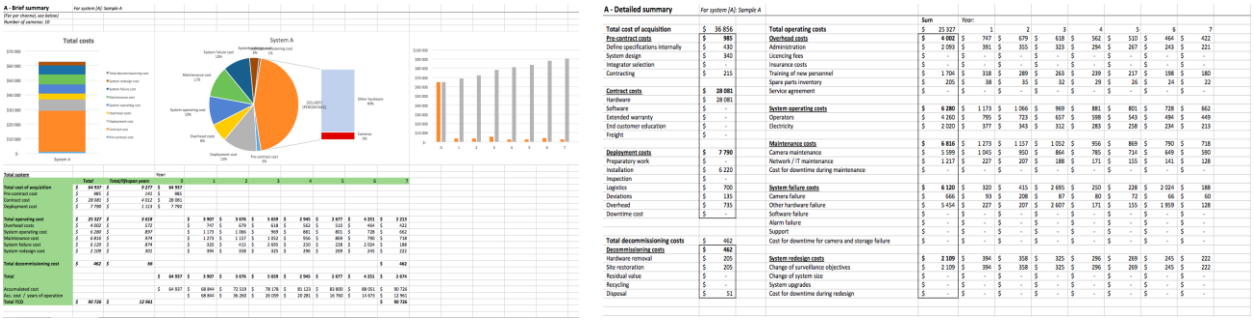

Figure 26. Screenshots from two of the result sheets.

General parameters

Highlight key parameters?	No
Lifespan A: Sample A (years)	7
Lifespan B: Sample B (years)	6
Number of sites	5
Cost of capital / internal interest rate (%)	10%
System operating days / week	7
System operating hours / day	24
Time to site, each way (h)	1
Work hours / day	8
Skylift cost / day	$ 150
Electricity cost per kWh	$ 0,13

Salary parameters	Cost per hour
Infrastructure installer	$ 40
Camera installer	$ 20
Network and storage configurator	$ 50
Project manager	$ 40
Operator	$ 35
Consultant	$ 34

Figure 27. Screenshot from the general input parameters sheet.

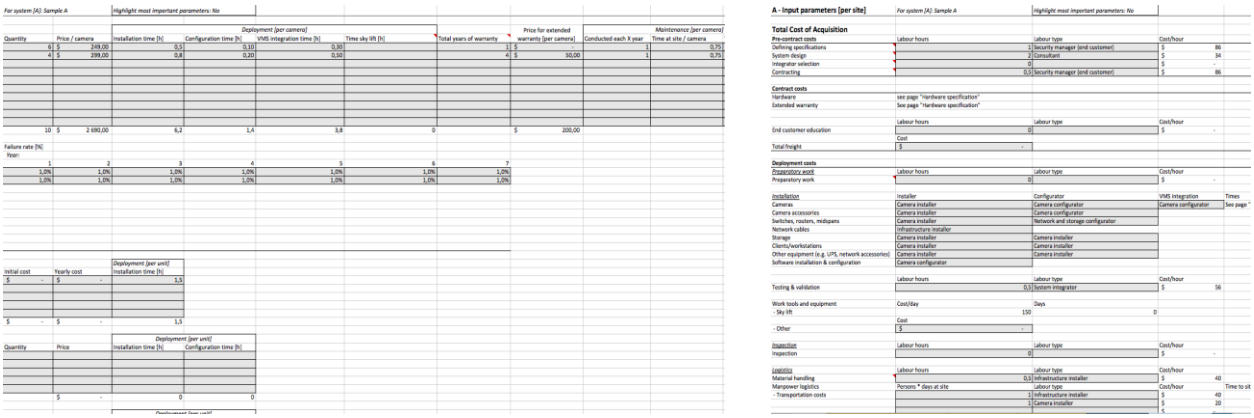

Figure 28. Screenshots from two of the system specific input sheets.