The customer service in Philips Cardio/Vascular Unit
modeling and improvement strategies for the current process

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The customer service in Philips Cardio/Vascular Unit: modeling and improvement strategies for the current process

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PREFACE

This master project concludes my study in Operations Management & Logistics at the Eindhoven University of Technology. This project was carried out in Philips Healthcare, specifically in the Cardio/Vascular business unit.

During the last two years, this master study has provided me with priceless experiences not only in the academic but also in the personal environment. Working and living with people from different cultural background but with a common objective have showed me the importance of respecting and tolerating cultures different than my own culture.

This work would not be possible without the support from several people. First, I would like to thank Professor Ton Weijters for his wise recommendations to stay focused on my topic and avoid tasks that did not contribute to the final outcome. I would like to thank Dennis de Haas who has guided me throughout this project. His practical way to face daily business issues joined with his constant enthusiasm have been fundamental during my time in Philips. My gratitude is also expressed to Professor Yuan Lu for her encouragement and concern that my internship time will be challenging as well as pleasant. I would also like to thank to Renate de Bruin for the endless meetings to interchange ideas and opinions when only problems were surroundings this project. I would also like to express my gratitude to Nol van Grinsven, Frank Spronck, Gerard Engelen, Adnan Unlu, Dominique Vanhee and the people from the Helpdesk: John Hameleers, Otto Klaasen, Peter Roesink, Ton van den Heuvel, Andre Vermeulen, Piet Heijboer, Eize van der Vegt, and Edwin Hoogendam. To all of you: *"Dank jullie wel voor alles"*.

The daily support from my family both in Peru and Dominican Republic has played a fundamental role in this journey. To my parents: Aparicio and Nelly and sisters: Ketty and Candy as well as my parents-in-law: Jose y Maritza, I just want to say: *"Muchas gracias por todo y que Dios los bendiga siempre"*. Finally, I reserved a special place to my soul-mate and wife: Heidi. It has been seven years since we met and felt in love, after that, everything has been different. This work is especially dedicated to you for your motivation, love, encouragement, and care that you provide me every day.

Anthony Veneros Castro
August, 2009

EXECUTIVE SUMMARY

Research Outline

Consumer products are now more complex than ever (Den Ouden, 2006) and healthcare products are probably one of the best examples because they must not only satisfy the costumer, who is now less tolerant to quality issues, but also comply with government agencies that regulate the healthcare market. This situation has caused as a consequence that processes that handle these products are also becoming more complex.

Philips Cardio/Vascular business unit looks like this scenario. A cardio/vascular (C/V) product is complex per nature and probably less can be done to change this figure. However, the processes that guide this product can be improved or at least some enhancement propositions can be suggested. After spending some time inside the customer service process of Philips C/V, a number of matters observed can be mentioned.

- The feedback process in Philips Cardio/Vascular is a vast and complicated one. Feedback information can be obtained internally (when the C/V system is manufactured), but it can also be obtained remotely (when the C/V system has already been installed) using Philips' Remote Service Network (RSN), or directly when the Flying Quality Squad (FQS) visits the hospital. Information is also coming through via call centers and Helpdesks that are distributed worldwide.
- The inherent complexity that surrounds cardio/vascular systems has made that the process used to manage the customer service has also become complicated. Figuring out the complete operation of the customer service is a task that demands weeks because the workflow is divided in several units and areas that at first glance seem not connected to each other.
- The action plans created by the help desk to solve technical issues that occurred in the field are rarely validated (i.e. no feedback is received). This situation has provoked that the amount of explicit knowledge generated and stored in knowledge management systems has not grown steadily in the last few years.

To provide answers to the above described problems, two research questions were formulated and investigated in this master project.

1. *What is the current customer service process in Philips Cardio/Vascular Unit?*
2. *How can best practices in business process redesign and knowledge management theories be used to generate strategies in order to improve the current process as well as the amount of validated knowledge in the feedback process?*

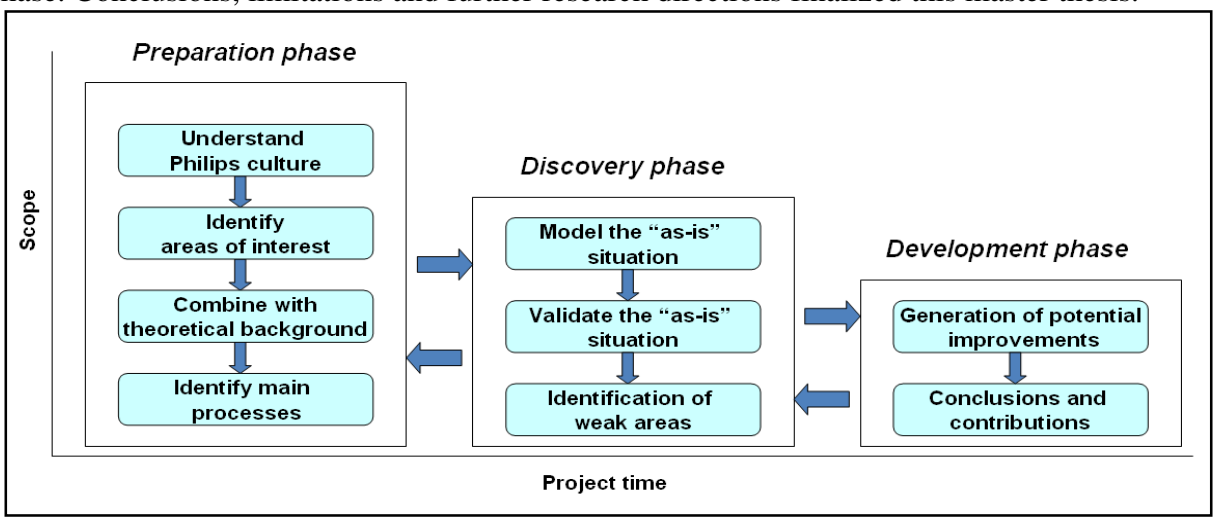
Methodology

To answer the research questions, the following methodology was proposed (See figure below). It is divided in three main phases: *preparation, discovery and development*. The preparation phase gave us a deep understanding of the Philips culture. It also allowed us to identify areas in the customer service where a further combination of theoretical background and practical experience can provide strategies to improve the current process. This phase finalized with the identification of the main processes inside the area of interest.

The discovery phase started with the modeling of the "as-is" situation for the main processes identified in the previous phase. A validation stage was made using an expert opinion and walkthrough case scenario techniques. This phase ended with the identification of weak areas within the processes modeled.

Finally, the development phases provided a number of strategies generated using "best practices" in business process redesign and knowledge management theories such as knowledge integration

and knowledge generation in order to tackle the issues presented at the end of the discovery phase. Conclusions, limitations and further research directions finalized this master thesis.



Results

The two main questions formulated at the beginning of this master project are revisited here the addition of their main results.

1. *What is the current customer service process in Philips Cardio/Vascular Unit?*
   The "as-is" model for each process (call handling, technical escalation, and complaint handling) was made with more details for the call handling and technical escalation process. Given the time restriction of this project, it was decided to focus on the most common process in the customer service which is the call handling. A knowledge flow map was prepared for this process to know how and where the information sources are used.
2. *How can best practices in business process redesign and knowledge management theories be used to improve the current customer service in Philips Cardio/Vascular Unit?*
   The modeling of the current customer service process and the knowledge acquired during the time spent in Philips Healthcare were the starting point to identify weak areas that can be improved using best practices in the business process redesign and knowledge management theories.
   Areas such as ordering of spare parts, call case routing, feedback information loop, handover policies, and application redundancy are identified. After that, a number of theoretical improvement strategies are developed to tackle these issues.
   Two redesign scenarios are proposed. One to enhance the process of ordering spare parts using best practices such as "task composition" and "technology integration" and the other to promote the quick and efficient respond in critical situations (e.g. the C/V system is down) using practices such as "task automation" and "contact reduction". These redesigns are complemented with one overall strategy to improve the feedback information process.
   This strategy proposes how to close the feedback information loop, a case handover policy with the addition of a new feature called *"Report tab"*, and an explanation of the current application redundancy. Its correct implementation will provide the foundations of a new feedback information process where action plans used to solve customer requests will be validated in the field and propelled into only one application (Clarify CRM) which will be armed with a knowledge database and analytic tools to generate further knowledge.

CONTENTS

LIST OF FIGURES

LIST OF TABLES

GLOSSARY

- ACD - Automation Call Distributors
- BPR - Business Process Redesign
- CFS - Customer Feedback System
- CRM - Customer Relationship Management
- C/V - Cardio/Vascular
- EECN - EMEA Customer Care Network
- EMEA - Europe, Middle East and Africa
- EMR - Electronic Maintenance Record
- e-SPF - Electronic Spare Part Finder
- FCO - Field Change Order
- FPR - Field Problem Report
- FQS - Flying Quality Squad
- FSE - Field Service Engineer
- HCS - Healthcare Call tracking System
- IPC - Interventional Patient Care
- MCR - Multi Country Region
- PMG - Program Management Group
- PMSR - Philips Medical System Response
- QMCB - Quality Maintenance Control Board
- RSC - Remote Support Center
- RSN - Remote Service Network
- SSD - Sale & Service District
- VIPER - Visual Philips Escalation Resolution
- WIP - Work In Process
- WOMPA - Work Order Management & Performance Assurance
- XML - Extensible Markup Language
- ZTS - Zone Technical Specialist

1. INTRODUCTION

In this chapter the problem description is given. Then, the research question and the approach used are mentioned. The deliverables of this project and the report outline finalize this chapter.

1.1. Problem Description

Consumer products are now more complex than ever (Den Ouden, 2006) and healthcare products are probably one of the best examples because they must not only satisfy the costumer, who is now less tolerant to quality issues, but also comply with government agencies that regulate the healthcare market. This situation has caused as a consequence that processes that handle these products are also becoming more complex.

This "complex product-process" scenario has brought some consequences to companies. Employees are now only focused on the part of the process that they are working on; interest is no longer shown in identifying, evaluating, and tackling problems that occurs outside of their confidence zone, even though these can be the key to their current issues. Another consequence is that the amount of information generated about the product, consumer, and process's feedback has exponentially increased. With the addition of Customer Relationship Management (CRM), Enterprise Resource Planning (ERP), and Product Life Cycle Management (PLCM) applications to the work environment, capturing feedback information is not longer the critical issue; the matter is to provide accurate information to the right position at the right time.

Philips Cardio/Vascular business unit resembles this scenario. A cardio/vascular (C/V) product is complex per nature and probably less can be done to change this figure. However, the processes that guide this product can be improved or at least some enhancement propositions can be suggested. During October to December of 2008, several visits and interviews were performed by members of the Data Fusion Project, which objective is to develop an information system to convert relevant but incoherent field feedback data into valuable decision support information, to understand the feedback process inside Philips Cardio/Vascular business unit.

Some of the matters observed during these visits are mentioned as follows. First, the feedback process in Philips Cardio/Vascular is a vast and complicated one. Feedback information can be obtained internally (when the C/V system is manufactured), but it can also be obtained remotely (when the C/V system has already been installed) using Philips' Remote Service Network (RSN), or directly when the Flying Quality Squad (FQS) visits the hospital. Information is also coming through via call centers and Helpdesks that are distributed worldwide.

Second, the inherent complexity that surrounds a cardio/vascular system has made that the process used to manage the customer service has also become complicated. Figuring out the complete operation of the customer service is a task that demands weeks because the workflow is divided in several units and areas that at first glance seem not connected to each other. At the moment, it is not possible to get a good understanding of the overall customer service in a single picture.

Finally, the action plans created by the help desk to solve technical issues that occurred in the field are rarely validated (i.e. no feedback is received). This situation has created an open loop in the feedback process which has brought as a consequence that the amount of explicit knowledge generated and stored in knowledge management systems has not grown steadily in the last few years.

1.2. Research Question

This project has two main objectives. The first one is oriented to tackle the lack of an overall picture or blueprint where the customer service process can be easily understood. Thus, the first objective is defined as follows.

- Model the current process of the customer service in Philips Cardio/Vascular unit in order to know the actors, stakeholders, applications and sources of information that are involved in this process.

The second one is meant to increase the amount of valid knowledge that can be captured when an action plan for a technical issue is generated. Hence, the second objective is stated as follows.

- Provide strategies that can increase the amount of explicit knowledge generated during the feedback process.

This project is focused primarily in the call center as well as the help desk service because they are, firstly, the most common source used in the customer service and, secondly, the others sources are related in one way or another to them. For instance, to analyze a problem reported by a customer, a log file obtained through the RSN service is analyzed by a field service engineer (FSE) who is part of the help desk service.

Based on the objectives of this project, two general research questions are stated as follows.

3. **What is the current customer service process in Philips Cardio/Vascular Unit?**
4. **How can best practices in business process redesign and knowledge management theories be used to generate strategies in order to improve the current process as well as the amount of validated knowledge in the feedback process?**

1.3. Research Approach

The approach of this project is based on *the conceptual project design* developed by Verschuren and Doorewaard (Van Aken et al., 2007) that addresses a business problem using four elements: 1) The subject of the analysis; 2) Theoretical perspectives applied in the analysis; 3) A confrontation between theoretical perspectives and the subject of analysis; and 4) The deliverables of the project. In other words, the mixture of recognized academic literature, the information and data available on the business processes result in a final definition of the business problem and potential solutions or action plans. The relationship between these four elements applied to the Philips C/V environment is shown in Figure 1.

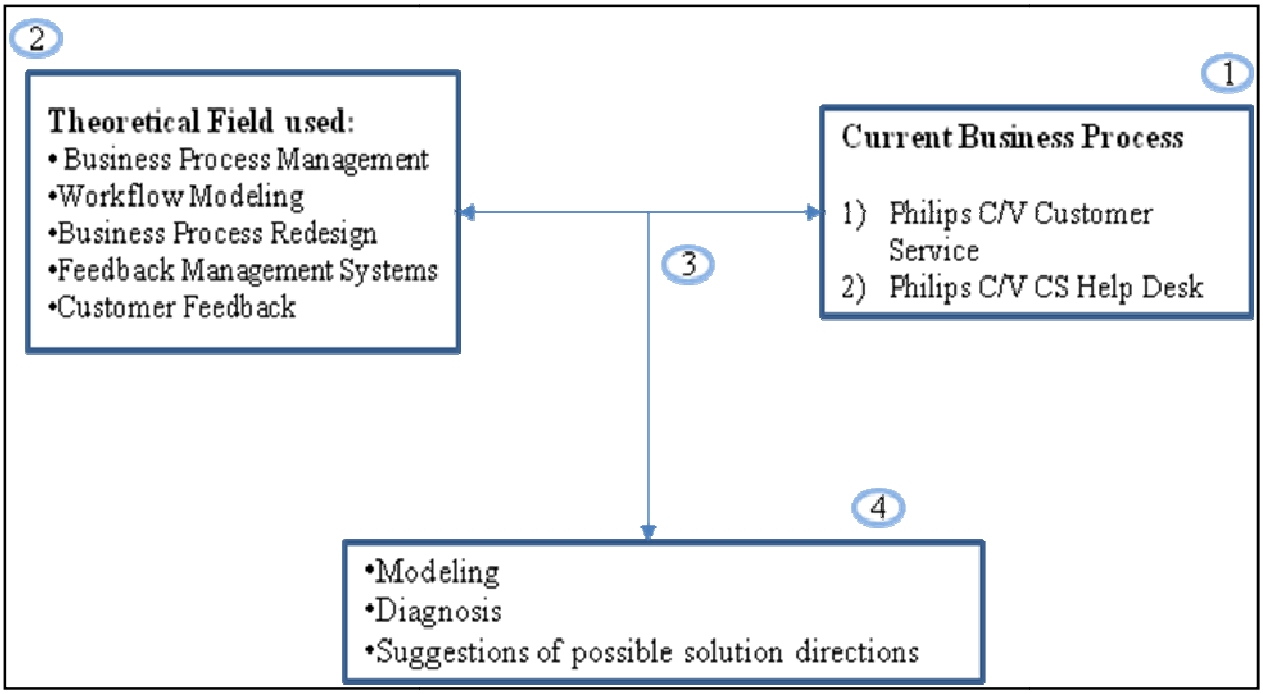


Figure 1 Conceptual approach used in this project

Based on this model, the project approach is divided as follows.

- Literature Review

It has been stated that a sound business problem solving (BPS) project must fulfill a set of quality criteria (Van Aken et al., 2007). One of these is that project must be theory-based which means that state-of-art knowledge and latest techniques has to be used to deal with the business problem. In order to accomplish this requirement a literature search is performed to find out the most recent works and/or studies in the fields specified in Figure 1. Moreover, this literature search allows to identify similar studies (if any) to avoid re-inventing the wheel. Finally, during the duration of this project, additional literature may be required on specific topics in order to justify some assumptions and decisions.

- Process Modeling and Validation

The modeling of the customer service process in Philips C/V is as follows. First, a high level process model also called *handoff model* (Sharp & McDermott, 2001) is obtained through personal interviews, documentation, and observation in the field. Then, a verification and validation process is executed to make sure that the modeled process replicates the reality and only the steps that are crucial are included. After that, a second model also called *flow level diagram* is developed where the details neglected in the first model are included. Those can be used to know decisions that affect the process in a significant way or discover loops where the information is delayed. This model also requires a verification and validation for the actors that actually perform these tasks. If it is required a third modeling layer called *task level diagram* will be used.

To assess the model obtained in this stage, a number of cases will be selected to track them down from the beginning of the process until their solution.

- Identification of areas for potential improvement

The models generated in the process modeling phase will be used here to identify areas or sub-processes that can be improved. The search of potential areas of improvement will follow two directions: the first one is oriented to the workflow of the process; this means daily activities that can enhance the process performance, for instance, the use of additional resources in the call center during peak hours or two resources working simultaneously in one case to speed up the throughput time. The second one is directed to look for enhancement opportunities in the feedback information process; that is identifying areas where strategies can augment the amount of explicit knowledge generated or information tools that can boost the current feedback process, for instance, expanding the current use of the Customer Relationship Management (CRM) system in order to provide knowledge database capability.

- Applying strategies to improve the current process

This section will provide a number of strategies generated in order to tackle the issues mentioned in the identification phase. They will be created using a balanced combination of grounded theories as well as practical experience obtained during the internship period. These strategies will remain at theoretical level. Finally, recommendations, conclusions, and further research directions are provided.

1.4. Project Deliverables

The deliverables of this project have divided in two phases. They are as follows.

Phase 1:

- A description of the "AS –IS" process model of the customer service in Philips C/V Unit. Special attention is given to the call handling process and escalation process.
- Information model that illustrates what kind of information is used in the process and the applications used to manage and store it.
- Validation of the model with some examples that follow the lifetime of some customer service request cases.

Phase 2:

- Identification of areas or sub-processes that can be enhanced.
- Application of strategies that can improve the issues identified.

1.5. Report Outline

The rest of this report is organized as follows. Chapter 2 provides a description of the environment where this research took place as well as the market where the modeling was done. Chapter 3 presents findings obtained from the literature review that are used to comprehend better our problem. Chapter 4 gives the complete modeling of the customer service. Chapter 5 is devoted to validate the model generated in the previous chapter. Chapter 6 specifies a number of the issues detected in the current customer service. Chapter 7 gives strategies to tackle these issues. Finally, Chapter 8 provides an overall conclusion, limitations and proposals for further research.

2. BUSINESS UNDERSTANDING

In this chapter, a brief description of the company where this research has taken place is given. Then, the attention is moved to the business unit under study. The customer service process is also explained. Finally, the market used for the modeling process is described.

2.1. Philips Electronics

Royal Philips Electronics Inc. is a global leader in healthcare, lighting and consumer lifestyle, delivering people-centric, innovative products, services and solutions. With approximately 121,100 employees in more than 60 countries worldwide, Philips reported sales of €26 billion in 2008 [33]. It is the market leader in medical diagnostic imaging and patient monitoring systems. Philips is organized around four business divisions (see Figure 2):

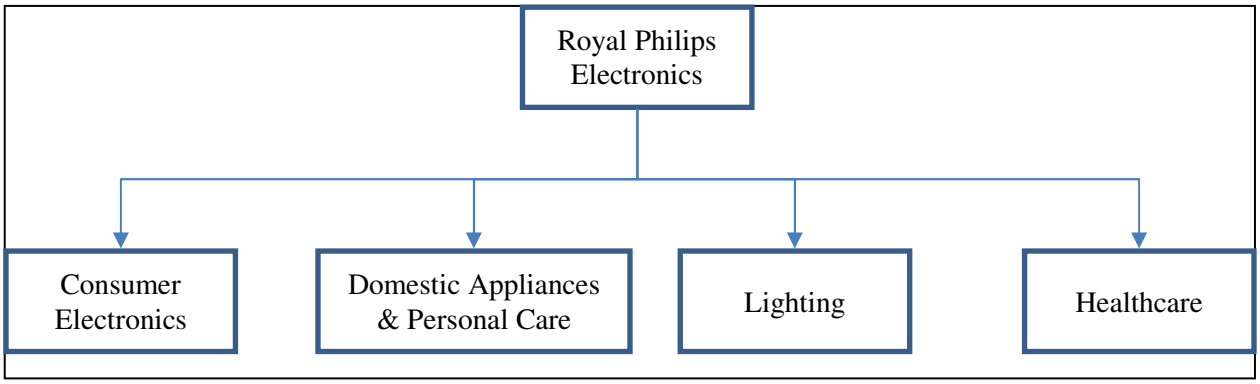


Figure 2 Royal Philips Electronics

- Philips Consumer Electronics is the third largest consumer electronics company in the world and a leader in the development of digital television systems and compact disc applications.
- Philips Domestic Appliances & Personal Care (DAP) includes the Male Shaving and Grooming, Body & Beauty, Food & Beverage, Home Environment Care and Oral Healthcare lines of business. The division manufactures and markets shavers, electric toothbrushes, women's beauty and health care products, as well as domestic appliances around the world.
- Philips Lighting Company is the world's largest lighting producer, manufacturer and marketer of products for industrial, commercial and consumer markets.
- Philips Healthcare, a global leader in the growing medical device and diagnostic industry, is committed to providing innovative technology and services that enable health care providers to achieve clinical excellence.

2.2. Philips Cardio / Vascular X-Ray Business Unit

The Cardio/Vascular (C/V) X-ray is one of the most important business units that composed Philips Imaging Systems which is at the same time part of Philips Healthcare (See Appendix 1). This business unit is responsible for the developing, manufacturing and delivering different kinds of cardio/vascular systems (See Appendix 2) such as Allura Xper F20 and its total revenue in 2008 was approximately € 864 millions [34]. In the cardio/vascular X-ray can be distinguished five different clinical segments that these products are aimed to:

- *Interventional Cardiology* that refers to diagnostics and non-surgical treatments of the heart. Cardiac interventions are used to treat coronary artery disease, valvular heart disease and congenital heart disease.
- *Interventional Radiology* which is a radiological sub-discipline that provides minimally invasive treatments performed under image guidance.
- *Interventional Neuro-Radiology* that is a minimally invasive approach in the treatment of vascular diseases of the brain and spine.
- *Pediatric Cardiology* that refers to diagnostics and non-surgical treatments of children with heart problems
- *Electrophysiology* refers to cardiac electrophysiology, the study, diagnosis, and treatment of irregular heart contractions or arrhythmias.

Zone	Key Markets	Sub-Markets	Countries			
North America	United States					
Emerging Market			Russia	India	China	Brazil
International	Adria		Italy			
	Benelux		Belgium	Netherlands	Luxemburg	
	DACH		Germany	Austria	Switzerland	
	France		France			
	Greater China		China			
	Iberia		Spain Portugal			
	Japan		Japan			
	MCR Asia		Korea	India	Australia	New Zealand
		ASEAN	Singapore	Thailand	Malaysia	
		VIPP	Vietnam	Indonesia	Philippines	Pakistan
	MCR EMEA	Middle East North Africa Ukraine East Europe				
	MCR LATAM	Andino	Venezuela	Colombia	Peru	Ecuador
		Brazil				
		North LATAM	Mexico	Puerto Rico		
		South LATAM	Argentina	Uruguay	Chile	Paraguay
	UK & Ireland		United Kingdom	Ireland		

Table 1 Philips Customer Service Distribution

2.3. Philips Healthcare Customer Service

At this point is important to give the reader a clear idea about how Philips Healthcare has designed its customer service. Philips Healthcare has divided its worldwide customer market in three main zones: North America, International and Emerging Market. North America's zone has only one key market: the United States which is at the same time the most important one for Philips Healthcare because it is accountable for almost 50 % of the current healthcare operations. The International zone is divided in 11 key markets (see Table 1) that cover Europe, Asia, Africa and Latin America. The Emerging market is the third zone and is a group of countries that

Philips Healthcare has identified as potential markets that can increase Philips market share in the future.

Each key market has its own customer service organization that attends customer's questions and requests. Before this explanation goes on, it is necessary to delimitate the term "customer service" in the context of this project. Costumer service in Philips Healthcare, in a broad sense, is a concept that contains an array of human, hardware and software resources that support the daily operations of its healthcare systems. However, in this project, the term "customer service" is used in a narrow sense and is related to the process that starts when a Philips' product-related issue is reported by its final user (technicians or medical operators) via email, phone call or written communication to the Philips' call center until it is solved by a Philips' technical specialist on-site or remotely.

The customer service of a key market within Philips Healthcare is built around three tiers that handle the customer service request. Tier 1 is a local customer service that handles mainly requests that do not require high degree of specialization and knowledge. If the request is not solved in this tier, it is handed over Tier 2 which is a regional customer service that is on charge of several local customer services and its personal has a deeper and specialized knowledge to solve more complex problems. If the request cannot be solved at this level, it is handed over to Tier 3 which is the global customer service where technical personnel specialized in the main components of any kind of C/V system are available.

Each tier is, at the same time, divided by modalities (See Appendix 1). A modality is an specialization area inside Philips Healthcare, for example Cardio/Vascular(C/V) modality develops X-ray systems to obtain images from the heart (Cardio) as well as from the veins (Vascular) or Computer Tomography modality that generates a three-dimensional image of the inside of an object from a series of two dimension images. The focus of this project is the customer service in the Cardio/Vascular area in the Benelux market

2.4. Customer Service Communication Channels

In the customer service three main channels that handle customer issues related to Philips Cardio/Vascular systems are identified (see Figure 3). The *call handling process* is the first one. This process starts when a customer calls the call centre and reports a product-related issue such as system down, system malfunctioning, software bug, mechanical problems, etc. Sometimes also non-product related issues such as maintenance contract renewal or upgrade bundles for the system are received by this channel.

The second way to report a Cardio/Vascular product-related issue is technical escalation which is a request made by the key market management to solve a difficult or a persistent product-related problem that after some trials have not been solved by the local technical personnel. Examples of technical escalation are: persistent technical issue that has increased customer anxiety, potential security breach such as virus, hackers and worms.

Product complaint is the third way to manage customer issues. It is a written, electronic or oral communication that claims deficiencies related to the quality, safety, reliability or performance of a Philips system after it is released. A failure of the system to perform based on its specifications, allegations that the system's failure rate is greater than the customer's expectations are examples of potential customer complaints.

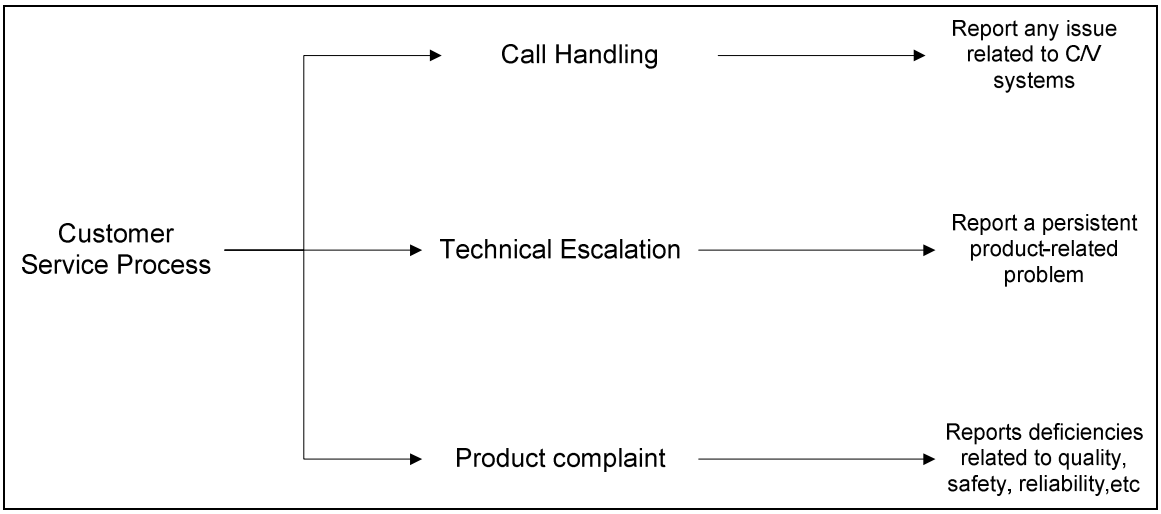


Figure 3 Channels used in the customer service

Of the three processes described, the call handling process is the most common and the one that used most resources (e.g. manpower, hardware, software, etc.). The other two processes are less recurrent but when they appeared consume more time and resources than a normal call handling case. Sometimes, technical escalation and product complaint are confused especially if one is outside of the process.

The following is an explanation of the differences between both processes. Technical escalation as well as product compliant deal with complex and resisted problems but two main differences can be distinguished: first, technical escalation is normally originated in the key market by field service engineers (FSE) or managers after a resisted problem has elevated tension between the local management and the customer. Product complaint, on the other hand, can be initiated at any moment as long as an issue is found. It can be reported not only for the key market but also for any member of Philips including manufacturing personnel. Second, while product complaint actually might require the participation of development in the solution of the issue, technical escalation can go as far as Tier 3 in the customer service process. If further support is required (i.e. development participation), this technical escalation must become first a product complaint.

2.5. The Benelux Key Market

In this master project, the focus is the Cardio/Vascular customer service with its three tiers. The key market selected is the Benelux market because it is reachable for the author and Tier 3, which is the worldwide Helpdesk service, is also located in this area, specifically in Best, The Netherlands.

The Benelux market is formed of three countries: Belgium, The Netherlands and Luxemburg. Tier 1 is located in Eindhoven and has four call takers; two of them are for the Netherlands and two for Belgium and Luxemburg. This separation is because of language, Dutch for The Netherlands and French, Dutch and Flemish for Belgium and Luxemburg. Tier 2 or Remote Support Center (RSC) is located in two different locations. One is situated in Eindhoven for the requests that come from the Netherlands and the other is located in Brussels for the requests from Belgium and Luxemburg. Figure 4 gives a graphical representation of the Benelux market.

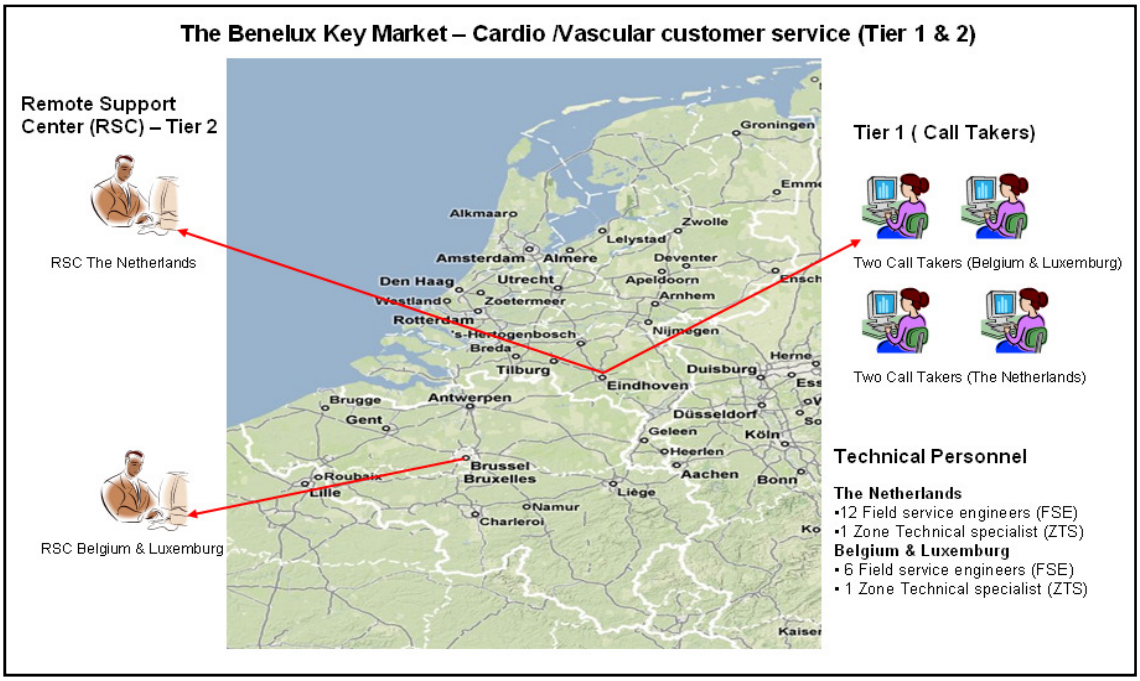


Figure 4 the Benelux Key Market

Field service engineers (FSEs) are important members of the customer service. They belong to Tier 1 and are technical employees trained by Philips to perform tasks such as: new system installations, field change orders and preventive and corrective maintenance. In the Netherlands, there are twelve field service engineers dedicated exclusively to deal with Cardio/Vascular systems. In addition there is one zone technical specialist (ZTS) who has more experience and provides support to the tasks of the field service engineers. In the Belgian and Luxembourg market, there are 6 field service engineers but some of them are the so called "multi-modality" engineers who have experience and knowledge in different types of system. For example, an engineer that knows about Cardio/Vascular systems can at the same time have some experience with X-ray systems. This normally happens in markets where the number of installed systems is not numerous, and having dedicated engineers would result in the under utilization of technical resources.

3. LITERATURE REVIEW

In this chapter a number of relevant concepts obtained from the literature are presented. The objective of this literature review is two-fold. First, to provide the required theoretical background that can help the reader understand better the remaining document. And, second, to identify well-grounded theories that can support the approach used in this master project to tackle the problem described. The following subjects are considered for this master project:

- Business Process Modeling
- Customer Feedback Systems
- Business Process Redesign
- Knowledge Generation & Integration

3.1. Business Process Modeling

Business process modeling refers to the actual representation of the business process in terms of a business process model using a process language (Weske et al., 2004). A business process is a collection of related, structured activities or tasks that produce a specific service or product (serve a particular goal) for a particular customer or customers. The "As-is" process, on the other hand, is an abbreviation of the situation "as it is" at the moment of a research is conducted. It is normally the starting point for the Business process management (BPM) life-cycle.

Two aspects must be kept on mind when a process needs to be modeled. The first one is the selection of modeling language and the other is the approach used to capture that process because both will have further implications if the model wants to be implemented.

3.1.1. Selection of the modeling language

Aguilar-Saven (2004) developed a complete guide that allows any user to select the modeling technique that best fits his requirements or needs. The author created a classification framework using two parameters: change permissiveness and model purpose. The purpose of the model is divided into four main categories:

1. Descriptive models for learning
2. Descriptive and analytical models for decision support to process development and design
3. Enactable or analytical models for decision support during process execution, and control
4. Enactment support models to Information Technology

Change permissiveness, on the other hand, classified process modeling techniques in two areas: passive techniques which mean that they do not have the capability to allow the user to interact with, or change them without totally remodeling the process and active techniques that allow user to make changes (e.g. simulation models). The modeling language classification based on these two parameters is shown in Figure 5.

3.1.2. Modeling Methodology

The other aspect is the methodology used to capture any process in detail. Law and Kelton (1999) proposed one approach to that consists of 4 steps:

1. Conversations with the subject experts
2. Observation of the system
3. Interact with the manager, if possible on regular basis
4. Perform a structured walk-through of the conceptual model

Sharp and McDermott (2001), on the other hand, proposed an approach not only to capture the "as-is" model but also to make an overall business process redesign. Their approach consists of 4 main steps:

1. Frame the process
   - Identify a set of related processes, including the target process to be improved
   - Establish the scope of the target process
2. Understand as-is process
   - Map the current process workflow
   - Develop swimlane diagrams
   - Use progressive levels of detail, stopping when process behavior is understood
3. Design to-be process
   - Characterize the to-be process
   - Design the to-be process workflow
4. Develop use cases
   - Identify use case scenarios
   - Develop individual use case scenarios

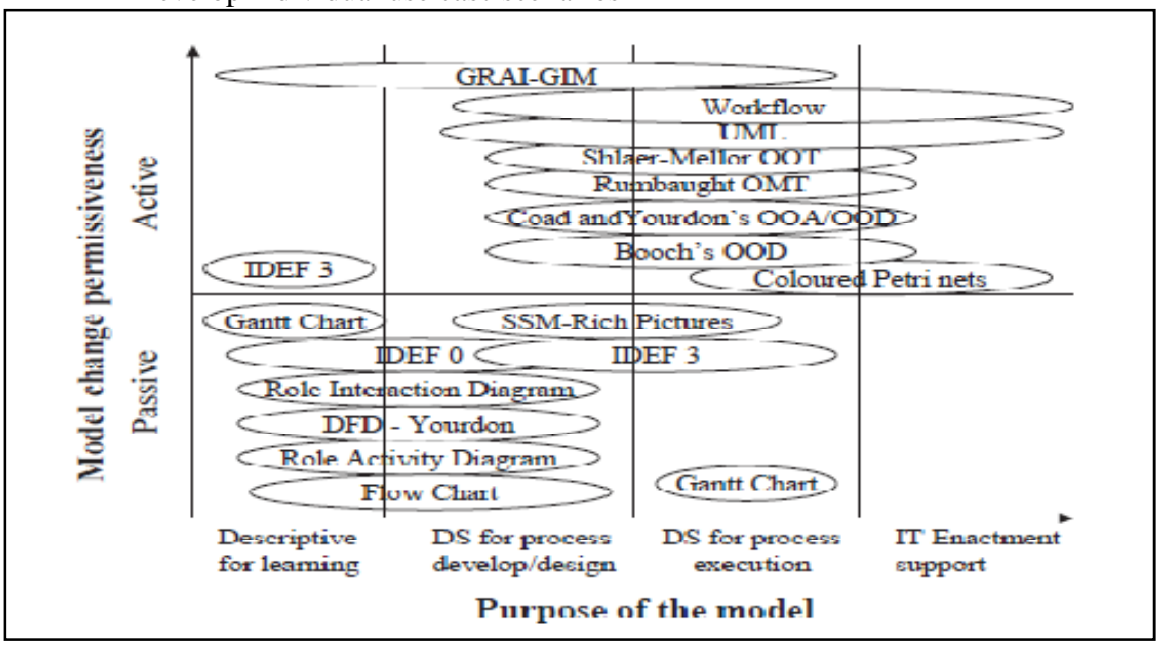


Figure 5 Modeling Techniques Classification

3.2. Customer Feedback Systems

In this section the customer feedback systems (CFS) are discussed. They have been a recurrent topic of research (Funding and Bergman, 2003; Petkova, 2003; Den Ouden, 2006; Petkova et al., 2006; Swami, 2006; van Doesburg, 2008) in the last few years. Reducing development times and increasing product reliability through the rapid discovery of faults have been mentioned among their benefits. However, implementing a comprehensive CFS that can reunite in only one place different sources of information and provide to the user a unified view remains still at theoretical level.

Davenport et al. (2000) discussed about an "integrated customer repository" where the company can put everything important that they know about their customers in one physically or virtually integrated database. They argued that the concept is appealing but their study based on contacts

with more than 70 firms and interviews with over 24 leading adopters of customer knowledge management concluded that fully-integrated customer knowledge environment is not a realistic possibility at that moment.

The reasons that led the authors to make that conclusion are as follows. First, companies deal with different types of customers that have diverse requirements and needs; companies must adjust their tools to satisfy them. Second, the needs from company's functional areas are different; what is relevant for Research & Development is maybe not for Customer Service. Third, companies do not want to depend or be attached to only one product or system; a high dependence degree might create difficulties to attend in timely fashion a new trend or if a new revolutionary technology from a different provider appeared and company's success depends of its adaptation. Finally, the authors could not find a company that combines effectively "hard" (data-derived) and "soft" (human-derived) knowledge in one integrated customer database.

They concluded that customer knowledge management can not measure up to the "integrated customer repository" ideal because customer knowledge is much too complex to store in one format and location, or to be synthesized into one consistent customer profile.

It has been ten years since Davenport et al. (2000) pointed out their skepticism about the customer feedback system. However, new IT technologies such as customer relationship management (CRM) new capabilities and more theoretical studies about building feedback systems have appeared in the last few years.

3.2.1. Customer relationship management (CRM)

Customer relationship management (CRM) is a broad concept that has been subjected to multiple definitions. Goldenberg (2000) believed that CRM is not merely technology applications for marketing, sales and service, but rather, when fully and successfully implemented a cross-functional, customer-driven, technology-integrated business process management strategy that maximizes relationships and encompasses the entire organization. Kumar and Ramani (2004) viewed CRM as the process of achieving and maintaining an ongoing relationship with customers across multiple customer touch points through differential and tailored treatment of individual customers.

Even though CRM was born as a concept in the nineties, the IT advances have provided it with new features that make its use still very appealing in the business market. Features such as knowledge database, analytical tools (association rules, clustering, etc.), and remote access have shifted the CRM orientation from one operational to a new one more analytical and collaborative-oriented.

Xu and Walton (2005) found the following types of CRM. Operational CRM where customer data is collected through multiple points (contact centre, phone, email, etc.) and stored in a customer centric database; Analytical CRM that analyzes data store in the centric database using a range of analytical tools (association rules, clustering, classification and evaluation of customer value) in order to generate customer profiles, identify behavior patterns, determine satisfaction level, and support customer segmentation; Collaborative CRM that are systems integrated with enterprise-wide systems to allow greater responsiveness to customers throughout the supply chain. For instance, a CRM can be extended to include employees, suppliers, or partners. A collaborative selling CRM can offer knowledge and tools to everyone in the extended enterprise, and to help drive sales through every channel from call centre to the web. Finally, e-CRM that allows customer information to be available at all touch-points within the company and among external business partners through the internet and the intranet.

3.2.2. Customer Feedback system requirements

Defining the requirements that a customer feedback system must possess is a compulsory task. In a case study made to develop customer feedback system before market release, Petkova et al. (2006) provided a number of functional requirements that lead to the development of a sounded feedback system. They argued that a feedback system must fulfill the following four requirements: (1) it must generate technical root cause information about (potential) field failures; (2) it must generate information about possible gaps between the technical specification of a product and the actual usability as experienced by the end-user; (3) before full-scale production: it has to generate product quality / reliability information early enough to enable product improvement with respect to unforeseen product flaws; (4) Once full production has started: it must generate speedy feedback to "correct" product / production problems.

Finally, an important aspect that must also take into account when a feedback information system wants to be implemented is the characteristics of the market (Voss et al., 2004). Some evidence has shown that customer behavior varies from one country to another. For instance, when compared to UK customers, US customers are more willing to leave a tip which traduced in practical things might mean that, for instance, an internet forum could be less likely used in UK than in US to collect valuable feedback information from the customer.

3.3. Business Process Redesign

An important area in the BPM is the business process redesign (BPR). Since it was defined in the nineties by Davenport and Short (1990) in their article about information technology and business process redesign and used by Hammer and Champy(1994) in their book called "Reengineering the Corporation", BPR has become a recurrent source of improvement for companies that want to excel in their sector. BPR has been defined as the critical analysis and radical redesign of existing business processes to achieve breakthrough improvements in performance.

3.3.1. Best practices in business process redesign

In an effort to collect practical rules that can lead to successful business process redesign, Reijers and Mansar (2005) identified a set of some recurrent patterns and convert them into a so-called "best practices". The best practices are intended to improve the process in six different areas: customer, business process operation, business process behavior, organization, information, technology, and external environment. Some of the best practices are: *control relocation*; move controls towards the customer, *control reduction*; reduce the number of contacts with customers and third parties, *task elimination*; eliminate unnecessary tasks from a business process, *parallelism*; consider whether tasks may be executed in parallel, *task automation*; consider automating tasks, *trusted party*; instead of determining information oneself, use results of a trusted party, and *interfacing*; consider a standardized interface with customers and partners.

3.3.2. BPR in call centers

BPR has been mostly used in processes that are more or less stable over time such as banking or assurance companies. However, attempts to cross this field over other areas such as healthcare and call centers have been made. Jansen et al. (2006) proposed a number redesigns scenarios for call centers in order to improve performance characteristics such as: service level, speed of answer, and throughput time. They used a set of best practices found in the literature and

compiled by Reijers and Seymar (2005) to propose and simulate some redesign scenarios that can improve the current process performance. Using best practices such as task composition, generalist/specialist optimal number, task automation and flexibility, the authors concluded that favorable designs can be developed and simulated to analyze the possible trade-offs that may arise between operational costs, throughput times, and service levels.

3.3.3. Evaluation framework

To analyze the impact and trade-offs made by proposed process redesigns, a measurement framework called "Devil's Quadrangle" (Brand and Van der Kolk, 1995) is used. Its aim is to illustrate what are the advantages and disadvantages that will likely occur when a redesign strategy wants to be implemented. This framework that is shown in Figure 6 gives the theoretical effect in four dimensions (Cost, Quality, Time, and Flexibility).

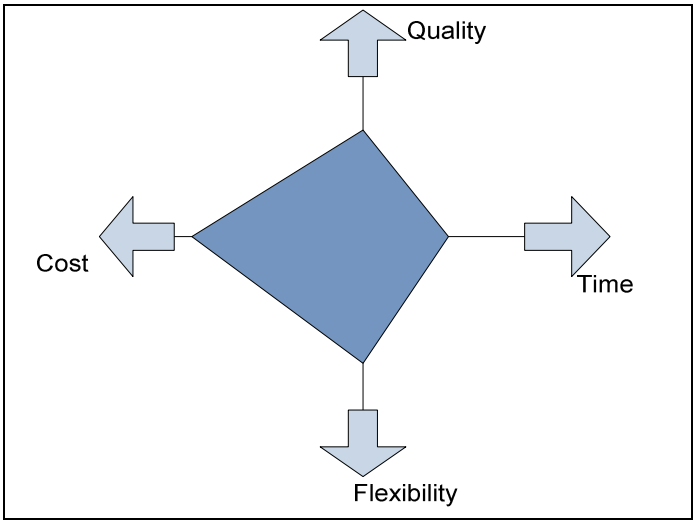


Figure 6 the Devil's Quadrangle

3.4. Knowledge Generation & Integration

Knowledge management is the practice of adding actionable value to information by capturing tacit knowledge and converting it to explicit knowledge (Nemati et al., 2002); by filtering, storing, retrieving and disseminating explicit knowledge; and by creating and testing new knowledge.

New knowledge is created through the synergistic relationship and interplay between tacit and explicit knowledge (see Figure 7), specifically, through a four-step process of socialization, articulation, integration, and understanding/internalization (Nemati et al., 2002). Explicit Knowledge is expressed in words and numbers. It is shared in the form of data, scientific formulas, product specifications, manuals, etc. Tacit or Implicit Knowledge, on the other hand, is highly attached to personal experiences and hard to formalize, making it difficult to communicate or share with others. Subjective insights, intuitions and feelings fall into this category of knowledge.

Two aspects of knowledge: knowledge generation and knowledge integration have called the attention of management in the last few years.

3.4.1. Knowledge generation

It is defined as the amount of information entered by human beings that has been validated by experience. The amount of knowledge generated depends of different factors. Song et al. (2006) argued that managerial controllable variables such as R&D budget, co-location of R&D personnel, job rotation, information technologies, lead user, and supplier networks can influence the level of knowledge generation in new product development. Based on literature and field research on seven knowledge-intensive organizations, the authors developed hypotheses such as: (1) an increase in R&D budget is positively related to a higher level of knowledge generation; (2) co-location of R&D personnel is positively correlated to the level of knowledge generation; (3) the use of lead user and supplier networks are positively correlated to the level of knowledge generation; (4) job rotation is positively correlated to the level of knowledge generation; etc. and tested these hypotheses using data collected from 277 firms in high technology industries. Their results show that support was found for hypothesizes (1) and (4). Hypothesis (3) appears to have a negative influence on the level of knowledge generation and hypothesis (2) was found insignificant.

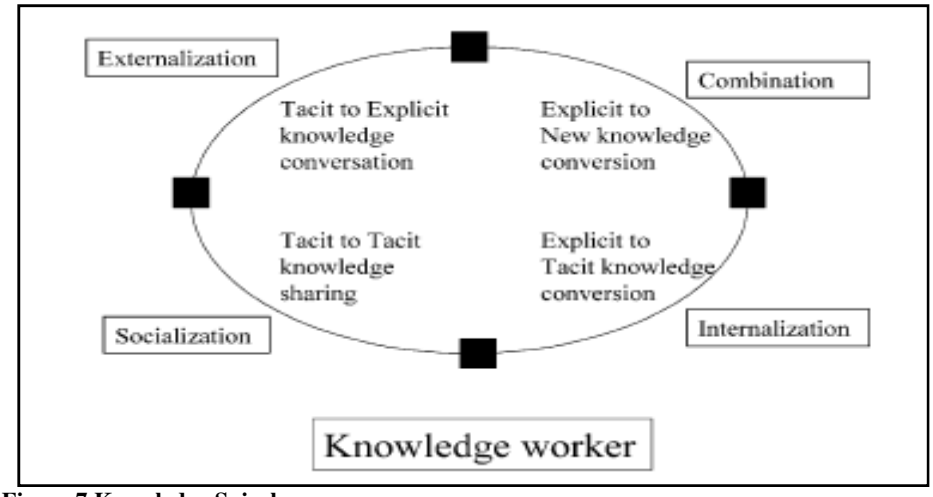


Figure 7 Knowledge Spiral

3.4.2. Knowledge integration

Knowledge integration refers to the process where different pockets of knowledge, which are valuable for a particular organizational process and held by different organization members, are applied to that organizational process (Berends et al., 2006). The increment of complexity in the development and manufacturing of products has pushed management to look for techniques and strategies that can cope with it. Knowledge integration is one of these because it allows knowledge dispersed in the whole process to be connected.

Berends et al. (2006) provided six different knowledge integration mechanisms: *sequencing, decision support systems, direction, thinking along, group problem-solving, and knowledge transfer*. These mechanisms can be used separately and/or in combination with each other. Sequencing of task exploits the specialization of organization members. It refers to the assignment of tasks to those organization members who have the relevant knowledge for it. Another integration knowledge strategy is the use of decision support systems to codify the knowledge and make it explicit. Thus, it can be accessed by other organization members. Direction is a mechanism that allows specialists in one area to direct and guide non-specialists, less mature specialists, and specialists in other fields. Thinking along consists in the temporary

application of one's knowledge to somebody else's problem. The application of this knowledge – including tacit knowledge- may yield ideas that contribute to the process of knowledge creation.
Group problem-solving is another knowledge integration mechanisms that consists of the direct combination of knowledge previously dispersed over individuals in order to solve a problem or make a decision. Finally, the most important and studied knowledge integration mechanism is knowledge transfer. Although knowledge integration can be realized through knowledge transfer, knowledge transfer alone does not constitute knowledge integration. Knowledge integration requires that the receivers of knowledge are able to absorb it, combine it with their existing knowledge, and apply it into an organizational process.

3.4.3. Techniques for knowledge integration

Jetter et al. (2006) described some techniques that can enhance the level of knowledge integration insides companies. They proposed some elicitation techniques in order to extract knowledge from the experts. Techniques such as *thinking aloud* (asked persons to express everything that comes to mind while solving a problem), *sorting* (persons are asked to build categories of related objects), and *probing* (persons are interviewed during or after a problem for a specific learning situation) are mentioned. It is critical to notice that experts need to benefit from sharing knowledge, e.g., through recognition, through the satisfaction of being considered an expert or through future ease of work. Knowledge source map that does not depict functions, responsibility and hierarchy, but expertise is also mentioned by Jetter et al. (2006) as an affective knowledge tool. It codifies "knowledge about knowledge" and is used with the intention to assess reality in order to identify relevant knowledge and to improve processes.
Knowledge flow map, on the other hand, shows the order in which knowledge resources are and should be used. The map can be used to identify: knowledge dumps (e.g., receivers, such as databases, that receive knowledge but are rarely sending anywhere), inadequate communication methods (e.g. the attempt to transfer tacit knowledge, such as experience, with written documents), and people and divisions who do not communicate (lack of paths).

4. MODELING THE CUSTOMER SERVICE PROCESS

This chapter is devoted to the modeling of the current process within Philips C/V customer service. It starts defining the methodology and the modeling language used. The models at high and medium level with their most important remarks are subsequently given. A knowledge flow map and a conclusion section finalize this chapter.

4.1. Methodology

The methodology used to model the "as-is" situation in the customer service is a combination of the approaches given by Law and Kelton (1999) and Sharp and McDermott (2001). Features such as *conversations with the subject experts* and *observation of the system* from the former approach are combined with *the use of progressive level of detail* from the latter approach. The motivation to combine both methodologies is based on the fact that Law and Kelton (1999) approach can get in a timely fashion the essence of the process, but it does not provide a structured step-by-step approach to obtain process details which is something that can be gained using Sharp and McDermott (2001) approach.

The first step was to interview managers of the three tiers to find out how they see their processes. These interviews were open and semi-structured. In parallel, a number of days were spent with the operative personnel to observe how they are doing their job (i.e. observation of the system). The output is a high level model (handover level). The second step was to add details to this model creating the so-called "flow level diagram". If more details are required a third level diagram called "task level diagram" can be used.

As it was mentioned in section 2.4, there are three processes that communicate customer issues to the customer service. These are: call handling, technical escalation and complaint handling. In this project, the focus is basically the call handling and technical escalation process. A brief description about complaint handling is given in this project, more information is found in the master thesis of Eelco Lippinkof (2009) which is also part of the Data Fusion project.

4.2. Modeling Language

Despite all the graphical modeling languages (XML, BPML, EEML, UML, IDEF, Petri nets) available in the market, flow chart language is used here. The reasons behind this decision are explained below.

1. Flow charts are a descriptive language that allows the user to gain knowledge of what it has been modeled (Aguilar-Saven, 2004). This is an important point because the objective of this thesis is to know the current process inside Philips C/V customer service.
2. Flow charts are self-explanatory. While other techniques may require considerable training before they can be read, flow charts are immediately understandable by almost everyone. This is a considerable advantage because the models are shown to employees that do not have plenty of time to understand them.
3. Flow charts are independent of any software syntax and can be implemented in any modeling workflow software.
4. Finally, most of the processes described within Philips C/V are using flow charts. Their use and understanding have already been tested there and their implementation in a new Philips procedure or workflow application would be readily accepted.

4.3. High Level Process

4.3.1. Call handling process

The call handling process is the most common of the three processes here modeled. It is managed by three tiers that formed the customer service. Figure 8 gives this process at high level with the participants located in the left side.

This process starts when a customer calls to the call center in order to report an issue related to the Cardio/Vascular system. If the call is reporting a product-related issue, the operator will create a Clarify CRM case (Clarify is a customer relationship management (CRM) application that Philips have selected as their worldwide costumer call handling tool). After the case is created, it is normally handing over to Tier 2 which is also called remote support center (RSC). If the RSC operator can solve the issue, the case is reported as solved to the client. Otherwise, a FSE is dispatched to solve it. Communication is sent back to RSC by FSE to inform whether the problem has been solved. If no solution is found, then the case is handed over Tier 3 also called Helpdesk. Occasionally Tier 3 deals with problems that need detailed and specialized knowledge that can only be acquired in the development area. In this situation, a communication is established with the C/V development area to provide further assistance. Appendix 3 describes this step-by-step from the moment that a customer request is received until a solution is found. Moreover, Appendix 10 explains the flowchart language use to create the models presented here.

The remaining of this section is used to bring out some observations made during the modeling process. First, the process shows in Figure 8 represents "the average behavior" of the call handling. Exceptions such as direct contact with Tier 3 or re-scheduling of FSE are not considered because at this point we want to discover the average process not its abnormalities.

Second, personnel in the process are so oriented to their task that sometimes forget the overall process, the issue with this situation is that they are trying to improve their part individually but optimizing the individual parts does not necessarily optimize the whole (Sharp and McDermott, 2001). The emergence of local tools is one of the consequences that these local optimizations have brought to the process. It makes the process understanding complicated and the acceptance of a worldwide tool even harder by personnel that have to move from a customized tool to a new generic one. Another consequence is that the information shared between tiers is sometimes limited which makes that the understanding of one case becomes an endless interchange of emails and telephone calls. For instance, reporting one case with only a description announced that "the system is down" without further details could start a quest of information that might easily take days before a "real" support is provided (i.e. an action oriented to solve the problem, not just a call saying that the request has been received).

Third, tools are not necessarily used as they were intended or sometimes they are not used at all. When the call handling process is explained by managers, their idea is that some applications have been used in a determined way to solve or get something. However, in practice, these tools are rarely used or sometimes ignored. An example clarifies this point. FSEs sometimes run into an unknown issue that requires more information in order to be solved. Management is aware of this situation and has created tools such as a knowledge database called KNOVA and a documentation platform called In-Center. However, most of the times, FSEs prefer to call their peers or call centers in order to look for that information instead of using these tools because , they argued, information is hard to find and time is a luxury that they cannot afford.

Finally, modeling the high level of the call handling has provided us with an overview of the current process. It can be seen that this process follows the traditional multi-tier approach

(Mandelbaum, 2004) where the specialization of knowledge increased as a case goes up through the tiers. However, more information and details are needed to obtain a thoroughly understanding of the call handling process. Details such as applications used or options available when a case is received are needed. Hence, a higher detail model is needed.

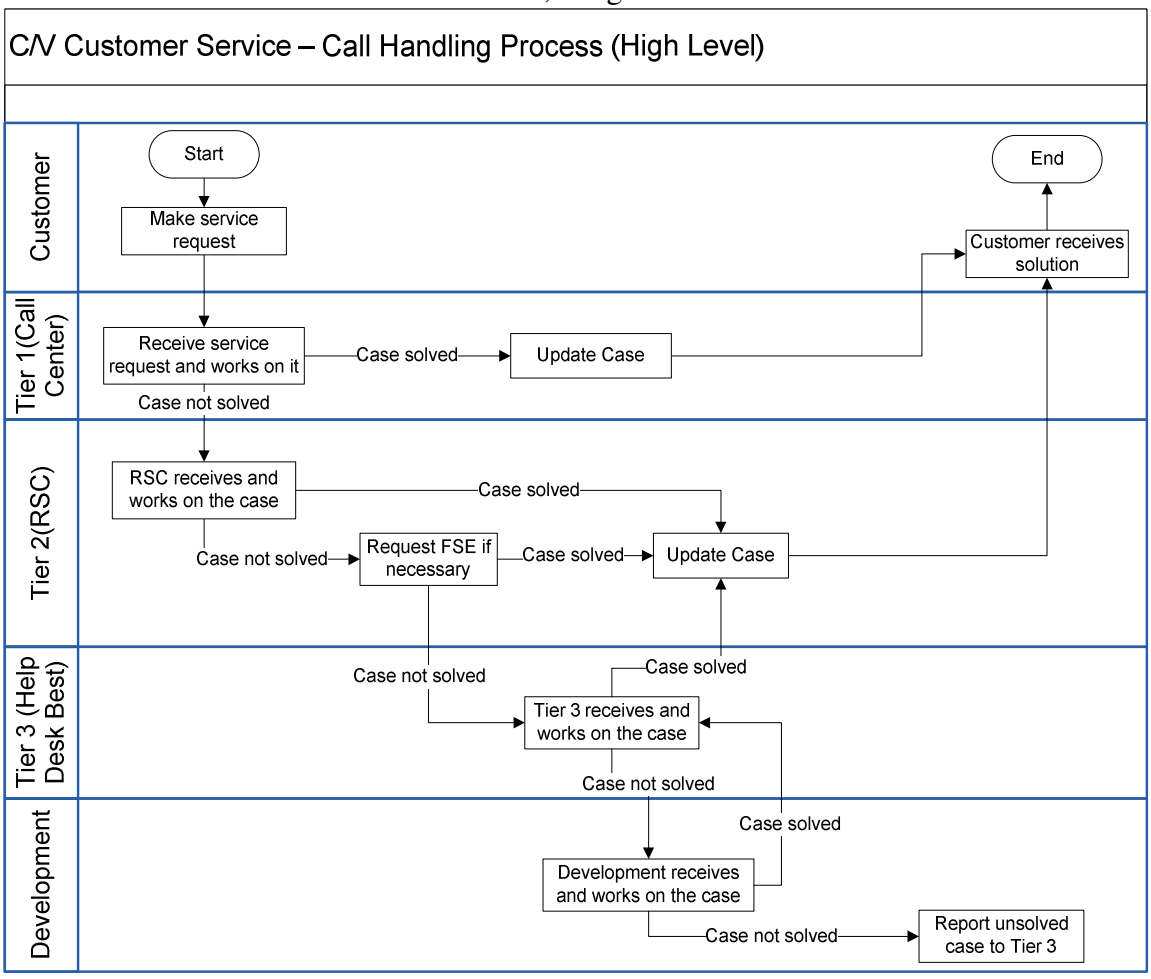


Figure 8 Call Handling Process - High Level

4.3.2. Technical escalation process

The objective of a technical escalation as defined by Philips' official document (UXW-060022) is to decrease customer dissatisfaction due to technical malfunctions in Philips equipment through effective mobilization of resources and timely communications. This process normally starts when a technical problem has not been solved using the call handling process. The unsolved issue can generate that the customer satisfaction decreases affecting the relationship between the client and Philips Healthcare.

This process is based also on three levels. The first attempt to solve the technical escalation is made at the local level using resources and personnel included management participation only from Tier 1. If solution is not found, the case is escalating to the other tiers. The escalation model is shown in Figure 9 and its step-by-step description is given by Appendix 3. Some of the differences with the call handling process and peculiar features of this process are given as follows.

Compare to the call handling process, technical escalation does not start by the unilateral choice of the customer, normally it is a consensus decision made between FSEs and the customer. In the Benelux market where this research took place, the technical escalations are communicated to the zone technical specialist (ZTS) who is the one that reports them to the local management.
Technical escalations are managed using only one worldwide procedure with one tool called VIPER that keeps everyone (FSEs, managers, ZTS) inform of the steps taken to solve the case. This is a main difference compared to the call handling process that used different tools for different key markets, even though the efforts of Philips Healthcare for migrating to only one application (Clarify CRM).
During the journey to discover the "as-is" process behind technical escalations, some conversations were taken with technical personnel especially from Tier 3 to capture their thoughts about escalations and what are the practical differences with others processes such as complaint handling. It was noticed that they know how to deal with escalations but explaining what is in fact an escalation and how it differs from a complaint leads sometimes to a conceptual confusion especially if someone is listening these concepts for the first time. However, it was clear in personnel's mind that technical escalation is more about the client satisfaction; in other words, it is likely that a reported problem does not have at this moment a known solution (i.e. a solution is expected in three months with a new software update) but the aim is to exhibit that the client is the most important asset for Philips Healthcare through the application of a temporary solution and management involvement to assure that the issue will be solved as soon as possible.

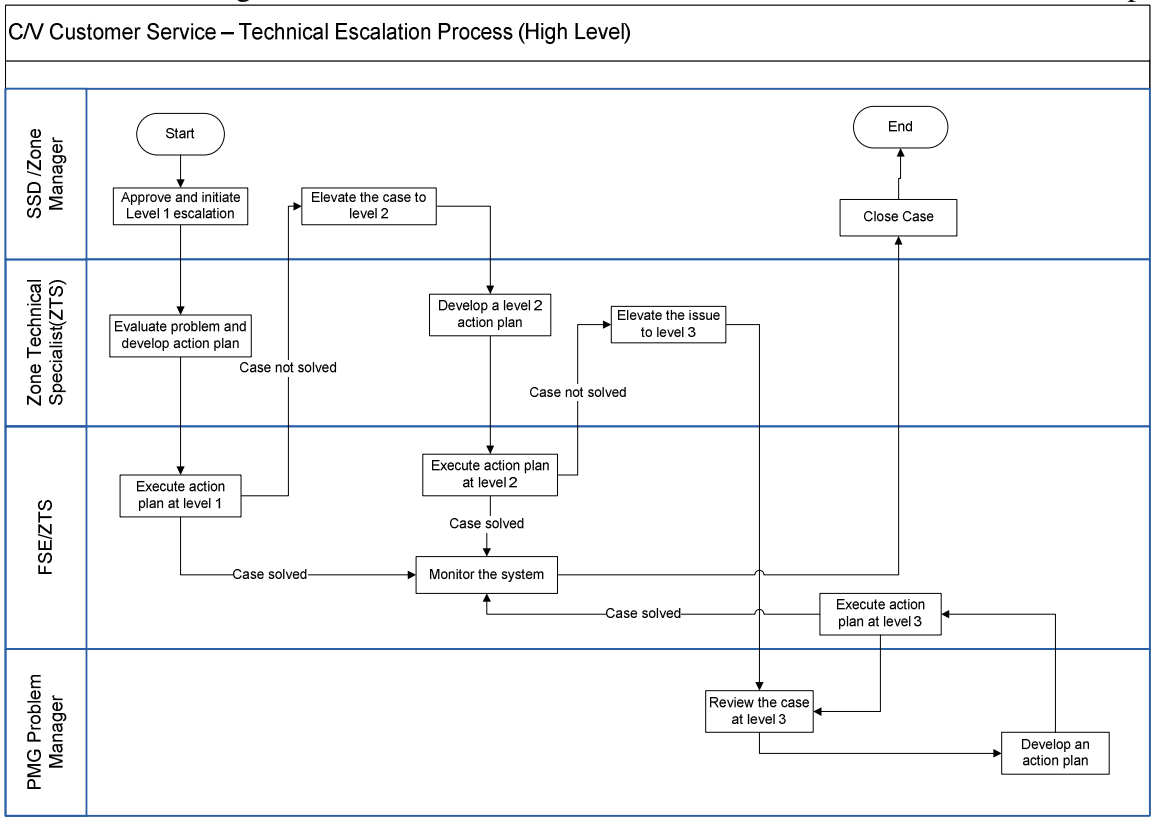


Figure 9 Technical Escalation Process - High Level

4.3.3. Complaint handling process

It was mentioned before that the complaint handling process will be treated here superficially because there is another master thesis that is dealing in deep with this process. Another reason is that complaint handling and technical escalation are processes well documented and their workflows have a general consensus among the different key markets; something that call handling has yet not reached.

Some of the actors that participate in the technical escalation process are also part of the complaint process; but the tool (Clearquest), the report generated (FPR-field problem report), and the information flow are different. A graphical representation of this process is given in Figure 10.

Using this process, any product-related issue (e.g. quality, safety, reliability, and effectiveness issue) can be reported but the solution time frame is larger compared to technical escalation and calling handling because stakeholders from different areas are involved. For instance, two members of the Tier 3 or Helpdesk are involved in the so-called QMCB (Quality Maintenance Control Board) team which is a cross-functional group with people from Quality, Customer Service, Marketing, and Development that deals with product compliant.

Sometimes the response time is an impediment to report an issue especially when it comes from the field. As one FSE stated when it was questioned for the different channels of customer service available, he argued that the odds of one product complaint to be heard are higher if the same problem is reported simultaneously in other key markets. However, if the complaint is an individual occurrence from his key market, then the chances to receive appropriate support are lower. In this kind of situation, FSEs prefer report the issue as a technical escalation which is considered by them generally as more effective.

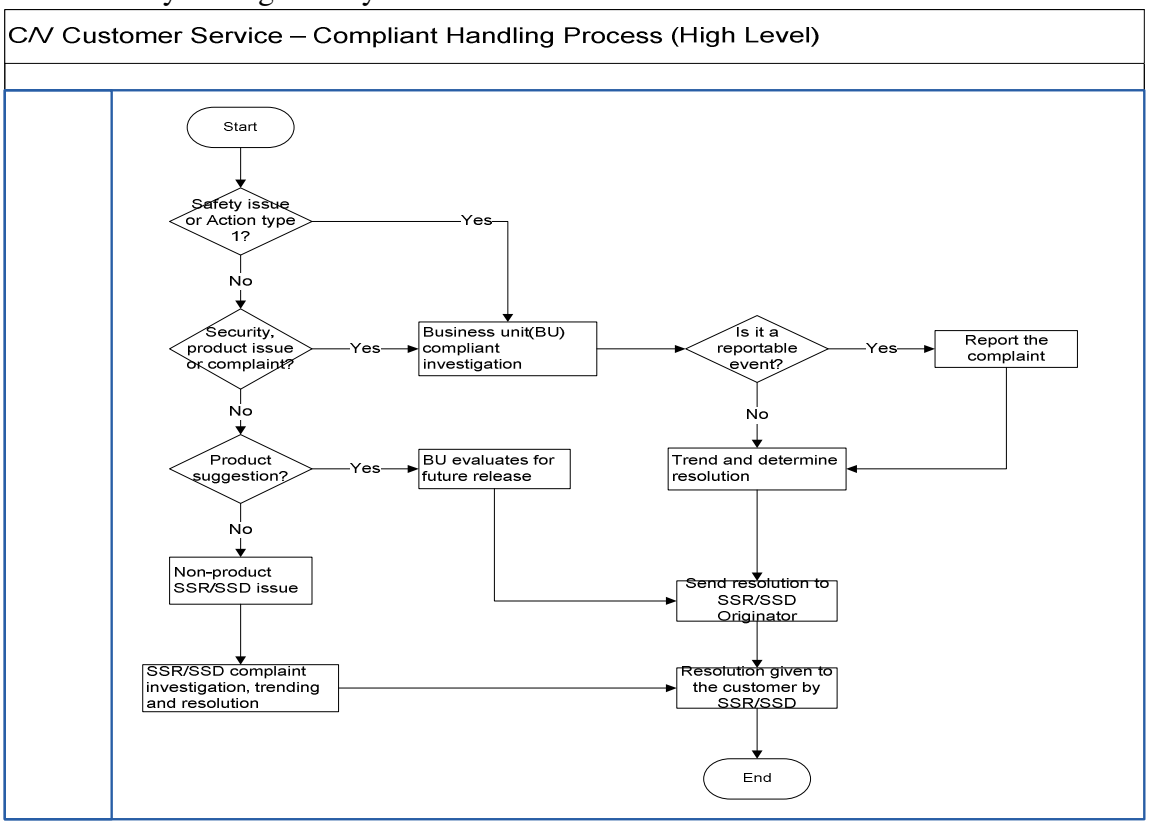


Figure 10 Complaint Handling Process

4.3.4. Adding details to the high level processes

The three high-level models have provided us with an overall view of the processes. However, to get a better understanding of the current issues that the modeled processes are facing off, a higher detail level in the modeling is required.

The reasons that motivated us to go for a higher detail level of modeling are mentioned as follows.

- It would allow to the detection of weak spots that are not visible with the current modeling level.
- The participation and task description of the actors in the processes would be clear.
- Information and tools used in the processes would be clearly described.
- To look for managerial or operational decisions that affects the processes in a significant way.

Hence, a medium level modeling is offered in the next section for two of the three main processes identified in this project.

4.4. Medium Level Process

4.4.1. Call handling process

The medium level model for the call handling process is presented here. The workflow has been divided in four parts that are related each other using a circular reference, for instance the action *"transfer the case to RSC"* in Figure 11 is followed by the number 1 which makes reference to the activity *"RSC receives the case"* that is preceded by the number 1 in Figure 12.The process is completely described by Appendix 3.Here, the focus is to point out the most interesting findings made during the time spent in the customer service unit.

- The contact options available at C/V Benelux call center are too limited. Considering the advance in automation call distributors (ACD) technology, having only one channel to receive any kind of customer requests is somewhat frustrating especially when an emergency call (e.g. there is a patient on the table) has to follow the same path than a regular one (e.g. request a quotation for a new system add-on). Figure 11 shows this situation with only one input and the subsequent classification made by the call taker ("Determine case priority").
- Tier 1- Call takers are limited to create Clarify cases and hand them over Tier 2. At this stage no case resolution is found, their main tasks consist of creating cases, dispatching FSEs and ordering spare parts when the product ID is known.

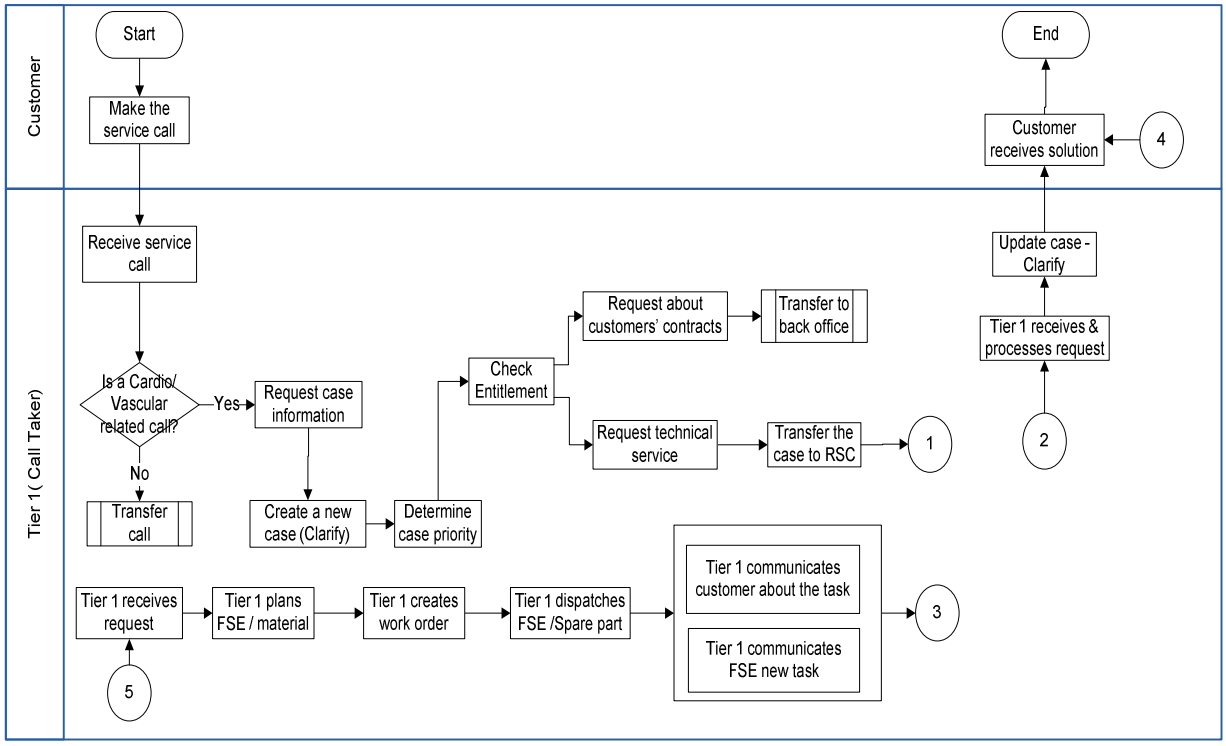


Figure 11 Call Handling - Medium Level 1

- Figure 12 shows the participation of Tier 2 (Remote support center, RSC) in the call handling process. They analyze remotely the system in order to solve the reported issue. The system log file generated while the issue first appeared is a key element to solve the case. However, the phase *"RSC analyze log"* is sometimes skipped and sent the log directly to Tier 3 due to the lack of knowledge to read a log file. There is not an official document that describe to what extend Tier 2 must go further with a log file before they hand it over Tier 3.
- It was interesting to see that the application (*Navigator*) used to connect remotely the RSC with old systems (Integris) has more functionalities than the application (RSN Environment) used for the new systems (Xper). For instance, changing start-up system parameters or accessing remotely the cabinets that formed a C/V system is a feature that is currently not available with RSN Environment. The decision is made in the *"Connect to the system"* phase shows in Figure 12.
- The lack of feedback mechanisms is another characteristic that calls heavily our attention. There is a general consensus among customer service personnel that feedback information is highly important for the C/V unit. But this remains only at rhetorical level; no procedure is currently established that guides feedback information from where it is generated to areas where something sensible can be done with it.

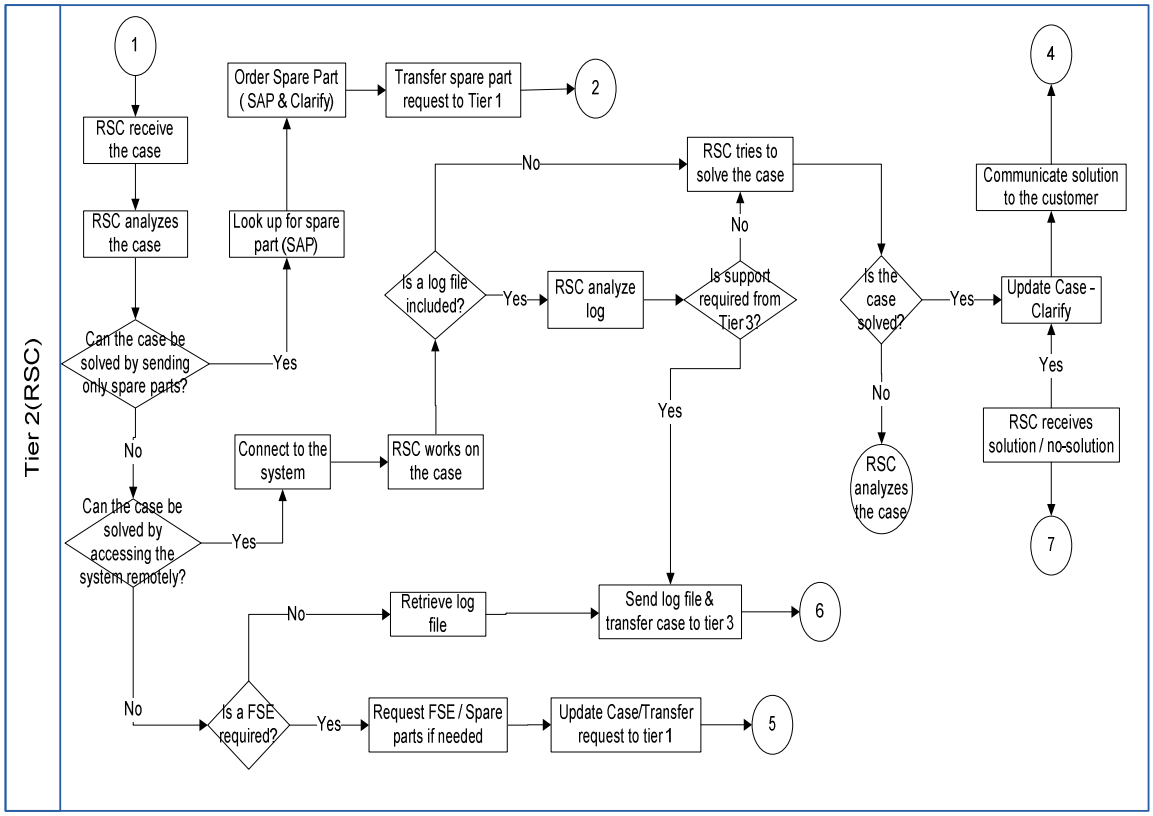


Figure 12 Call Handling - Medium Level 2

- Figure 13 shows the activities that take place in Tier 3 (Help Desk) when a new case is received. The first aspect that captures attention is the Clarify vs. Non-Clarify case distinction. The argumentation of this application redundancy to handle customer service requests is two-fold. One is that some key markets are not yet moved to Clarify but needed to be attended; and, the other is that some field service engineers avoid the official communication path (first call RSC, see Figure 13 on decision *"is support required"*) to request support by sending an email or calling directly to Tier 3. Thus, Tier 3 uses HCS to create one case for each email or call that cannot be answered immediately.
- The solution of a given case is normally obtained from three sources: previous knowledge, knowledge databases, and colleagues' advice. It was a surprise to know that knowledge databases such as KNOVA are rarely used to find a stored solution. The personnel not only from Tier 3 but also from Tier 2 explain us that searching in these databases is sometimes a painful task because the keywords must be carefully chosen in order to get a valuable result. They told us that void results can be obtained one day for a certain keyword, but the next day using the same keyword an answer can be found. KNOVA is described in detail in Appendix 4.

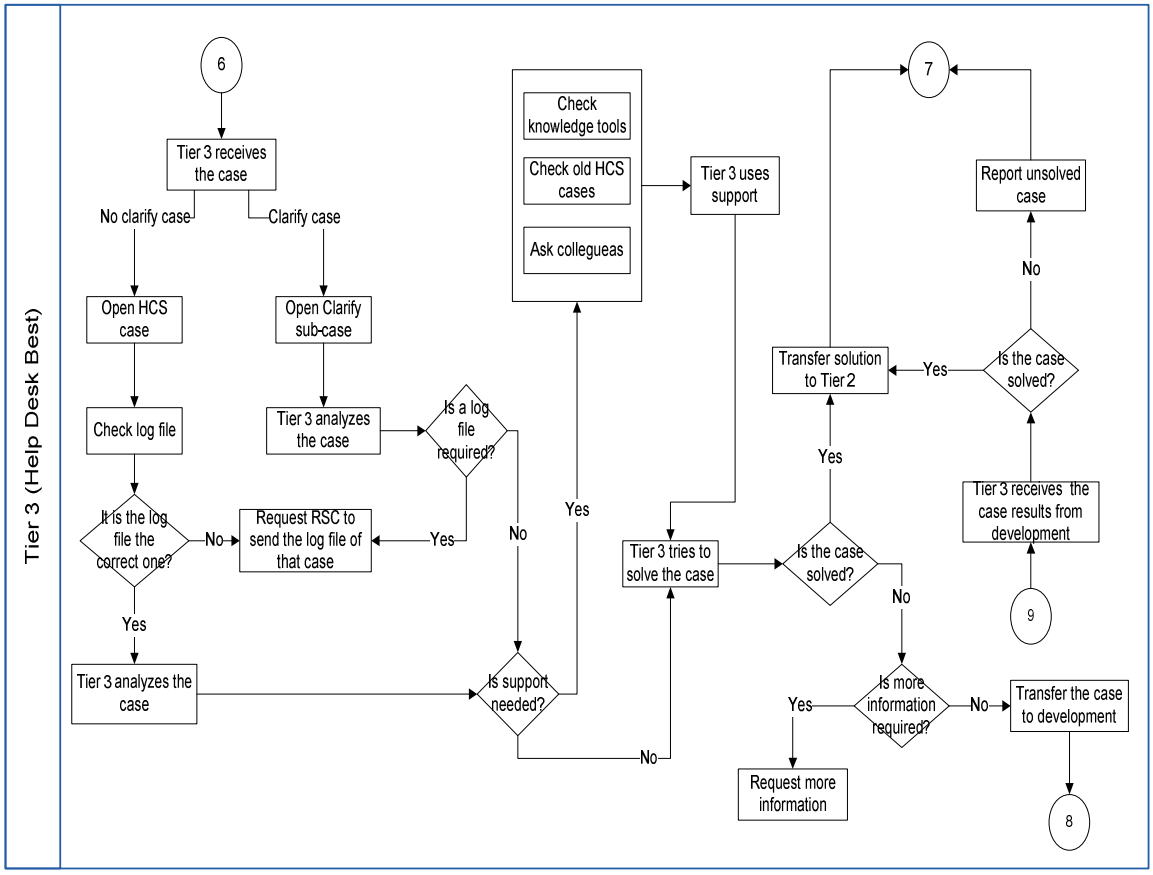


Figure 13 Call Handling - Medium Level 3

- The FSE as well as Development participation in the call handling process are shown in Figure 14. It can be seen the four main activities performed by a FSE: C/V system installation, Field change order (FCO), preventive maintenance, and corrective maintenance. Corrective maintenance occurs when an issue reported by the call handling process needs the presence of a FSE on-site.
- The work done by the FSE on field is registered in the so-called "job-sheet" which is a report generated to describe the activities performed in the system when a technical issue has appeared (see activity *"Generate job sheets"* in Figure 14). Currently, job sheets are used by C/V analysts to capture the spare parts value utilized during the corrective maintenance. However, information such as the steps followed to solve a case or problems found during the application of an action plan is at this moment not utilized.
- Finally, it was noticed that the communication between Tier 3 (Helpdesk) and C/V Development is informally. There is not an official procedure that illustrates how the communication between these two areas must be done. Currently, it is made by telephone or email because of the familiarity and friendship between them. The advantage gained is a spontaneous process that can go forward and backward without the presence of the stress factor. The disadvantage, on the other hand, is that no information is recorded or stored in order to create further knowledge.

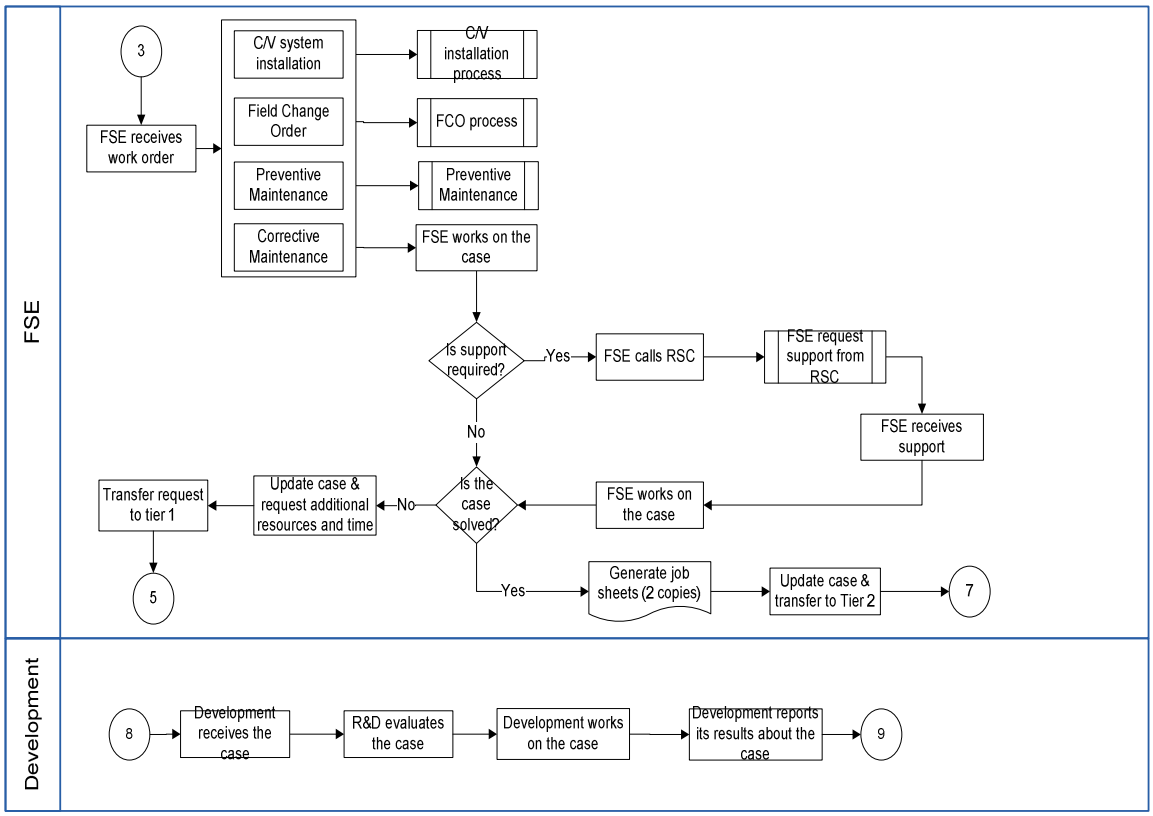


Figure 14 Call Handling - Medium Level 4

4.4.2. Technical escalation process

The technical escalation process is modeled again here but more details are added. This is a worldwide process followed by Philips Healthcare to deal with customer dissatisfaction generated by a product malfunctioning. The main addition is the presence of a new actor (SSO-SSR officer) that is involved in the generation of the action plan when the reported issue is related to security events such as virus attack or system bugs. The addition of VIPER which is the Lotus Note application to support the technical escalation process is also found in this medium modeling. It is important to remember that the technical escalation process is divided in three levels. Level 1 and Level 2 are handling locally; no member of Tier 3 is involved here. The action plan is developed by the zone technical specialist (ZTS) who is a FSE with higher knowledge and experience. Only when the available resources to handle a technical escalation have been depleted, the case is translated to a global jurisdiction which is the escalation at Level 3.

Tier 3 will take actions depending of the color (like traffic light) that the case has, red means that immediately response is needed, yellow means that the client is anxious and a response is required, and green means that some time is allowed to take care of that matter. When the case arrives at level 3, a coordinator will decide which member of Tier 3 will be on charge of the case. The decision is based on the expertise required to solve the case.

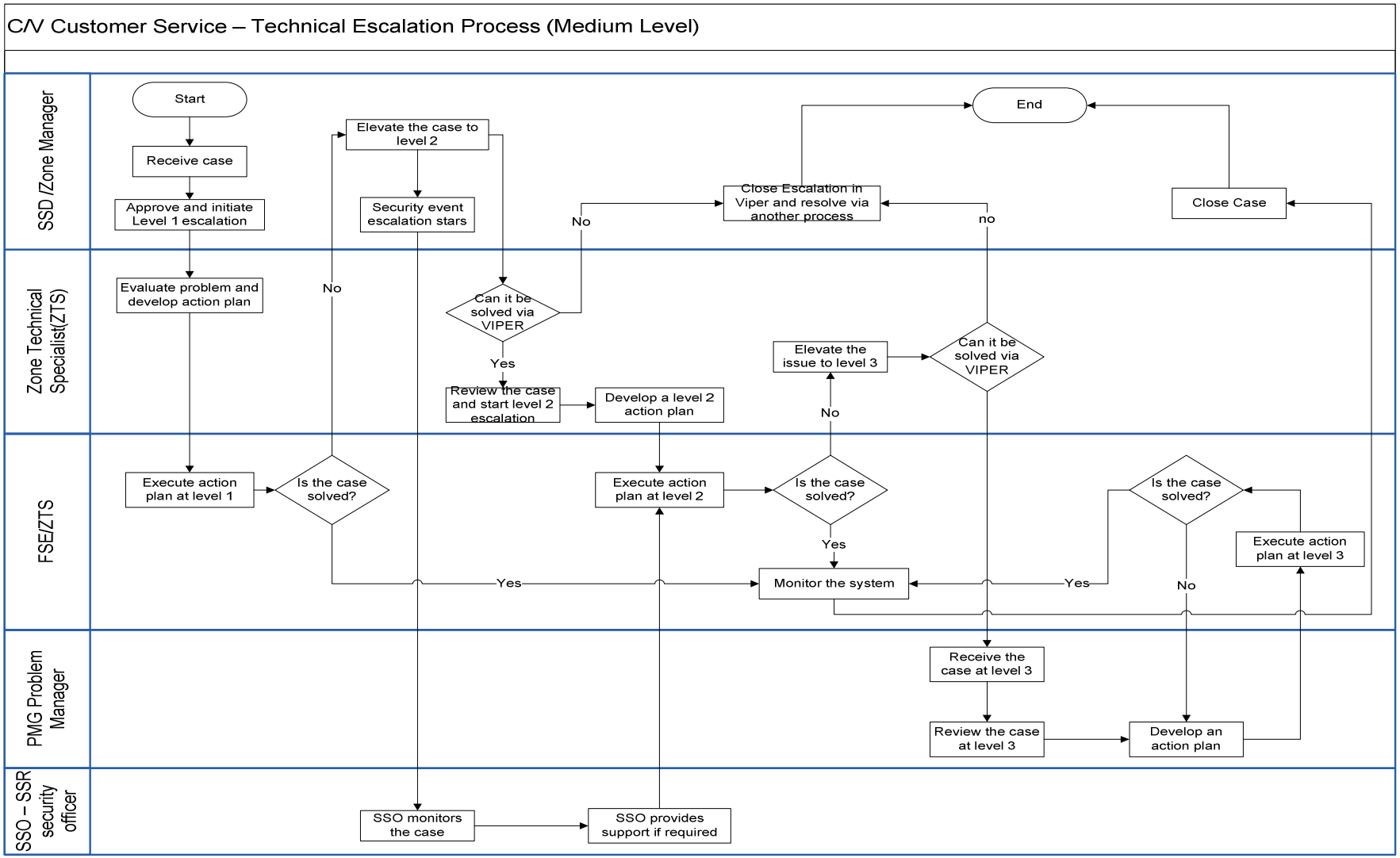


Figure 15 Technical Escalation Process - Medium Level

4.5. Software applications in the customer service

As one Philips employee colloquial said to our group during our weekly visits last year: "One thing is to understand the process and another completely different is to comprehend how and where the applications are used to manage this process". It is amazing the amount of applications that Philips C/V has currently available. Only for the call handling process, 16 applications officially accepted by Philips C/V can be counted. Table 2 provides that information, the column *Scope* gives the range of the tool which means that the tool is available in a given area but it does not mean necessarily that the tool is used there. For instance the e-SPF is available for any Philips employee but it is rarely used by one call taker (Tier 1).

For that reason, a knowledge flow map that shows the user where the applications are used during the call handling process is presented. The objective is to provide the reader with an overall vision of the call handling in terms of software applications. The main advantage gained with this application modeling is that further researchers will only concentrate in the data that these applications can generate and not where they are utilized. The knowledge map is given in Figure 16 and Appendix 3 provides a complete description of it.

Nr.	Tool	Description	Scope
1	TPA-PE 7.1	Telephone management application	All tiers
2	Clarify CRM	Customer relationship management application	All tiers
3	Remote service network (RSN)	Philips network to connect XPER systems	Tier 2, Tier 3 and FSEs
4	Navigator 3.1	Application to connect remotely with INTEGRIS systems	Tier 2
5	In-Center	Documentation platform available on-line	All tiers included FSEs
6	Radar	An on-line application build over RSN to access remotely XPER systems	Tier 2, Tier 3 and FSEs
7	Knova	Knowledge database	All tiers included FSEs
8	e-SPF	Electronic spare part finder	All tiers included FSEs
9	SAP	ERP application used by Philips	All tiers
10	Log Viewer 2.0	Application to analyze visually a log file	Tier 2 and Tier 3
11	PROMise	Process mining application used to analyze log files in detail	Tier 2 and Tier 3
12	Click	Workforce planning application	Tier 1
13	IBM Lotus Note	Client-server application that hosts applications such as Viper and HCS	Tier 2 and Tier 3
14	HCS	Application embedded in Lotus Note used to manage customers requests	Tier 3
15	WOMPA	Work order management & Performance Assurance is the official tool for FSEs	FSEs
16	EMR	Electronic maintenance record that stores information about maintenance of the installed C/V systems	FSEs

Table 2 Applications used in the call handling process

Beside the applications mentioned in Table 2, there are also local applications developed by Philips personnel such as MS Access databases or graphical user interfaces (GUI) written in MS Visual Basic that were left out of this modeling because they are local solutions that are not available in the different instances of the process.

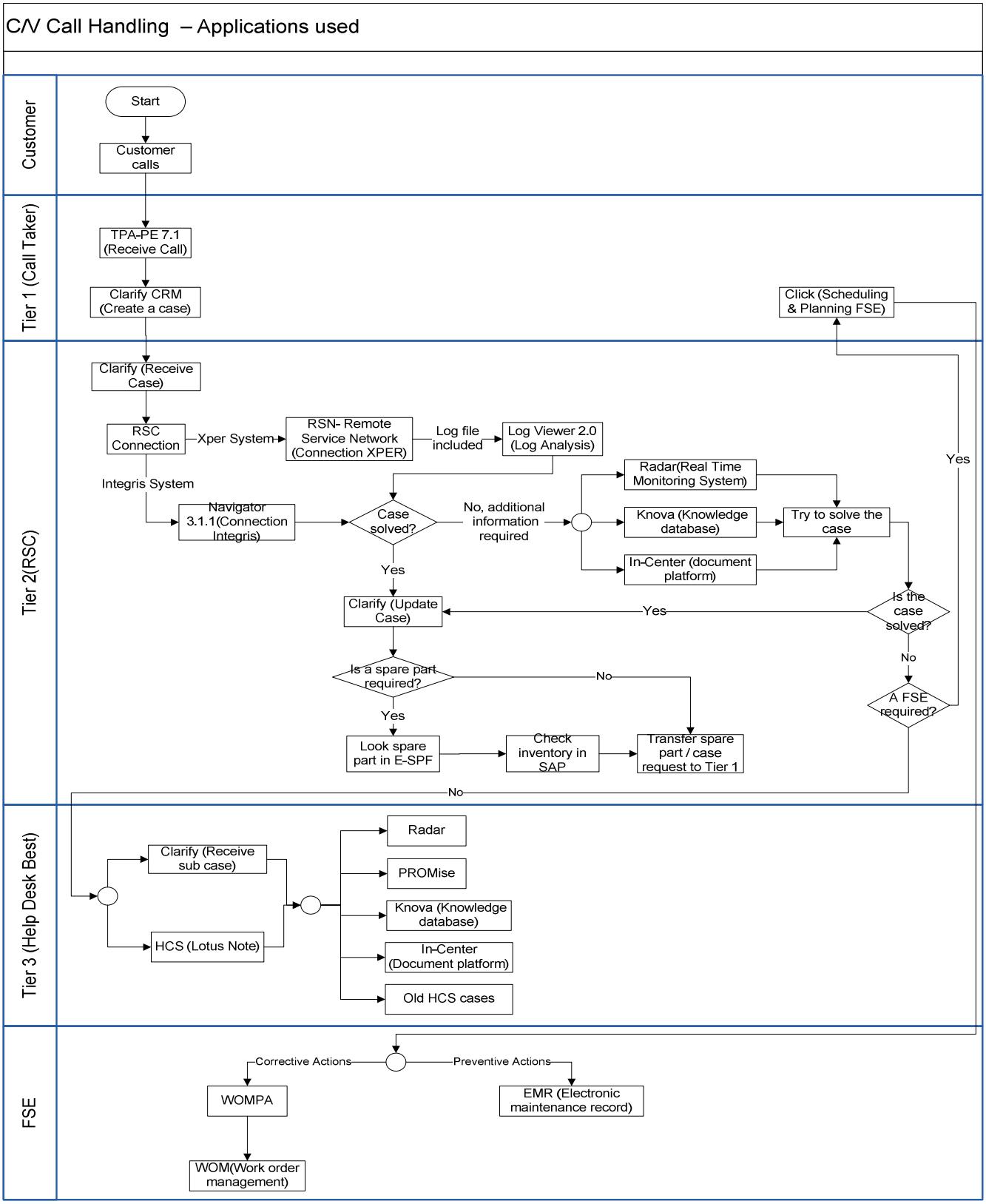


Figure 16 Knowledge flow map for applications

4.6. Chapter Conclusions

The main conclusions obtained during the modeling of the customer service are given here.

- ✓ Three main processes were modeled: call handling, technical escalation, and product complaint. Emphasis was put mainly in the first process because it is the one that is more recurrent in the customer service; it starts normally the other two processes; and, it has more opportunities of being improved.
- ✓ The average behavior of the call handling process was modeled at high and medium level. A third level of modeling was not required because at medium level sufficient understanding of the process was reached and details required to propose further improvements were captured.
- ✓ Some of the issues observed during the call handling modeling are:
  - The number of communication channels that the customer has is limited which makes that customer calls cannot be sorted adequately.
  - The emergence of local tools to optimize the process has led more to create a burdensome process with diverse applications and data formats than to normalize it with few applications and a common data standard.
  - Analyzing a log file has become an accountability issue. Since it is not defined to what extent Tier 2 must go before the case is handed over Tier 3.
  - The use of two applications in Tier 3 to manage the same task has created a situation of information duplicity and extra resource utilization.
  - Searching information in some tools has become a nightmare for Philips C/V personnel since information found today is doubtfully to be found tomorrow.
  - Information generated in the field is at the moment not analyzed thoroughly (i.e. job sheets).
  - There is not an official feedback mechanism that guides Philips personnel to collect feedback information.
- ✓ Technical escalation has an established procedure which is followed by the worldwide customer service with one tool that supports and stores the required information to solve the case.
- ✓ The aim of the technical escalation is two-fold. One is to provide in a reasonable time a solution for a persistent problem, and the other is to show that the customer really cares through the involvement not only of technical personnel but also of management to strength the customer-company relationship.
- ✓ It was found that FSEs prefer to start a technical escalation instead of a product complaint because their chances to be heard, according to them, are higher.
- ✓ Complaint handling is treated here superficially because another master project deals with it in detail. But, it can be mentioned that this process has, on average, larger solution cycle time than call handling and technical escalation because stakeholders from many areas are involved.

5. VALIDATING THE CUSTOMER SERVICE PROCESS

This chapter explains the methodology used to validate the processes modeled in the previous chapter. It also provides a number of cases utilized to make the validation. The validation results and conclusion finalize this chapter.

5.1. Methodology

The methodology used to validate the customer process modeled is here described. It consists of three steps.

- *Select a theoretical validation background*

Unfortunately flowcharts do not allow the user to validate the models using semantics or another kind of well-grounded theory. To mitigate this situation, a combination of expert opinion and walk trough case scenario (Sharp and McDermott, 2001) is used. The first technique is expert opinion that consists in showing the process modeled to employees and managers that are actually involved in the process, and ask if the model proposed is actually resembled what they are doing. This is an iterative process, every time that a reasonable advance in the model has been made; a meeting is set with the responsible and his opinion is used to validate the part modeled.

The second technique called walk trough case scenario follows a particular case from the moment it is created until is solved and stored. The idea of walking through a given scenario is to capture in practice possible deviations that were not considered at the moment of modeling. Cases from a market different than Benelux are used to validate the model.

- *Select the validation environment*

The second step is to select the environment where the validation process will take place. The EMEA Customer Care Network (ECCN) is the key market selected for the following reasons. First, it uses almost the same applications as the Benelux Key Market. Both key markets have Clarify CRM as their official customer relationship management application. Second, it is reachable for the researcher since its offices are located in Eindhoven, the Netherlands. Finally, the relationships between the advisor of this master project and personnel from ECCN are excellent which make the collaboration with this project open and friendly.

The ECCN was created with the intention to provide a cooperative customer service for Europe, Middle East & Africa (EMEA) but issues such as language problems and lack of shared resources that are out of the scope of this project make it unfeasible. ECCN attends at this moment cases from the UK & Ireland Key Market, some Multi Country Region (MCR) such as MCR Nordic (Norway, Denmark, etc.) and independent distributors located in countries where Philips has not representation.

- *Select the cases*

A number of cases that arrives via synchronous or asynchronous ways to the key market previously selected is analyzed. Each case is, firstly, briefly described. Then, it is followed thoroughly and each step is compared with the service process modeled. Discrepancies between the cases and the model are also pointed out. Figure 17 shows a number of figures used to provide a better understanding of the cases.

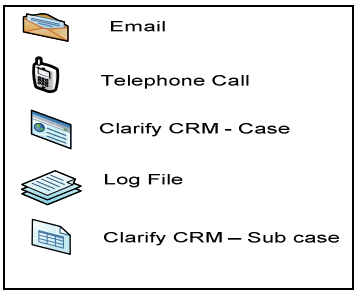


Figure 17 Symbols used in the validation process

5.2. The Cases

1. Case Nr. 4924052 – FSE needs support from Tier 2

This case reports one incident of degree 3 in the severity scale (scale from 1 to 5 where the lower the value, the worse is the case) that is not specified in the problem description. The case title just mentioned that *"FSE needs support from Tier 2"*. After the case is created by the local call center (Tier 1 – MCR Nordic), it is put in the WIP (Work in process) bin of Tier 2 (ECCN located in The Netherlands). Meanwhile, the FSE that initiated this case sends the log files of that case via email to the Tier1 (PMSR) who attaches them to the case created. Tier 2 receives the updated case and triages it.

He determines that support from Tier 3(Help Desk) is required. In the meantime, the FSE communicates via email to Tier 2 that the case has been solved but no information about the solution is provided. To get feedback about that case, Tier 2 tries to contact with the FSE to know how the problem was solved. After a reasonable amount of time without an answer, Tier 2 requests to the case owner to close the case. The case has remained in the status: "Open-Awaiting confirmation" because the case has not been closed when this report was written. The case flow can be seen in Figure 18.

Some differences can be noticed between this case and the modeled process in section 4.4.1. The actor that starts the process is the FSE and not personnel from the hospital where the C/V system is installed. The reason could be that a scheduled task in that system has unleashed an unexpected situation that needs support from specialized personnel (Tier 2) or a C/V system installation has run into a sudden technical issue. Another difference is that the case is terminated unilaterally by the FSE without providing any kind of feedback to Tier 2. In this case is not known whether it was solved and how. It was also interesting to find out that Tier 2 in the ECCN market rarely use remote services such as Radar or RSN connection. The log files that needed are requested directly to the FSE that has reported the case. This situation adds more delay to the solution cycle time.

2. Case Nr. 4895598 – Integris H5000 "Fluoroscopy APR not accepted – Call Service"

This case reports an issue with an old C/V Integris system. The customer communicates that the system is reporting in its first booting the following message: "Fluoroscopy APR not accepted call service". But when the system is restarted, the message disappears. An interesting feature of this case is the fact that the Cardio/Vascular market (Israel) from where this case comes is managed by an independent distributor. In this kind of situations the case is received by a call taker that belongs to a unit called Philips Medical System Response (PMSR). This call generates a Clarify case that can be appreciated in Figure 19. This case is closed after a solution is sent to the customer.

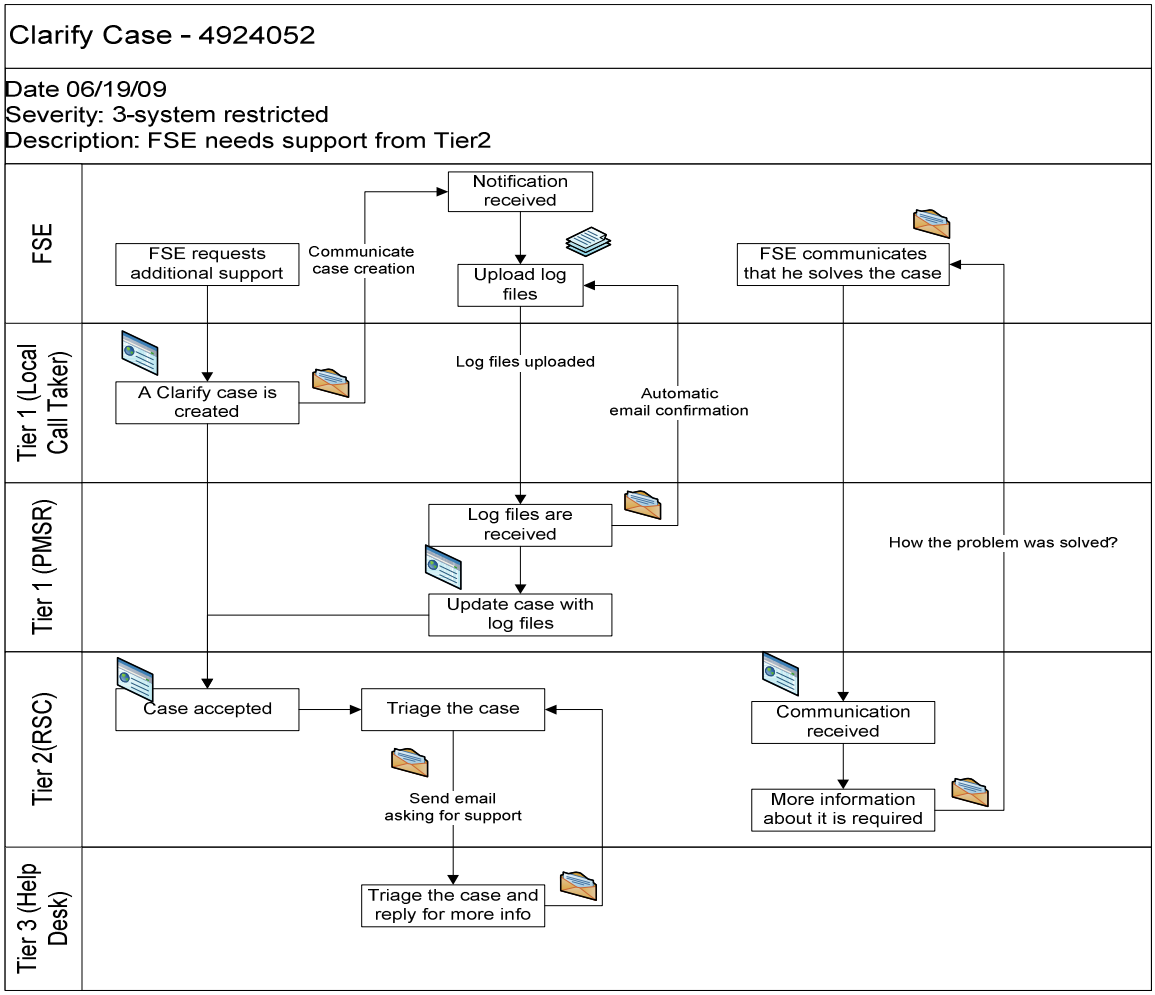


Figure 18 Flowchart of Case Nr. 4924052

3. Case Nr. 4912291 – Factory values requested for validation

In this case the parameters set by the factory for a given C/V component are required. The case starts with a call to Tier 1 (PMSR) reporting that some measurements have been taken and official validation is required from development. The case is transferred to Tier 2 who decides that this case can only be solved by Tier 3 because of their contact with Development. After the case received by the Tier 3 (Helpdesk), they communicate to Tier 2 that information about the equipment settings that lead these results is required. Tier 2, then, translates these requirements to the originator (FSE). The current status of this case is "Closed" but the case has not been solved. It is closed because the FSE that raises this issue is currently on vacation. The modeled part of the case can be seen in Figure 20.

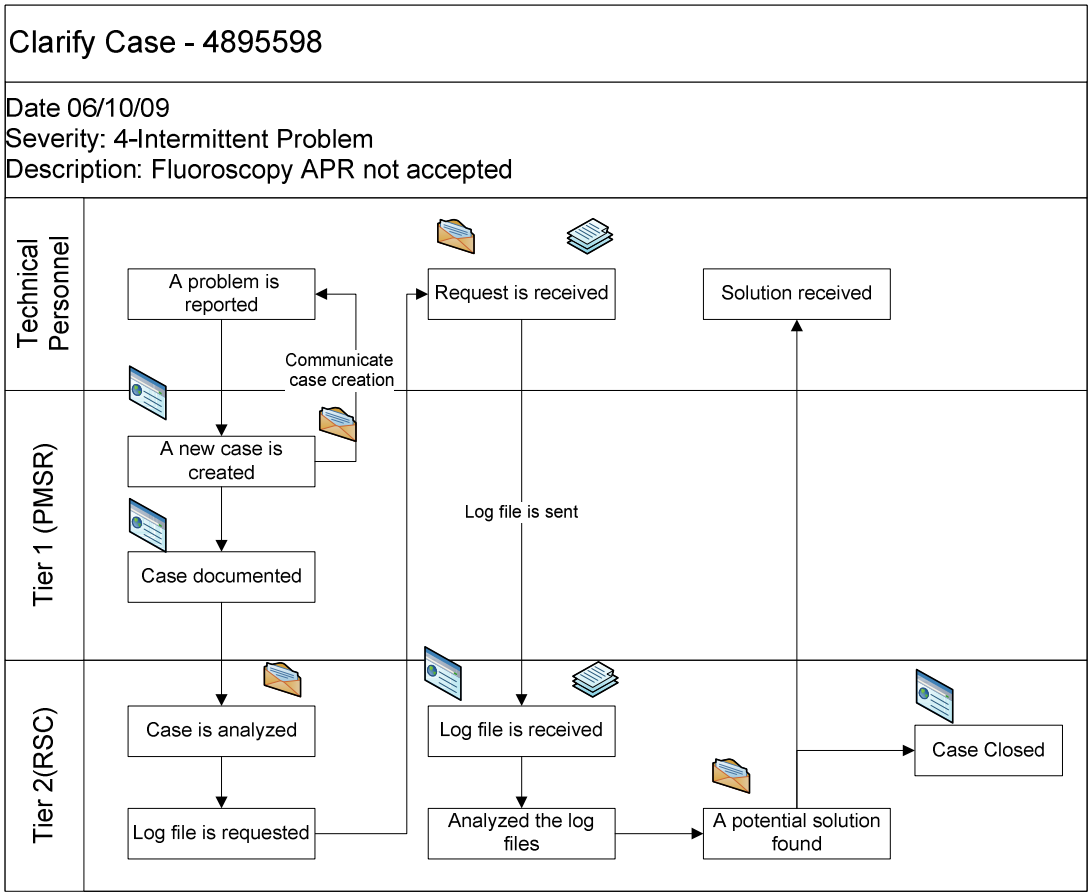


Figure 19 Flowchart of Case Nr. 4895598

4. Case Nr. 4874893 – Intermittent VISUB does not start up

This case reports an issue with the digitalization process in one C/V system. After the case is reported, a FSE is sent to analyze the case on site. He decided to replace one electronic board from the system. After it is restarted and some tests are made, he communicates to the customer that his system is ready. Two days later, the same issue is reported. To solve it, a FSE is sending back to the site. He checks the system and makes some adjustments; he tests the system and decides that now the system is ready. A week later, the same issue appears again, this time a communication is made with Tier 2 in order to obtain further support. The FSE and Tier 2 conclude that changing the same board that was previously changed could solve the problem. They argued that the first board changed was probably dead on arrival. After the board was changed and tested, the FSE communicates that the case is solved and closed. The flowchart of this case can be appreciated in Figure 21. It is interesting to mention that the solution of this case was already posted in KNOVA (See Appendix 4, Figure 45) but the history log of this case does not contain any reference about it.

5. Case Nr. 4870542 – IPC with FD 10/10

A software issue is reported in this case. The case is received via the Tier 1 (PMSR) and sent directly to Tier 2 who after triages the case decides to send it (sub case) to Helpdesk or Tier 3 which is not the same one that has been mentioned throughout this thesis. The problem reported is related to a new cardiology monitoring technology (Witt Biomedical) acquires by Philips and this kind of issues is handled by a Helpdesk or Tier 3 (Interventional Patient Care) located in the United States. After Tier 3 receives the problem, an action plan is found and communicated back

to FSE who is on charge of implementing it to the system. Figure 22 shows how this case has moved during its lifetime.

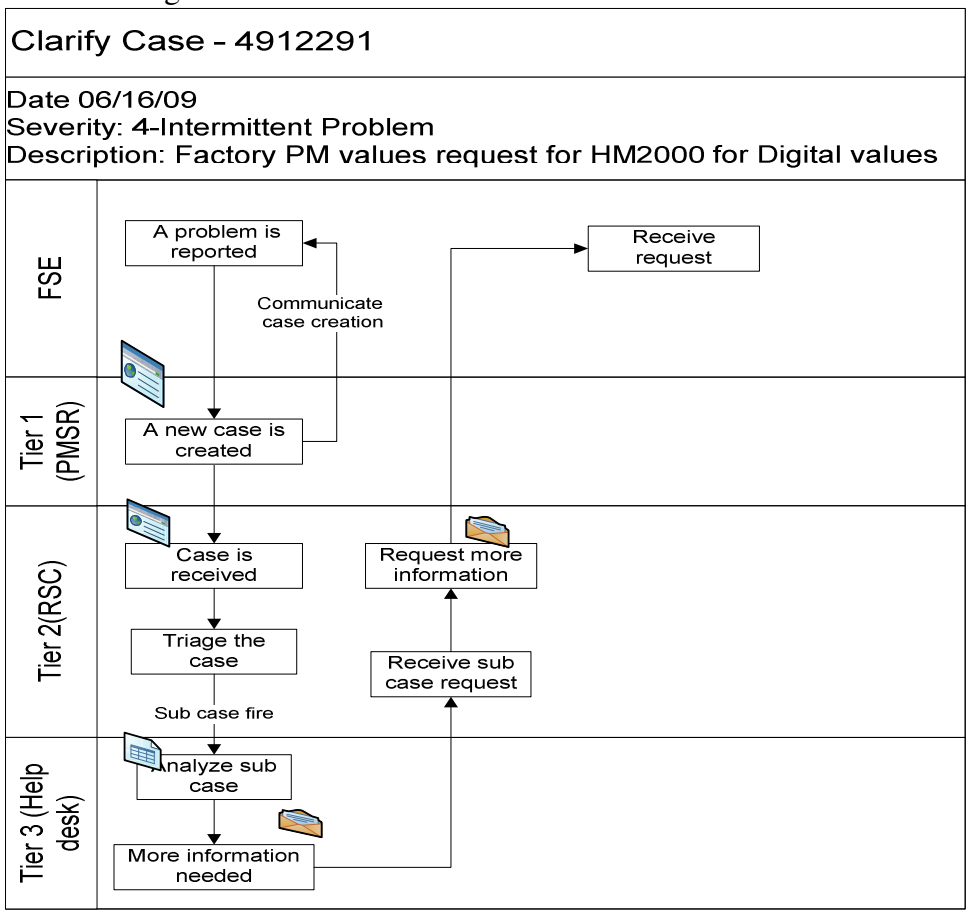


Figure 20 Flowchart of Case Nr. 4912291

5.3. Validation results

After applying the two paths (Expert opinion and Walkthrough case scenario) mentioned in the validation methodology, the results are mentioned as follows.

Expert opinion

- Each participant of the customer service was interviewed (call taker, remote support engineer, Helpdesk member, Helpdesk manager, and field service engineer, monitoring team). After each meeting, part of the process that the interviewee is accountable for was modeled. Then a second meeting was required to show him/her the model and received his/her feedback. In some cases, the same person was not reachable but another person that is doing the same job was interviewed. The field service engineers were interviewed during their training session in Philips Academy (Best) because, on the field, it was difficult to reach them. Three FSE interviews were made (One from UK& Ireland market, another from the Belgium market and the other from The Netherlands market).
- The model validated using expert opinion is shown in section 4.4.
- The technical escalation process has been only validated using the expert opinion because it is a worldwide process which means that there is no market where similar cases can be selected.

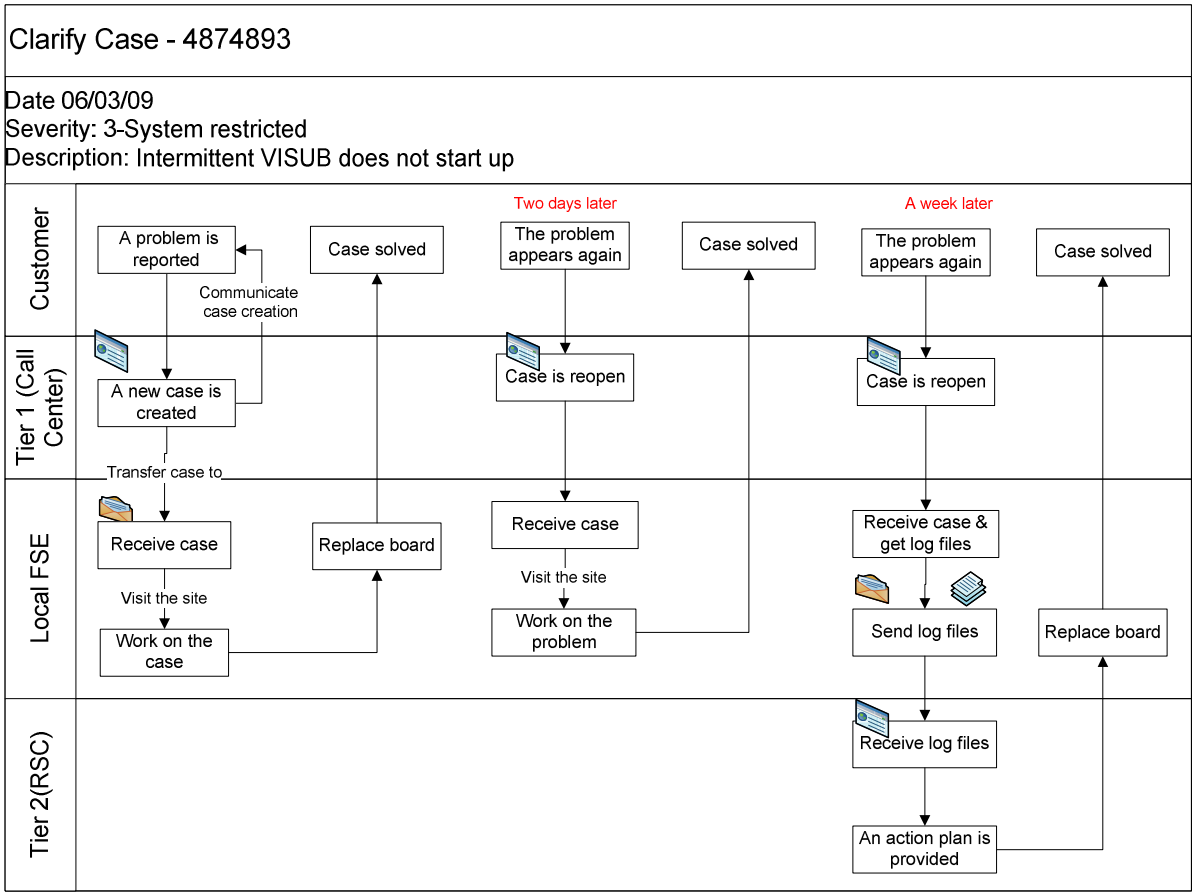


Figure 21 Flowchart of Case Nr. 4874893

Walkthrough case scenario

The results show that in general the cases that were tracked down in the test market comply with the model presented in section 4.4. Clear examples are the second case (*Case Nr. 4895598*), fourth case (Case Nr. 4874893), and fifth case (Case Nr. 4870542) followed. The other two cases have also followed mostly the workflow defined by the call handling model. An unexpected ending (accountable FSE solve himself the problem-*Case Nr. 4924052)* and unusual reasons (accountable FSE went on vacations-*Case Nr. 4912291*) cause some deviations from the modeled process.

The sample used in the walkthrough case scenario is 10 cases. It seems at first glance that the number of cases is a little bit insignificant. However, the average lead time of one case that has passed for the three tiers is around 3 to 4 days. It must be mentioned that Philips customer service has established that a first response, which is normally not the solution, must be generated by the tiers within certain time depending of the contract service signed between the customer and Philips Healthcare. For instance, the first response after a case is reported to the call center must be made within half-hour and it is normally performed by Tier 2. The service level agreement established with Tier 3 is that they have 8 hours to answer a case reported. The reason of that difference between Tier 2 and Tier 3 time response is the complexity level that a case normally reports to Tier 3 possess. Considering the restricted time period of this master project and the average case length, ten cases are a reasonable sample that may allow us to get some conclusions for the validation phase.

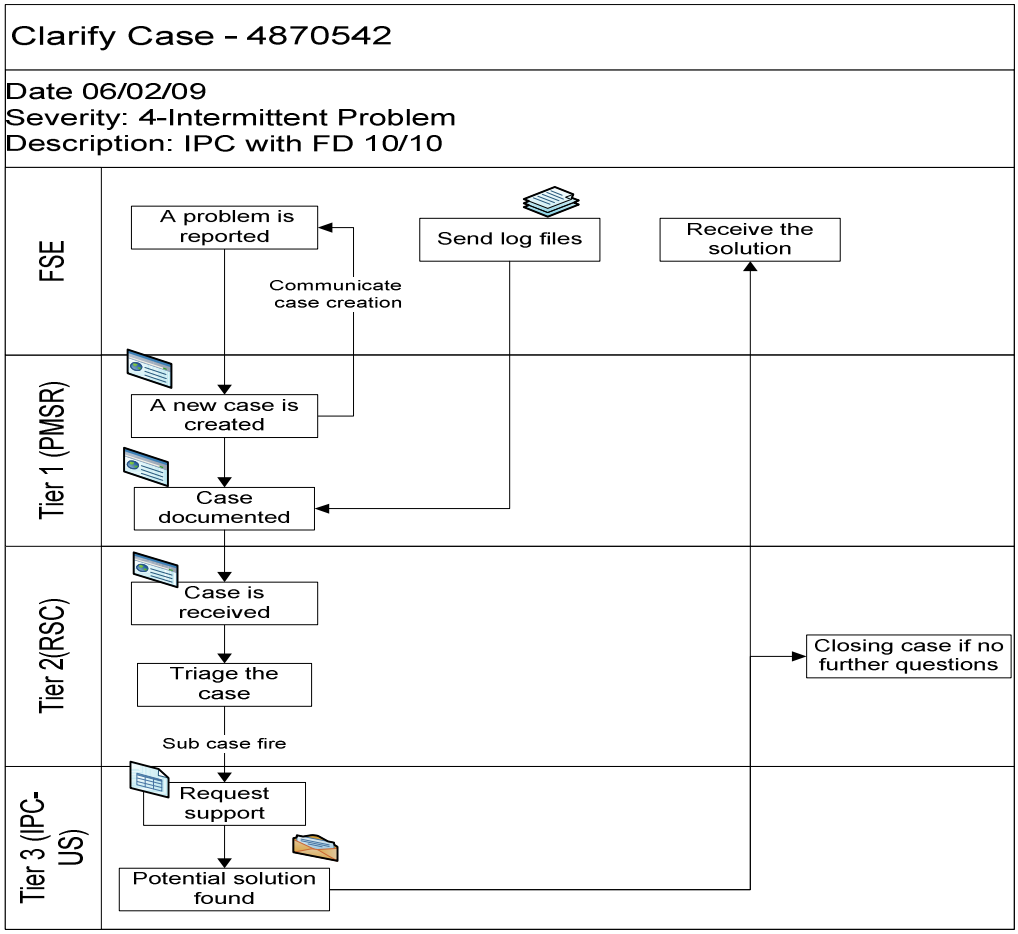


Figure 22 Flowchart of Case Nr. 4870542

The differences between the modeled (Benelux) and tested (ECCN) environment can be resumed as follows.

- The Benelux market used two inputs (telephone call and email) and one resource (Tier 1) to initialize a case. The tested market, on the other hand, used one additional input (internet forum) and two resources (Tier 1UK or Tier 1 Nordic plus a Tier 1-ECCN) to start a case. Case Nr. 4924052 shows this situation. Forums are used in countries where the presence of Philips is limited; the question posted in a forum is then translated in one Clarify case as shown in Figure 23.

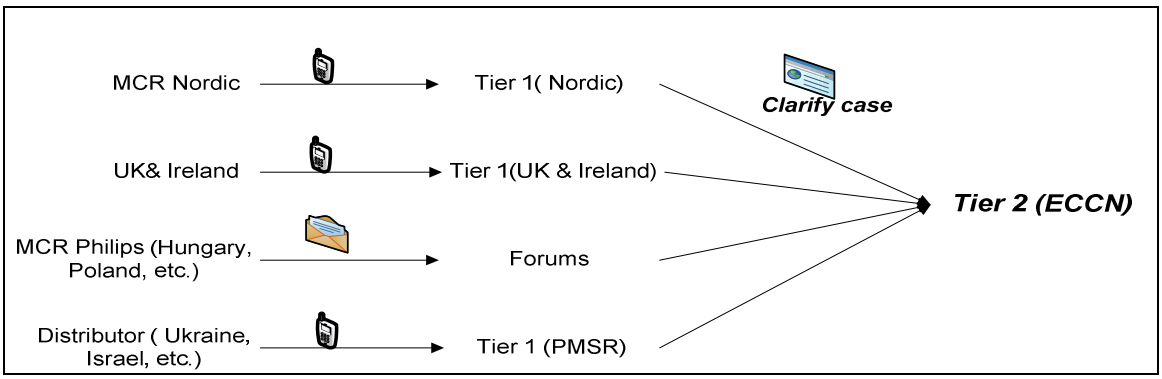


Figure 23 Different inputs for remaining ECCN and UK & Ireland

- The use of remote services such as Radar is more common in the modeled market than in the tested market. In the cases used to validate the modeled process, none of them were analyzed using a remote tool. Any information (log file) needed from the system is requested to the FSE in charge who sends the information via email.
- The starting point of a case is also different. In the Benelux area, technical personnel that belong to the hospital normally report cases directly to Tier 1. In market where Philips presence is limited or distributors are on charge, the case is normally reported by technical or medical personnel to the field service engineer who subsequently will report the case to Tier 1-ECCN.

5.4. Chapter Conclusions

The results of both validation paths have shown that the modeled customer service process comply with tested cases. However, some cautions need to be taken into account before it can be generalized. First, because the validation was made using only 10 cases due to time that each case consumed from its opening until it is closed, and second, because the sample used here only characterizes a portion of the different types of cases that can occur in the customer service.
Some of the most interesting findings during the validation phase were:

- None of the ten cases analyzed uses any kind of remote services during the interaction between Tier 1 and Tier 2. This is a clear difference between the modeled key-market and the validation key-market.
- The actor that starts a case mostly in the sample validated is a FSE. This differs from the modeled key-market where generally is hospital personnel that start a case
- Tier 2 is actually not analyzing log files thoroughly; this is made mainly by Tier 3 personnel.
- A solution of one case (4874893) was found in a later search in KNOVA which is the knowledge database available in Philips. However, references in the history log of the case do not mention that the case solution used information from KNOVA.
- It was surprised to find that a case reported can be ended unilaterally by the FSE without providing further information to Tier 2 about the reasons that made FSE close it.
- None of the cases analyzed has been used to generate further feedback information that can be stored in a knowledge base (KNOVA) to be used afterward.

6. IDENTIFICATION OF POTENTIAL IMPROVEMENTS

In this chapter a number of potential improvement opportunities are presented. They were identified during the modeling phase and the interaction with employees that deal on daily basis with customer issues.

6.1. Ordering of Spare Parts

The current customer service has established in a way that the spare part request process must be done as follows. First, the customer (hospital technical personnel or FSE) calls the call center (Tier 1) to order a spare part. If the customer knows the material number (12 digits number also called 12NC code) and that part is included in the contract service (it can be verified in Clarify), the spare part will be ordered and the case is closed. However, when the customer does not know the material number, his case is transferred to Remote Support Center (RSC) or Tier 2 where he will find out what part is required. When the part is found, the case is sent back to Tier 1 who will make the respective spare part order.

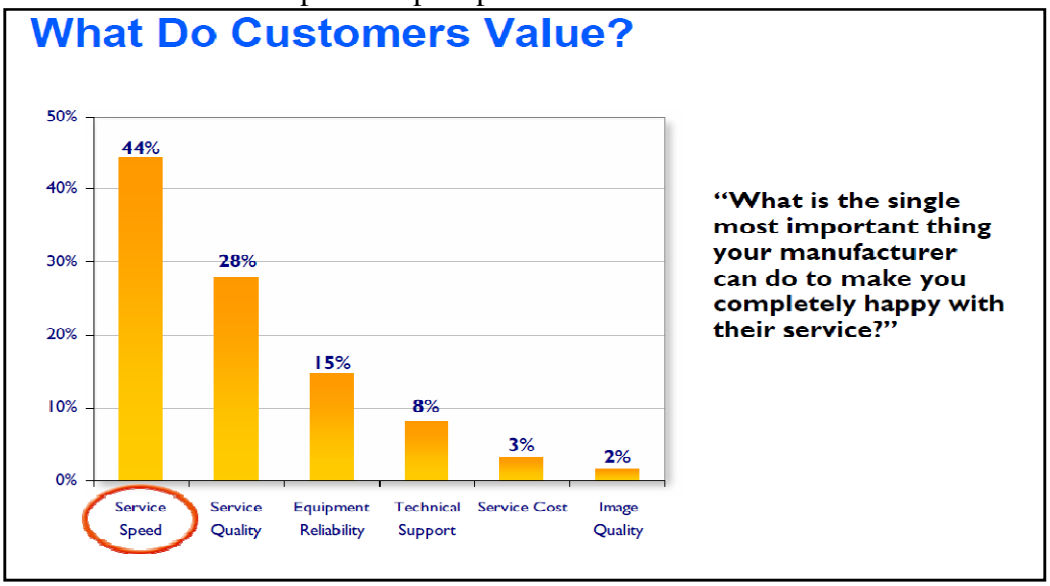


Figure 24 Philips survey [35]

This process seems flawless if time is not considered as one indicator of quality service. However, what the customer wants is that his problems must be solved in timely fashion with the minimum downtime. Philips C/V is aware of this situation as it shows in Figure 25 where a survey indicates that the most important thing for customer is service speed.

Let us consider the following scenario to clarify this point. An unexpected issue in one Cardio/Vascular system located in Gent (Belgium part of the Benelux Market) has stopped the operations of the surgery department in a crowded day. The technical personnel from the hospital and the FSE who just has arrived to the hospital have determined that a part of the control board is damaged and its change will solve the problem. The only inconvenient is that 12NC is not known; just the product description can be seen. When the FSE calls to the call center (Tier 1 located in Eindhoven, The Netherlands) and explains this situation and his urgency to solve the case, Tier 1 argues that he can only order a spare part if the 12 NC is known and what he can do is to create one customer case and transfer the call to Tier 2 (located in Brussels). However, at that specific moment Tier 2 (RSC) is dealing with another issue which means that Tier 1 will communicate to the FSE that the RSC is not available at this moment and the RSC will call him

as soon as they can. Meanwhile, precious time is wasting. But what would happen if the Tier 1 has also the capability of searching spare parts using a sort of database tool where the information about them can be obtained.

6.2. Case routing

The current layout of call handling process is organized around three tiers. The call is received by one operator (call taker) and the process goes on. All the calls are received using the same filter that decides the priority level that a given request service can have. This routing way seems to work properly. However, there are some aspects not considered that make this area a one of potential redesign. The following example shows them.

In the Benelux Market, all customer calls concerning C/V and X-Ray are received by two operators. They collect information about the issue and create a case if the information is about a product's issue; otherwise, they transfer the call to another agent. Each case is classified by complexity level and transferred to Tier 2. They will contact later to the customer or immediately if a Tier 2 resource is available. The aspects not considered are: First, the complexity level 1 (patient is on the table) and level 2 (system down) must require support instantaneously from the Tier 2. That is a direct channel must exist for these situations. Second, avoid information repetition when complicated cases appear. Right now the customer must provide the same information twice or even more times before receiving a proper response. This is not necessarily a proactive way of working and as it was shown in Figure 24 what the customer wants is service speed. Finally, the current process is organized in a way that the call taker receives any kind of call, even if the call is intended to negotiate the addition of new functionalities (add-on applications) to the C/V system that would normally be attended for sales personnel. It would be better if these calls can be rerouted to the commercial department using IT utilities such as more advanced automation call distributors (ACD).

6.3. Incomplete Feedback Loop

The objective of Tier 2 and Tier 3 is to provide reliable and quick solutions to the customer issues. Tier 2 and Tier 3 use all the means available (documentation, log files, knowledge database, remote connections, past own and colleagues experiences, etc.) to generate action plans that can be implemented in the field to solve unexpected issues in C/V systems. However, the communication after the problem has been received is only one way. There is not an official procedure to know if an action plan sent to the field actually works because the implementer of that plan (field service engineer or zone technical engineer) does not have among his duties transfer the feedback of that plan to its creators. This lack of feedback is here called *incomplete feedback loop.* Tier 2 and Tier 3 generally receive news from the implementer if the action plan delivered was not successful. This situation might imply that as long as the implementer does not call Tier 2 o Tier 3 back then the action plan was correct. But, this deduction is risky and can lead to further issues, the following statement obtained during an interview with one field service engineer from the Ireland market explains better this situation: "Normally if an action plan works, I moved to another work and no feedback is sent back, what I did I will put in the job sheet and that is all. However, if the plan did not work, then I normally do not call to the same place because I know that another solution from that side will take longer time and I cannot afford that. Based on my time zone and personal experience, I can call either to the Tier 2 in US or Tier 2 in Israel and ask if a solution is available for my problem". In this case, the Tier 2 (from the UK & Ireland) that came up with the plan probably never receives any feedback about that

case. Even worse, if they assume that because no negative feedback was heard about it, the plan actually works. This "solution" can be communicated to others field service engineers that run into the same issue generating more problems.
The *incomplete feedback loop* must not be seen as only the lack of field service engineer feedback; this problem implicates share responsibilities between the different tiers that are involved in the customer service process. The consequences that the incomplete feedback loop has brought to the customer service can be resumed as follows:

- A repeated problem sometimes makes that Tier 2 or Tier 3 creates a new action plan because an old action plan has not been validated or simply at that particular moment, they are not aware that this is a repeated problem.
- Action plans are not validated which unauthorized these to be used as an explicit knowledge packet that can be stored and shared in a knowledge database, for example in KNOVA.
- Developing of local solutions to tackle this issue that consumes resources and time. For instance, Tier 3- Helpdesk has its own troubleshooting database and Tier 2 – Benelux has also its own local database where information of previous cases is stored.

6.4. Case Handover Policy

Define to what extent is Tier 2 responsible for a reported case and what are the conditions that must be fulfilled to transfer that case to Tier 3 are important issues in the customer service. The desk research that was conducted at the beginning of this research found that none of these has been clearly established. The handover of work between Tier 2 and Tier 3 is currently made based on the experience accumulated over years. This lack of clear rules has originated that cases that must be handled by Tier2 are actually managing by Tier 3 or vice versa. The following example illustrates better this situation.
The use of log files (a XML file that records the execution of C/V system activities) to analyze and detect a possible malfunctioning of the system is a common practice in the customer service, especially if the system is located miles away from where the specialist is. However, analyzing a log file is not a trouble-free task; besides of its bulk, it requires that the specialist knows in detail, first, how to read it; second, what information is in there; and third, connecting that information with the part of the system where the problem might be. These preconditions have created a situation where Tier 2 is sometimes reluctance to analyze a log file and he restricts himself to just handle the case over Tier 3 generating a dependency that delays the case solution.

6.5. Application Redundancy

A critical issue detected in Tier 3 (Helpdesk) is the use of two applications to manage the call handling process: HCS and Clarify CRM. A brief description of the reasons that have led the Helpdesk to use both applications will clarify the actual situation.
Prior to 2008, the customer cases received by Tier 3 were managed in an email agent called HCS embedded in the Lotus Note application. Each email with a customer issue reported not only by Tier 2 but also by field service engineers became automatically a HCS case. Furthermore, Tier 3 also created HCS cases to keep record of the telephone calls made by FSEs that were attended.
Ease of use, the ability to create threads like a network social application (e.g. Facebook), search capability to find old cases, and fast information access are some of the features that the HCS users have claimed. However, there are also some disadvantages that this application has brought to the process. For instance, lack of case ownership, resources employ to solve the case are not

recorded for further analysis (e.g. manpower, spare parts, time, etc.), no information to analyze the C/V system historical record (e.g. downtime per month, repair time, etc.), and disorganized flow of information because requests can come from several sources (e.g. FSE, ZTS, Tier 2, etc.).

In an attempt to normalize their customer service process, Philips Healthcare launched in 2008 their *Clarify T2-PMG Project* with the idea of "improving the way Tier 2 engineers and Program Management Group (PMG) Helpdesk engineers collaborate on customer corrective maintenance issues". The objective of this project was to provide one tool (Clarify CRM) that can handle the costumer service request since it is received by the call center until it is solved remotely or by one field service engineer. By the second quarter of 2008, the project was rolled out and the Cardio/Vascular Helpdesk started to receive only cases in Clarify CRM. However, few weeks later complaints due to lack of support and tardiness in case resolutions started arriving to the business unit. This situation forced management to maintain the use of both applications.

Management is aware that using both applications represents not only an expense (e.g. personal HCS license costs almost €800 per year) but also an extra use of resources such as time consumed, information redundancy and system maintenance. The final solution of this problem must be thoroughly considered because, firstly, it is a trade-off scenario (i.e. process quality vs. time resolution), and secondly, the field service engineer is one of the most important customers in the service process (e.g. in US almost 40% of the calls that are received in Philips call centers come from the FSEs).

6.6. Information Not Reusable

The use of Clarify CRM in the customer service has made that the user changes his way of working because now more information is needed as an input to create a new case but at the same time more information can be obtained to analyze the customer needs. When Clarify CRM was introduced, management defined that a customer case must be handled as it is shown in Figure 25. First, a case is created after Tier 1 received a request from a customer which can be synchronous (telephone call, personal contact) or asynchronous (email, fax). This case is normally transferred to Tier 2 who starts a triage process in order to solve the case. If no solution is found in this stage, then the case is sent to Tier 3 as a sub case (i.e. only information that is practical to solve the case). Normally, at this stage, the case is solved. Otherwise, the development area is involved or other procedures can arise.

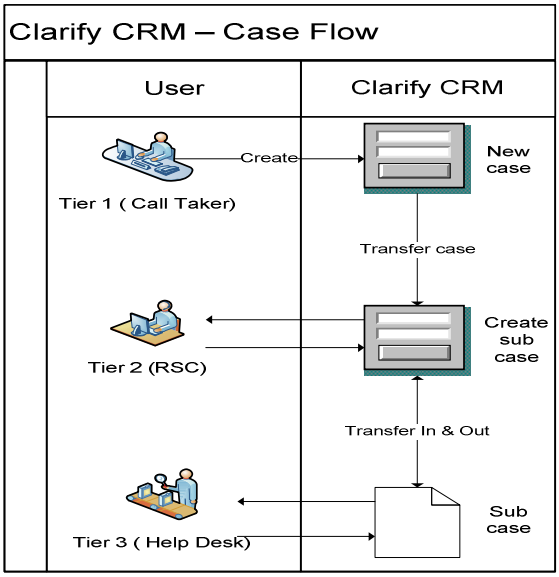


Figure 25 Clarify CRM- Case Flow

The issue with this process is not to add additional information such as print screen or log file as an attachment to a created case. Although it is not the most user friendly process, it can be made and after a while the user gets used to it. The real issue is to retrieve and use the information that is already inside Clarify CRM to solve another case that can be the same (different customer) or similar to a previous one solved by the same or another technical analyst.

At least three disadvantages that limit Clarify CRM to reuse the stored information for further cased can be mentioned.

1. The user must remember the case number where the needed information is stored. The main access to a previous case is using the window shown in Figure 49. If the user does not know the case ID, nothing else can be done in this window.
2. The alternative option to access a case is using a query (see Figure 50) which is not precisely a quick and easy way to find information. The user must have some notions about structured query languages and know exactly what is looking for each field considered in the query.
3. After the case is found, the information that can be useful to solve another case is embedded in one field called “Case history”. This text box contains not only information that can solve the case but also notes made by the call taker, information of the attachments annexed to the case, and each step that a member involved in the case has made. The disadvantage is that this mixed-up of information does not allow the user to retrieve in a timely fashion only the information that matters to solve the case. Figure 51 shows this situation.

7. STRATEGIES TO IMPROVE THE CUSTOMER SERVICE PROCESS

At this point the modeling of the "As-Is" process, its validation, and the identification of some areas that can be improved have been done. This chapter provides a number of strategies created using a combination of grounded theories and knowledge captured in the daily interaction with the members of the customer service.

7.1. Ordering of Spare Parts – Redesign Scenario and the e-SPF addition

In Section 6.1 it was argued that the current spare part ordering process could add some delay problems to handle customer order in timely fashion when the resource (Tier 2) is not available. This issue is caused due to the fact that the ordering process is a dependent one (Tier 2 as well as Tier 1 must be present) when the customer does not know the correct product code (12NC) or product description. In other situations, the case is handled directly by Tier 1. Figure 28 shows in its left side the current situation.

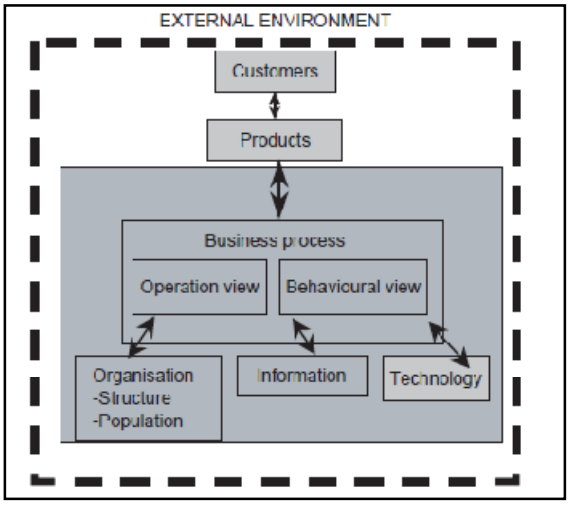


Figure 26 Framework for business process redesign

To improve this process, the "best practices" in business process redesign are used. Before starting with the use of these, it is important to utilize a framework that provides the different areas (customers, organization, information, technology, etc) in the organization that can be affected when a best practice is adopted. Here the framework (see Figure 26) derived by Reijers and Mansar (2005) is used.

In order to come up with a redesign process that reduces the response time from the moment the customer calls for a spare part, the following steps must be followed. When the customer does not know the product description or code, Tier 1 will search for that part using the electronic spare part finder (e-SPF) which is a tool developed by Philips but at this moment is only used by field service engineers to look for parts. This tool has an option to search parts by product description or code using wildcards when one or both fields are not completely known. Another interesting feature is the possibility of search spare parts sorted by C/V system. Figure 27 shows a screenshot of the e-SPF where the main components of an X-per system can be appreciated.

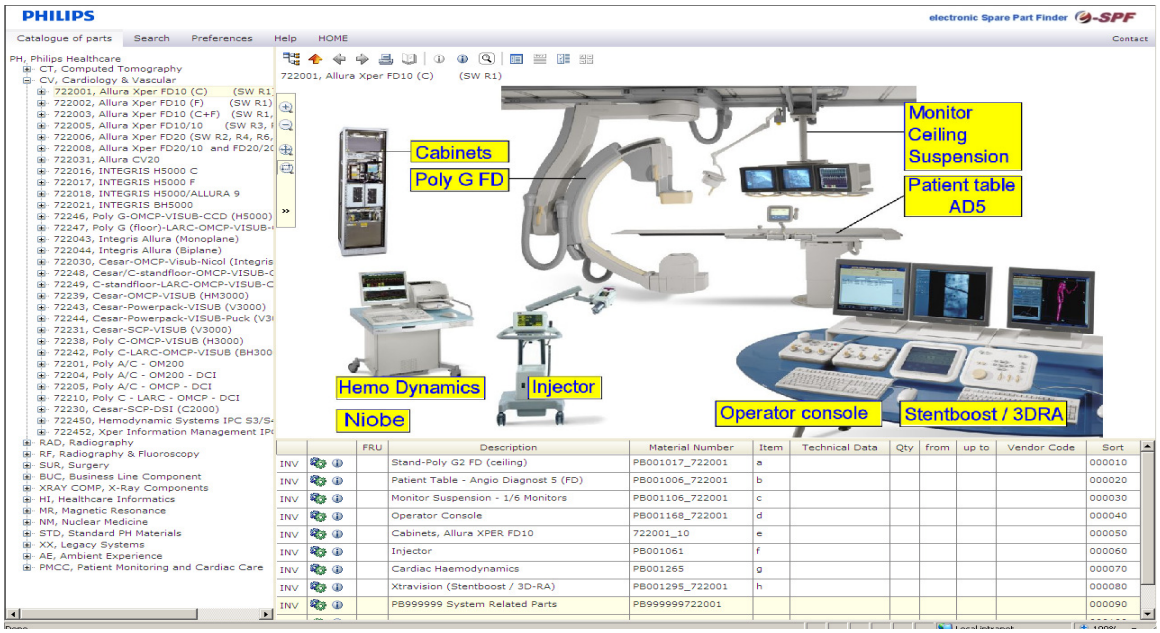


Figure 27 Electronic Spare Part Finder

The application of this tool is not a straightforward process, on the contrary, it requires a patient training program that allows members of Tier 1 to know how to use this tool and handle some exceptions. Moreover, it must require at the beginning some monitoring process from Tier 2 to correct and support complicated requirements.

The application of this tool to order spare parts must create a new scenario which is shown in the right side of Figure 28.

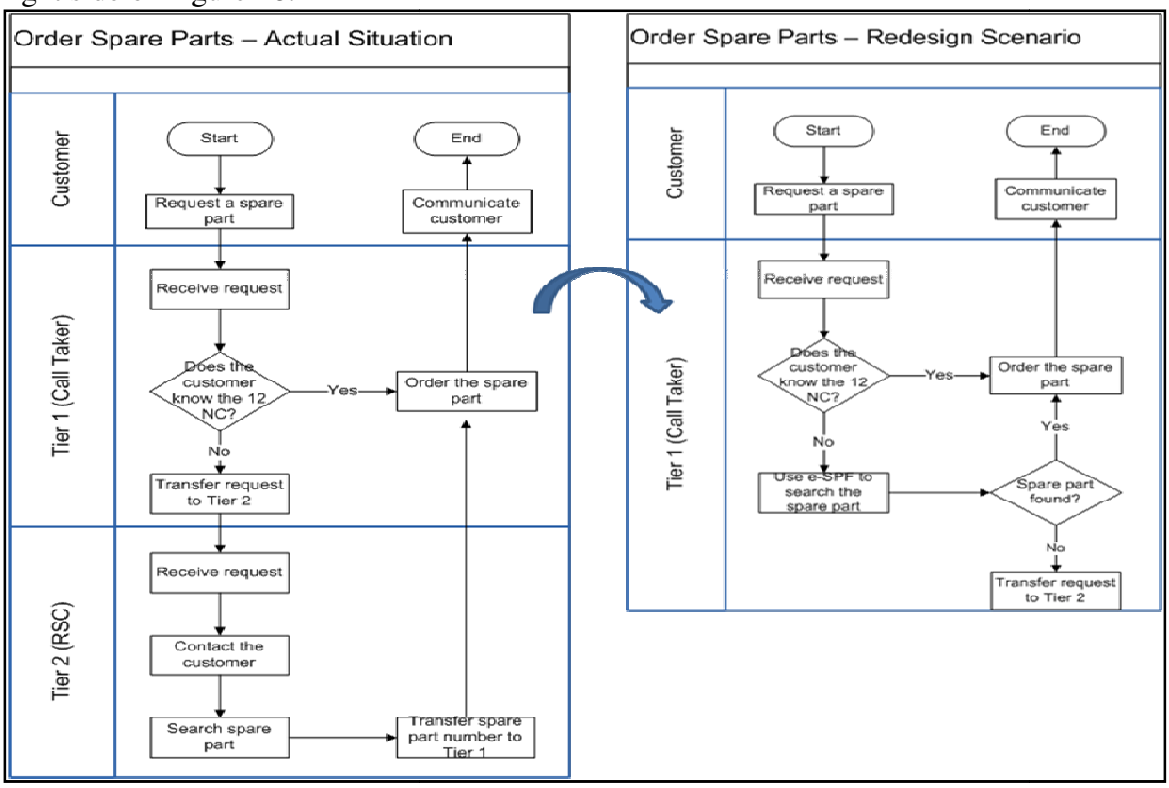


Figure 28 The current and future ordering spare parts process

In this redesign scenario some "best practices" can be mentioned, for instance, "contact reduction" because this redesign will lead that the customer makes contact directly with the resource (Tier 1) that solves his problem. Also, a "task composition" practice is gained because Tier 1 is going to combine small tasks into a consolidated one. Finally, this redesign leads to "the integration of technology" where the ordering process can be improved using a new technology (e-SPF).

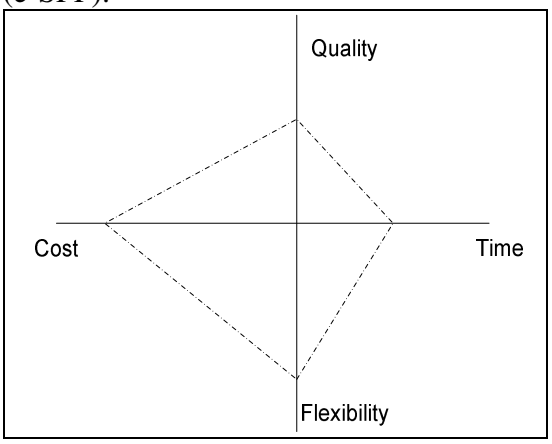


Figure 29 Evaluation of ordering spare part

This redesign is evaluated using the devil's quadrangle frame defined in section 3.3. As it was mentioned there, every redesign leads to a number of advantages and disadvantages that must be put in perspective if the redesign wants to be implemented. The main improvement seen here is the reduction of the response time (Tier 1 will do the complete process) and the increment of flexibility (keeping open other options such as recurring to Tier 2). However, the quality of the service might be compromised if a correct training is not provided to the employees on charge of this operation. The training process implies in the short term that the cost of the process could increase. But in the long term, cost savings can be gained due to the reduction of resources used by this operation. Figure 29 shows the qualitative evaluation using the devil quadrangle.

7.2. Case routing – Adding advanced ACD

The situation when a call arrives to the call center is depicted in the left side of Figure 30.The red dotted line shows the repeated inquiry of information made by Tier 2 because normally Tier 1 provides an insufficient description of the problem reported. The same figure shows the current Automatic Call Distributor (ACD) menu for the Benelux Market with only three options for the different modalities available in the market.

The approach used to improve this situation is to add a second or third level to the ACD menu, thus the customer can select the option that suits best his problem; the example provides four options: system down, technical issue, spare part request, and service contract. This add-on to the current situation will provide customers in extreme situation (severity level 1 or 2) the possibility of connecting directly with personnel (Tier 2) that can do more for them than just recording their problem. Furthermore, it will avoid customers provide the same information twice or receive a call back from the customer service (Tier 2) to find out what the issue is. The addition of an advanced ACD is mentioned by Jansen-Vullers et al. (2006) as one form of "task automation" that can lead to the increment of performance in call centers. "Contact reduction" is another best practice that can be achieved with the proper implementation of an advanced ACD solution. The right side of Figure 30 shows the redesign process where available options have been augmented and critical calls are attended directly by Tier 2 and calls concerned to customer service contract or renewal as well as new system application or feature quotation are attending somewhere else.

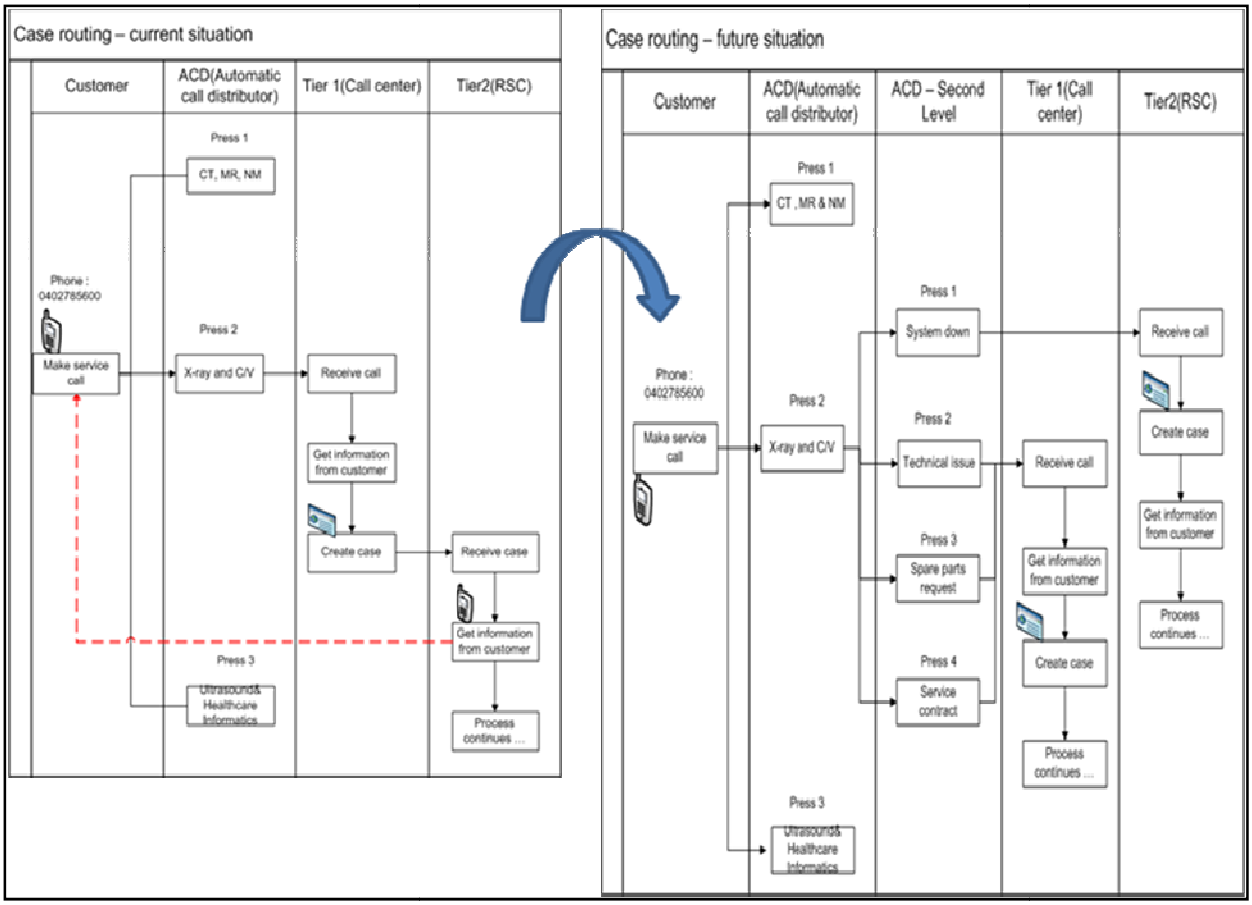


Figure 30 Adding advanced ACD menu

The evaluation of this new ACD menu with extended options is given in Figure 31. The trade-off among four indicators can be appreciated. For instance, it is expected that the quality of process from the perspective of the customer increase and the response time can be reduced. However, smaller number of contacts might lead to the loss of essential information. The flexibility of the process is also affected because the options available in the ACD menu restrain the customer possibilities when a call is made.

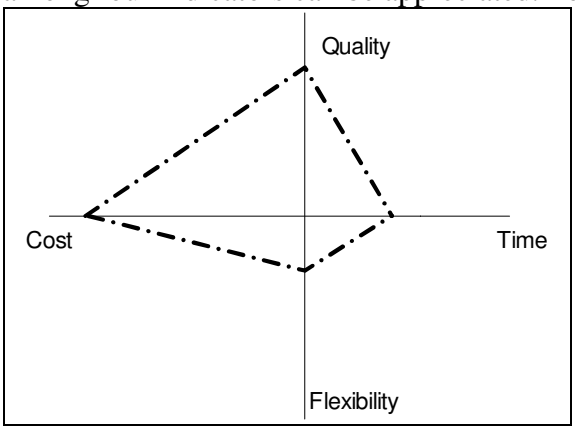


Figure 31 Evaluation of adding an ACD menu

Overall, this redesign can reduce the response time; increase the service quality; but the cost of the process is increased because of the investment made in the new technology and the flexibility of the process is reduced due to the limited number of options available. Despite of the advantages that this redesign can bring to the current process, there is an issue that must be carefully considered. It is the possibility that the customer judges all his cases as system down in order to receive a quick answer. This situation could create a bottleneck situation for Tier 2 that

can make the process poorer compared to the current situation. An active communication phase with the client is required to explain the advantages that he can gain if the correct option is used to report a problem.

7.3. Improving the feedback information process

From Section 6.3 to 6.6 a number of issues found during the modeling were presented. All of them are related to information flow that is generated in the process from the moment that a customer technical request is received. Figure 32 shows how these are linked to each other. The lack of feedback information (1) that creates an incomplete loop is portrayed by the red dashed line between FSE and Tier 2 as well as Tier 2 and Tier 3. The case handover policy (2) discusses the minimum requirements needed to hand over a case between Tier 2 and Tier 3. Two tools (HCS and Clarify CRM) illustrate the current redundancy of applications (3) to store customer cases; the blue dot dash lines entering to Clarify CRM and HCS give the actual situation about storing and retrieving (currently made only by HCS) information for old and new cases. The red dot dash line coming out from Clarify CRM shows that no information is actually retrieved from Clarify CRM (4) to solve a new or a recurrent technical problem (reuse of information).

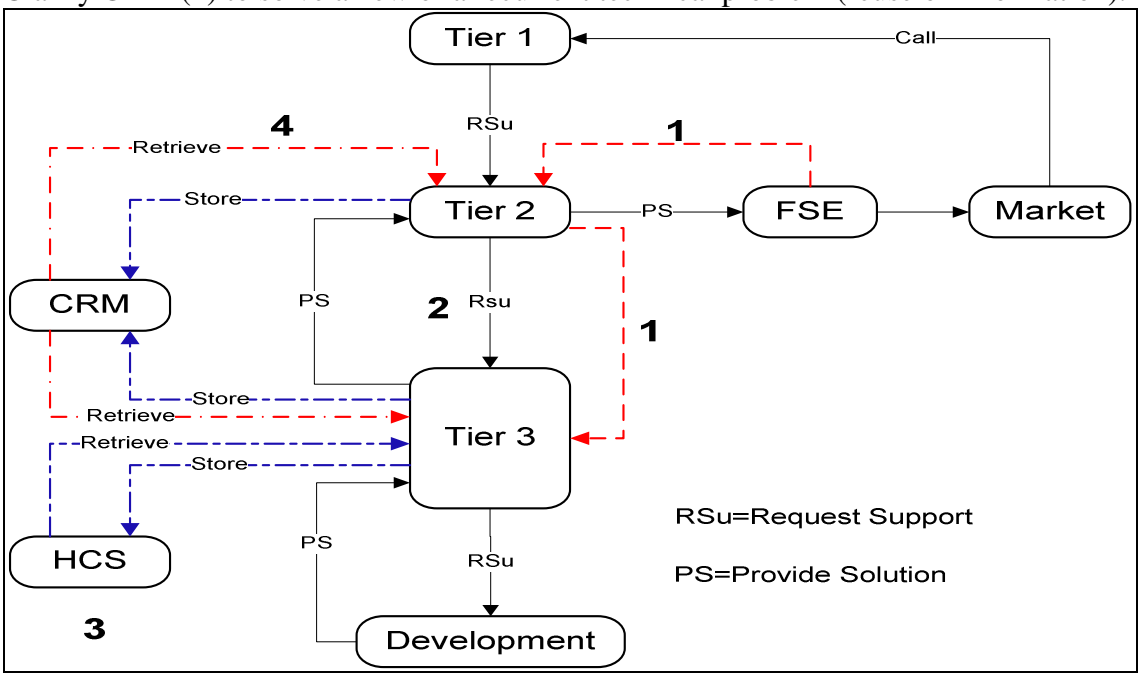


Figure 32 Areas detected during modeling of the call handling process

The remaining of this section is organized as follows. Section 7.3.1 gives some theories and practical applications currently used to collect effectively feedback information. Section 7.3.2 describes the participants and the reasons that make us to select Clarify CRM to close the feedback loop mentioned before. Section 7.3.3 explains how to close the feedback loop in the customer service. Section 7.3.4 clarifies the steps needed to implement a handover policy. Finally, section 7.3.5 discusses the issue of application redundancy presents at this moment in the Helpdesk area.

7.3.1. Current feedback applications and theories

The issue of customer feedback information is not new. In fact, almost 95% of companies collect feedback information [36]. Surprisingly, only 5% of them tell their customers that they have used

the feedback. The reasons are vary: feedback mechanisms poorly designated, no idea what to do with the data, or lack of culture of valuing customer feedback. However, during the last years this trend has started to change and customer feedback has become more important with the emergence of fields such as Enterprise Feedback Management (EFM), which is the discipline of managing multiple feedback collection projects covering all relevant business processes within the enterprise [42], and Customer Feedback Management (CFM) services. A clear example of this integrated approach to collect and use sensible feedback information is the one provided by Clarabridge [37] which is a company dedicated to capture unstructured feedback information from the field.

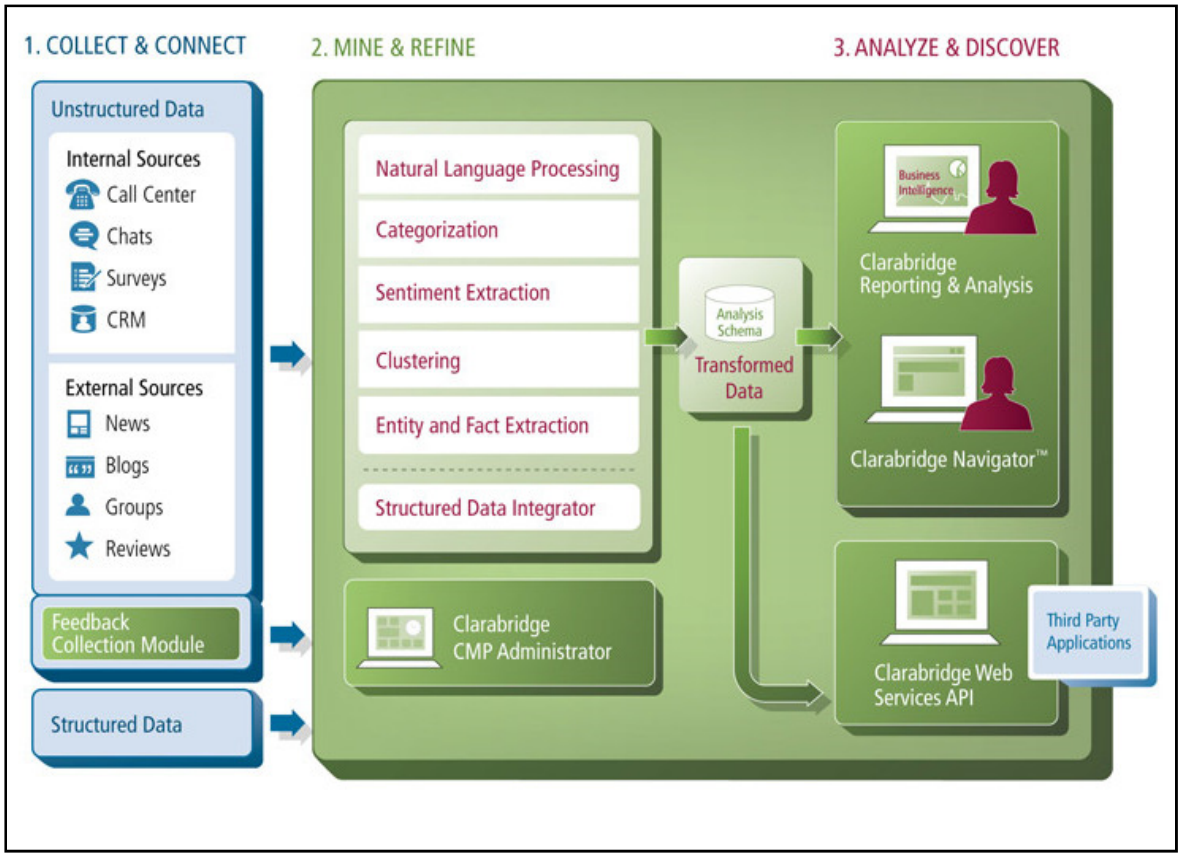


Figure 33 Feedback Approach from Clarabridge

Another approach to collect feedback information is proposed by Microsoft [38]. They argued that the most efficient, cost-effective way to collect and manage feedback is to categorize and structure it as it arrives. They proposed a four-step approach.

1. Start with a clean slate.
2. Choose tools that lead to structure
3. Look for patterns
4. Start to gather feedback internally

Even though all of the tools proposed in the previous approach are directed to use Microsoft tools, the major steps given are interesting if a closing feedback loop wants to be planned.

A feedback approach that is really interesting is the one used by Kampyle [39] which is a company that provides feedback analytics to websites. They use a web-form (See Figure 34) to collect information about users of a given website that will later analyze, manage and

communicate to the interested parties. Although the approach used by Kampyle is currently used only in websites, their idea can be used to collect, for instance, feedback from field service engineers.

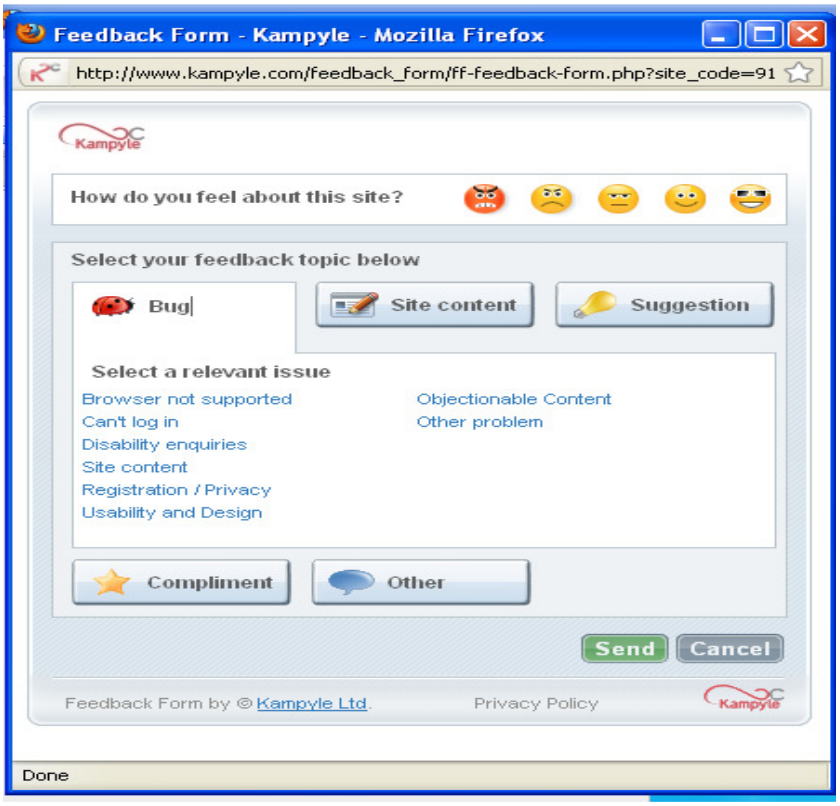


Figure 34 Kampyle Form used to collect feedback

A theoretical approach that can offer possible explanations for observations, discover knowledge, or allow making predictions is proposed by Nauck et al. (2006). They used a Bayesian networks approach to provide in-depth analysis of feedback information collected by a CRM application. They argued that most of the techniques used to perform data analysis are based on linear models because they are easy to understand. However, feedback data variables are rarely independent and normally distributed; basic assumptions to perform linear regression. For these reasons, the authors proposed an approach that can take into account these non-linear dependencies and randomly distributed data to generate valuable feedback information.

7.3.2. The participants and why Clarify CRM

The starting roadblock to deal with closing the feedback loop is to identify who the participants of this process are and what applications or tools are available. Tier 1 is only used to initiate the process; after the case is created technical information concerning to the product is not handled by this tier. The field service engineers (FSEs), Tier 2 (RSC) and Tier 3 (Help desk) are clearly the participants.

The application where the feedback information will be stored is not completely clear because even though KNOVA has been defined by Philips Healthcare as the Knowledge database, it is rarely used by the members of Tier 2 or Tier 3. There are at least two disadvantages with the decision of using KNOVA as the depository where the information feedback must be stored.

- The existing process to create, approve and upload a solution is too complicated. It includes a written request to add a solution, plus two evaluations from different content managers. Official Philips documentation [41] describes this process. It assures, on one hand, the quality of information but, on the other hand, it makes the process so lengthy that employees are discouraged to use it.
- The user must move forward and backward from his most common working tool (Clarify CRM) to another environment (KNOVA) to store information that was previously stored in his working tool

Both reasons make KNOVA unfeasible to be used as the daily depository where information recently generated in field can be stored, updated, and validated. Instead, in this work, Clarify CRM will be used as the information repository for the following reasons:

- It is the application used by Tier 2 and Tier 3 to handle technical customer requests. It can store and retrieve information as well as send it forward via email or text messages to the remaining participants.
- It has an in-built database capability that allows users to create solutions and link to reported customer cases.
- Philips Healthcare have already spent plenty of money in the deployment and customization of this tool and it makes more sense to use it in its fully capacity than change to another one.

An important component of the feedback process is the field service engineer who is on the field implementing the action plans given by Tier 2 or 3. He is the one that decides whether an action plan was successfully applied or further modifications are needed. Consequently, the FSE is the starting point of the feedback procedure. However, compromising the FSE to participate actively in this process is a difficult task because his main goal is to solve the technical problem as soon as possible and, then, to move to another case. This situation causes that the feedback communication of the action plan to its originator is seen as a secondary or even lower task priority by the FSE. During this internship, some interviews were made with FSEs to know in details their opinions about the lack of feedback information. Three of them argued that they communicate back to Tier 2 when a received solution actually works, but always via telephone. One FSE told me that a feedback mechanism would be supported as long as it takes no more than five minutes. All of them stated that they know about KNOVA and its purpose, but it is commonly not used in their daily work. Furthermore, they argued that when they used it, their queries returned, most of the time, no valuable answers.

Even though the interview sample is not reliable to obtain healthy conclusions about the FSE perceptions of the feedback process, some might be made. Firstly, field service engineers are actually communicating back when a solution or action plan works but they made it generally via telephone which can cause that the receiver lost this information if he does not transfer it immediately into explicit information (i.e. store it in a knowledge database). Secondly, getting feedback information from the FSE must be limited to a short time frame because the environment, where the FSE is working, does not provide him with the most pleasant conditions to transfer feedback information. The FSE must deal not only with the technical issue but also with unique features that surround it, for instance, doctor's intolerance, time pressure, lack of connectivity on the field, etc. Finally, there is a recurrent thought among FSEs that feedback systems can rarely do something for them, some of them see some importance on this issue but others issues such as reliable tools (WOMPA), availability of spare parts and administrative matters have largely their attention.

7.3.3. How to close the feedback loop

In order to close the feedback information loop, the following pre-conditions are required:

- The one that generates the solution or action plan is accountable for obtaining the feedback. For instance, if a member of Tier 3 has generated a solution or action plan, he must validate and store it in a knowledge repository.
- The knowledge database built in Clarify CRM will be used as knowledge repository.
- Clarify CRM does not have at this moment all the features required to create a close feedback information loop. However, it is the application that offers better chances to improve the current situation. Features such as automatic feedback dialog box after an action plan has been read, an automatic remainder when a deadline has passed without feedback, a reliable search tool and user's rating for available solutions need to be implemented.

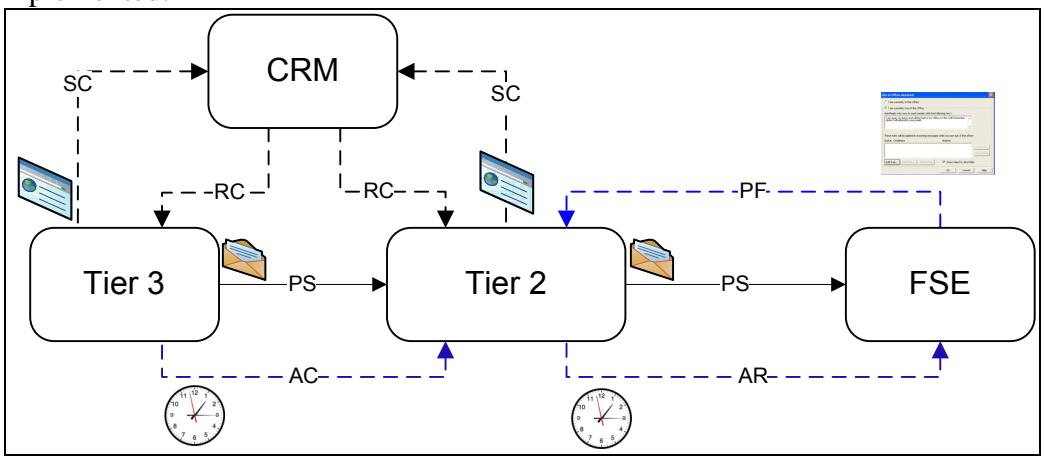


Figure 35 Complete feedback loop

The new process proposed is shown in Figure 35; the explanation is given as follows.

1. The solution or action plan must be transferred from Tier 3 to Tier 2 or from Tier 2 to FSEs via email generated by Clarify CRM; that is *Provide Solution (PS)* arrow. In case of urgency, it can be communicated via telephone but an email with the solution or action plan must be sent afterward.
2. After the FSE reads the email with the solution and wants to close it, a dialog box (*Provide Feedback (PF)* arrow) with only 2 fields: one asking if the action plan has solved the problem and other asking for valuable feedback or comments about the plan will be displayed. In case that the FSE chooses to close the window without sending any feedback, an *automatic remainder*(AR) message will be generated by Clarify CRM in a reasonable time to remember the FSE that a feedback from an action plan is still pending.
3. The feedback process between Tier 3 and Tier 2 is different because it is made inside Clarify CRM. The dialog between them to solve a case will remain stored in the History box, which is a Clarify's feature already used to store the interchange of information between the participants of a given case. However, when a solution or action plan is found, it will be stored in the in-built "Solution Form" available in the CRM application and linked to the case (See Appendix "Create Solution"). The linked process is automatic and the advantage is that an available solution can be used simultaneously for more than one case. This part of the process is identified in Figure 35 by the *Store Case* (SC) and *Retrieve Case* (RC) arrows that are coming in and out of the CRM application.

4. The action plan or solution can be edited by authorized personnel. They can be tracked down using the log history option available in Clarify CRM. At this time, there is not an option inside Clarify CRM to review current solutions. The addition of this feature would enhance the trustworthiness of this mechanism.
5. A valid feedback could be simply "Yes" or "No" for the first field and an empty answer in the second field. The responsible of the feedback must determine if further information is required.

The main advantage that can be gained if these changes are implemented is that solutions or action plans validated on the field will be available. They can be used so solve repeated problems faced not only by the author of the solution but also by any member that has access to Clarify CRM. Another advantage is the fact that information will become reusable. Hence, closing the loop will tackle at the same time the lack of reusable information identified in section 6.6.

An important feature needed to reuse the information that will be obtained is a reliable search tool inside Clarify CRM. This tool has to be capable of searching cases not only using the case description but also features such as C/V system version, date, or author's name. Finally, this proposed change is a step towards the creation of a knowledge warehouse (KW); Nemati et al. (2002) mentioned that one fundamental functional requirement, that any KW must possess, is the ability to update the KW via a feedback loop of validated analysis output.

The proposed schema has also potential drawbacks that must be carefully considered. For instance, the success of this change depends primarily of the intrinsic and extrinsic motivation that personnel (FSEs, Tier 2, and Tier 3) possess; especial attention must be put on the FSEs because they are the initiators of the feedback process and failure is likely to occur if they are not compromised. Furthermore, the lack of features such as automatic confirmation, feedback form, and solution rating required to support the proposed process shows in Figure 35 can jeopardy it. Moreover, Management must be committed with the proposed process. Niazi et al. (2006) found in their literature study about critical success factors (CSF) that the most mentioned critical success factor in the implementation of software projects is management commitment. The lack of it can generate situations such as project abandon, management distrust, and social loafing.

This section has discussed how the feedback information loop can be closed. An important part of this process that has not been yet mentioned is the handover process between Tier 2 and Tier 3. Now the attention is turned out to that point.

7.3.4. Case Handover Policy

It was argued in chapter 6 that one area of potential improvement is the handover of work (customer cases) between Tier 2 and Tier 3. The main benefit is to know the extent that Tier 2 has to go with a case before he transfers it to Tier 3. This situation helps Tier 3 by avoiding starting each case from scratch, reducing the solution odds because some have already tried, and documenting the steps taken with an open case.

The steps that this policy must comply are shown in Figure 36. Their description is given as follows.

1. The process starts with the analysis of C/V system reported using available resources (remote connection or via telephone). If solution is found, it is reported to the customer and Clarify CRM case is updated using the Clarify CRM "Solution Form" given in the previous section.

2. In case that no solution has found in the previous step, a log file that includes data from the days when the problem appeared is downloaded using a remote connection or requested via email.
3. A structured analysis starts from that moment using tools such as Log Viewer which is used to search for possible flaws inside the log or Radar that can match up the error or warning found in the log file with a previous stored solution. These are combined with other tools (In-Center, PROMise, Clarify cases, etc.), peer opinion, or previous experience to look for an action plan that can be solved this issue.
4. If an action plan is found in the previous phase, it is transferred to the implementer (FSEs) as well as stored in the Clarify CRM "Solution Form". Otherwise, the case is handed over Tier 3.
5. A number of requisites are needed to perform the handover. Firstly, the description of the system as well as its history, at least, of the last three months is required. Secondly, the steps taken by Tier 2 must be carefully described (i.e. what tools Tier 2 have used and what they have found). Finally, a previous search of similar cases in sources such as Knova, Clarify CRM, and In-Center should be performed. All these steps made before the case arrives to Tier 3 must be included in the ***Report tab*** feature which is not yet added to Clarify CRM.
6. When Tier 3 receives the case, he will start from the point where Tier 2 has left the case. This implies that a mutual trust must exist between both tiers to ensure that previous work was correctly done. Then, Tier 3 will focus on areas that were no considered by Tier 2 because of his lack of knowledge or experience.

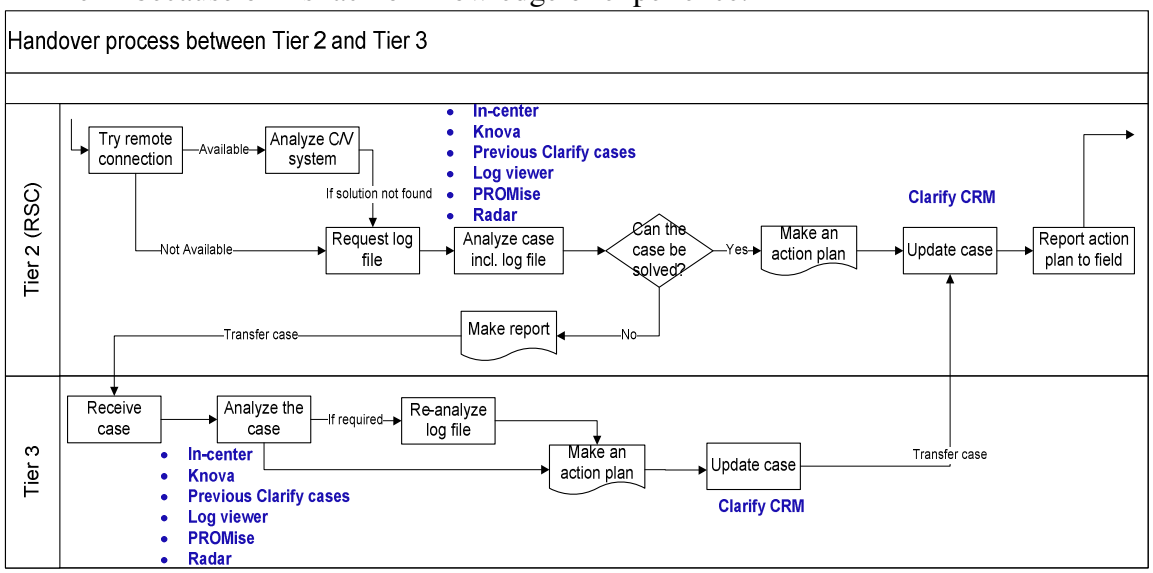


Figure 36 Handover between Tier 2 and Tier 3

7. If an action plan is found by Tier 3, it will be reported using the "Solution Form" and transferred back to Tier 2. This step and step 4 are fundamental points to close up the information loop.

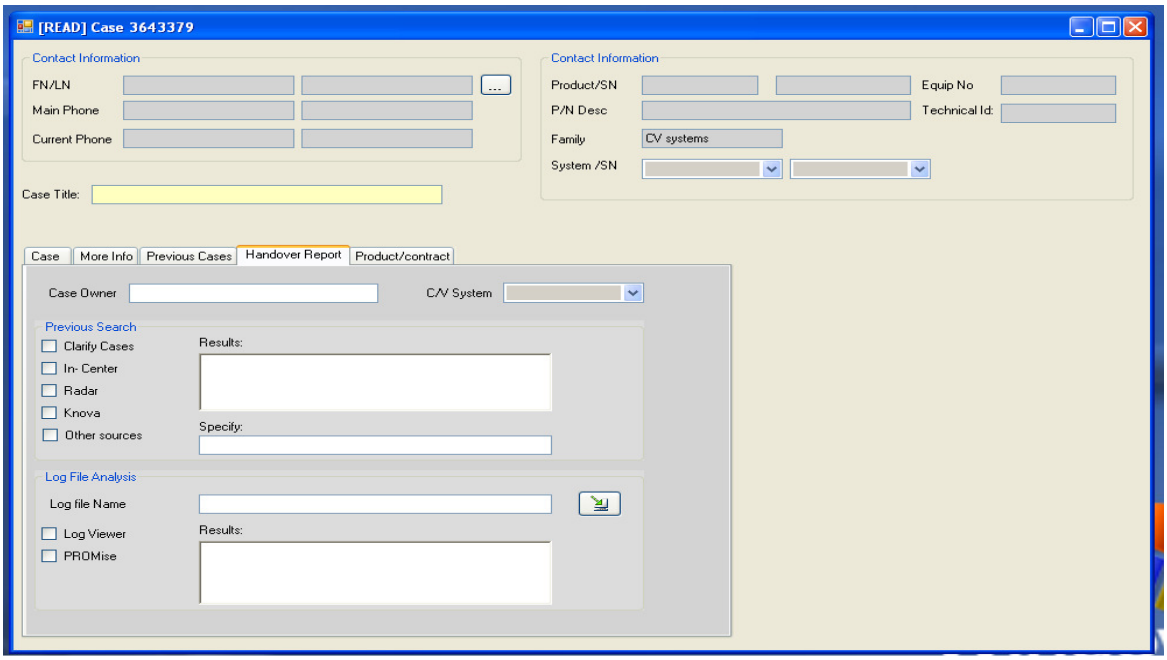


Figure 37 Adding the Handover Report

Improving the case handover policy as well as closing the feedback loop requires that new and redesign features should be added to Clarify CRM. An element required to improve the handover process is the ***"Report Tab"*** where the steps made by Tier 2 can be stored and accessed by any member of the customer process. A prototype report tab with the basic attributes required is shown in Figure 37.

7.3.5. Application Redundancy

The last issue mentioned in the previous chapter was the current use of two applications to handle customer calls in Tier 3. Clarify CRM and HCS are utilized indistinctly despite of the fact that management has decided that Clarify CRM should be the only tool to handle this kind of service. Arguments such as message threads, search capability, and quick information access are utilized by personnel to justify the HCS use. However, disadvantages such as lack of case ownership, absence of analytic capabilities, and unstructured information flow can also be recalled.

In an effort to understand this situation, the reasons presented by Tier 3 to prefer HCS over Clarify CRM are discussed. Then, answers, some obtained from the literature, are given. The reasons without importance order are mentioned below.

1. There is no additional benefit gained by using Clarify CRM.

A repeated argument used by Tier 3 to use HCS along with Clarify CRM is the fact that the former provides clear and quick information and the latter is only practical to store information but not to retrieve and use it later. No benefits are currently expected from Clarify CRM by Tier 3, especially the ones that can improve their current activities. On the other hand, the benefits of HCS are immediately mentioned when a question about both applications is raised.

This issue is not particular to Philips C/V unit; implementing successfully a CRM application is an enormous task that needs companies to view CRM not only as a technology but also as an integrated and balanced approach that combines technology, process, and people (Chen and

Popovich, 2003). In a study conducted within almost one hundred U.S.-based firms, Bohling et al. (2006) found that three are the factors that are associated with perceived success of CRM initiations. They are: *locus of* CRM or the decision to place the highest priority to the CRM implementation project; *Top management's attitude toward CRM*; and *alignment with key stakeholder* (employees, customers, and shareholders).

The factors previously mentioned provide some answers to the lack of acceptance of Clarify CRM. Firstly, the use of Clarify CRM was never consulted with the members of Tier 3 or other tiers in the Benelux market. The decision was taken by the top management. Secondly, the priority in the current customer service process is not emphasized in the use of only one application, there are other projects that are now demanding more attention (Remote C/V Applications projects, Mercury Project, etc.). Finally, after the Clarify CRM introduction project was finished in 2008, top management has not been involved anymore on this issue.

But the key question is to know if there are no additional benefits that can be gained by using Clarify CRM. The answer is a complicated one. How Clarify CRM is developed at this moment, the perception of lack of additional benefits from the employees will be growing up. But at the same time, the potential that this tool has to become a critical one inside customer service remains intact. Besides of the changes required to close the feedback information loop and develop a robust handover policy, Clarify CRM must be moved from its present *Operational View* (use to store information) to a new *Analytical View* (where information that matters to the process can be obtained). The idea of this movement is that employees can have tools inside their CRM application that provide them added-value information which is now not available.

Xu and Walton (2005) proposed that Analytical CRM might be an alternative to get more from the data stored. They argued that data can be analyzed through a range of analytical tools in order to generate customer profiles, identify behavior patterns, determine satisfaction level, and support customer segmentation. Technologies such as pattern discovery association rules, sequential patterns, clustering, classification and evaluation of customer value have to be used. An illustrative example of a combination between a CRM application and intelligent tools such as Bayesian Network is given by Nauck et al. (2006).

Moreover, an additional latent outcome of moving to an analytical CRM is that the knowledge circle shows in Figure 7 can be completed. That is implicit knowledge obtained from one customer case, after the feedback information process (socialization between members; FSEs and Helpdesk), can become explicit (store in one knowledge database; Externalization). This explicit knowledge inside the CRM with reliable analytic tools and an experimented analyst can create new knowledge (Combination or Integration), which then will be shared with other members (Internalization).

2. HCS is more user-friendly and information can be accessed faster and easier.

This is probably the most recurrent excuse to justify the use of HSC over Clarify CRM. And in fact, HCS is more user-friendly compared to Clarify CRM but, there must be clear that HCS is an email-based application and not a customer relationship management (CRM) application. Besides it is not so user-friendly when it is compared, for instance, to MS Outlook. The point here is that users are comparing two things that are completely different. This plus the fact that a CRM application possesses an intrinsic complexity level make users more likely to refuse Clarify CRM.

Bohling et al. (2006) found that the three main roadblocks for the successful CRM implementation are: lack of necessary resources (19%), insufficient focus on change

management (11%), and insufficient involvement of employees (9%). But the most interesting finding is that the least roadblock mentioned was technical complexity (1%). This means that in almost one hundred CRM implementation projects, only one claimed that using a CRM is a complicated task.

3. Clarify CRM contains unnecessary information

Another reason commonly given by Tier 3 is that Clarify CRM requires information that sometimes is not used at all during the call handling process. It is fair to say that Clarify CRM contains a lot of information but it is mainly because Clarify CRM contains data not only concerning to customer service but also another areas such as marketing and sales. However, when a customer case arrives to Tier 3 is in a sub-case form which is a reduced version of the original case where only relevant information to solve the case is available. The comparison with HCS is also recurrent at this point but again it is unfair to make it considering the differences between both applications explained in the previous point.

4. Customer can reach us faster.

A frequent reason offered by Tier 3 is that customer can get a quicker support if HCS is used instead of Clarify CRM. This is true because the case lands directly to Tier 3 skipping the normal process (Tier 1 →Tier 2 →Tier 3). But the downside is that no information is kept to be reused, to calculate the resources used or to measure performance indicators. An important observation made during the time spent in the Helpdesk or Tier 3 is that most of the cases received by the HCS application are reported by field service engineers (FSEs) and zone technical specialist (ZTS) that run into troubles when they work in a field case. This means that the removal of this application would affect the communication that some FSEs and ZTSs have with Tier 3 but not necessarily would affect the call handling process (the case is reported throughout a call center) which is main process inside the customer service area.

The solution of this application duality issue must be a coordinated effort between management and the users. As it was mentioned by Bohling et al. (2006), Management plays a fundamental role in the searching of one consensus solution where both stakeholders can be satisfied. The definitive approach requires, on one hand, that the "pro" and "cons" of using Clarify CRM should be clearly explained by Management and, on the other hand, compromise from the operative side must be mandatory if they decide to engage in a situation where only Clarify CRM should be used.

7.4. Chapter Conclusions

In this chapter opportunities areas discovered in chapter 6 were analyzed thoroughly and a number of redesigns and improvement strategies were given. Using the "best practices" in Business Process Redesign (BPR), two redesigns were formulated to enhance the performance in Tier 2, specifically the reduction of the throughput time in the spare part order process and the addition of advanced ACD technology to reduce the time response in critical situations (e.g. a C/V system is down).

In Section 7.3, strategies to deal with four areas closely related to feedback information were introduced. A new process that allows the use of an automatic feedback form between Tier 2 and FSEs and periodic remainder when no feedback has been received is proposed. Moreover, a handover policy with the addition of a new "handover form" is presented. Finally, some recurrent reasons that have forced management to maintain the use of two applications for one process are discussed and literature resources are used to find out valid answers.

8. CONCLUSIONS AND FUTURE RESEARCH DIRECTIONS

This last chapter is devoted to the conclusions, contributions, and limitations of this master project. Additional, further research directions are given.

8.1. Conclusions

This study is made of two assignments which are mentioned below with their main conclusion:

3. *What is the current customer service process in Philips Cardio/Vascular Unit?*
   Three main processes were identified and modeled: call handling, technical escalation, and complaint handling. The "as-is" model for each process was made with more details for the call handling and technical escalation process. Given the time restriction of this project, it was decided to focus on the most common process in the customer service which is the call handling. A knowledge flow map was prepared for this process to know how and where the information sources are used. Finally, the call handling validation was made using expert opinion and walkthrough case scenario.
4. *How can best practices in business process redesign and knowledge management theories be used to improve the current customer service in Philips Cardio/Vascular Unit?*
   The modeling of the current customer service process and the knowledge acquired during the time spent in Philips Healthcare were the starting point to identify weak areas that can be improved using best practices in the business process redesign and knowledge management theories. Areas such as ordering of spare parts, call case routing, feedback information loop, handover policies, and application redundancy are identified. After that, a number of theoretical improvement strategies are developed to tackle these issues.
   Two redesign scenarios are proposed. One to enhance the process of ordering spare parts using best practices such as "task composition" and "technology integration" and the other to promote the quick and efficient respond in critical situations (e.g. the C/V system is down) using practices such as "task automation" and "contact reduction". These redesigns are complemented with one overall strategy to improve the feedback information process.
   This strategy proposes how to close the feedback information loop, a case handover policy with the addition of a new feature called *"Report tab"*, and an explanation of the current application redundancy. Its correct implementation will provide the foundations of a new feedback information process where action plans used to solve customer requests will be validated in the field and propelled into only one application (Clarify CRM) which will be armed with a knowledge database and analytic tools to generate further knowledge.

Throughout this thesis, the one large-integrated information system dilemma where data from several sources can be jointly managed and sounded information will be readily available has been in my mind. Despite of the technological advances that have made the access of information easier than ever and the numerous theories that are continuously elaborating new ways to collect effectively feedback, I think that this ideal is far to be reached fundamentally for two reasons.

One is a technological reason. This work has found that only the process called "call handling" is using more than 16 applications to be managed and the number is expected to grow because the data that employees are dealing with is becoming more and more complex. For instance, log files from C/V systems are monsters of information where the normal knowledge that a technician has is impossible to read and understand them without the support from different areas.

The other reason is cultural. While there are people in Philips Healthcare that are aware of the amount of applications available to handle customer data and do their best to restrain it and think about an overall solution, some of them are content with this situation and, I dare to say, there are people who are even hungrier to create more applications that can make their business unit better than others and to show that their applications are indeed solving the problems that other applications were not capable of doing.

8.2. Contributions

The contributions of this master thesis is divided in two areas: one oriented to the practical relevance that this work left for Philips C/V Customer Service and the Data Fusion Project, and the other aimed to comply with the theoretical rigour through the use of well-known management theories.

- **Practical relevance**
  This master thesis has provided to Philips C/V business unit with an "as-is" situation of their customer service process as well as a number of strategies that can be used to improve their current call handling process and to obtain validated feedback information from the field.
  It also analyzes in detail one of the information sources (help desk data) that the Data Fusion Project is using as an input to develop an Information System to convert relevant but incoherent field feedback data into valuable decision information. Another practical contribution for the Data Fusion Project is the fact that their upcoming researchers will have a blueprint that can be used to accelerate their understanding of the three main processes in Philips C/V customer service.
- **Theoretical rigour**
  The outcome of this project provides new knowledge that can be used to improve the current call handling process performance through redesign Best Practices (Reijers and Mansar, 2005) and to enhance the quality of information in the feedback process through knowledge integration theories (Berends et al., 2006). Furthermore, the knowledge captured in this master project can be used for further researches or benchmarked studies with different environments that are also dealing with feedback information issues.

8.3. Limitations

The entire customer service process in Philips Cardio/Vascular unit is too broad to be studied in a single master thesis. Thus, the initial scope was narrowed down to focus only in the most common process which is the call handling process.

Even though a huge effort was put to understand and provide a clear modeling of the call handling process as well as the other two processes, details such as more interaction with field service engineer (FSE) or a larger sample in the validation phase that would enhance the results of this work need to be mentioned. During this study, meeting a FSE was only possible in a place different (Philips Healthcare Academy) than his normal habitat (Hospital). It would have been interesting for this project to see how FSEs perform in the field or what they do when an unexpected problem happens during a field work.

It was announced before that the redesigns and strategies presented here remain at theoretical level. Their implementation and further validation require that a number of requisites must be first fulfilled.

From a general perspective, this study is limited to the customer service process of Philips Cardio/Vascular business unit only. Generalizing this study's outcomes to other business process must be considered very carefully.

8.5. Further research directions

This master thesis has provided an "as-is" modeling of the current customer service. However, the validation was made with a limited case sample. Further work to validate this model with a larger sample would provide robust conclusions. Moreover, it can be used to compare with "as-is" situation from other modalities (e.g. Nuclear Medicine) in order to create a benchmark model for common processes (e.g. call handling).

A number of strategies were proposed here in order to improve the current customer service. Unfortunately, they have remained at theoretical level. A further implementation and validation of the two strategies related to the business process redesign could be the subject of future works. Furthermore, the implementation of the strategy oriented to collect validated feedback information could result in a future study to use it not only by Philips for their development area but also by the Data Fusion Project as an input for their upcoming information system.

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APPENDIX 1: PHILIPS HEALTHCARE

Philips Healthcare is divided around 8 main divisions (see Figure 38). One of these divisions is Imaging Systems which is at the same time divided by modalities such as General X-Ray, Magnetic Resonance, Nuclear Medicine, Cardio/Vascular X-Ray, Computed Tomography, and Operations.

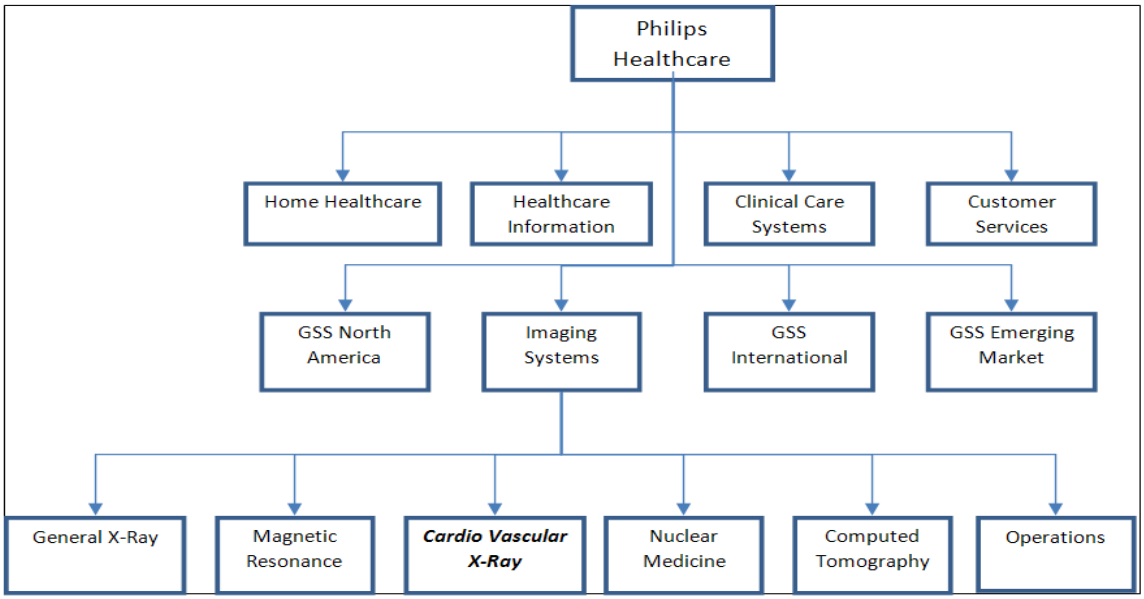

Figure 38 Philips Healthcare Organigram

Cardio/Vascular X-Ray Modality (See Figure 39) has also divided in a number of areas and programs such as Clinical Science, Research & Development, Customer Service, etc. This modality has its main operations located in Best, The Netherlands. This master project was specially focused on the customer service area.

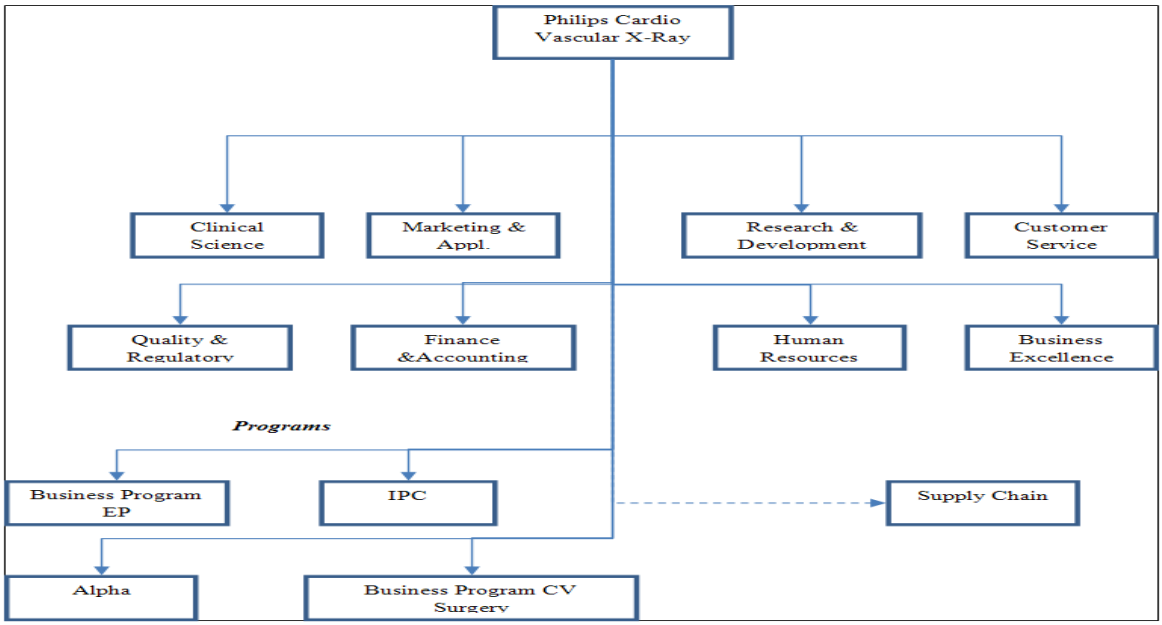

Figure 39 Philips Cardio Vascular X-Ray Organigram

It was mentioned above that the focus is the customer service area in Philips C/V. this area is divided in four units (See Figure 40). The Helpdesk is located in Service Support within Field Support Teams.

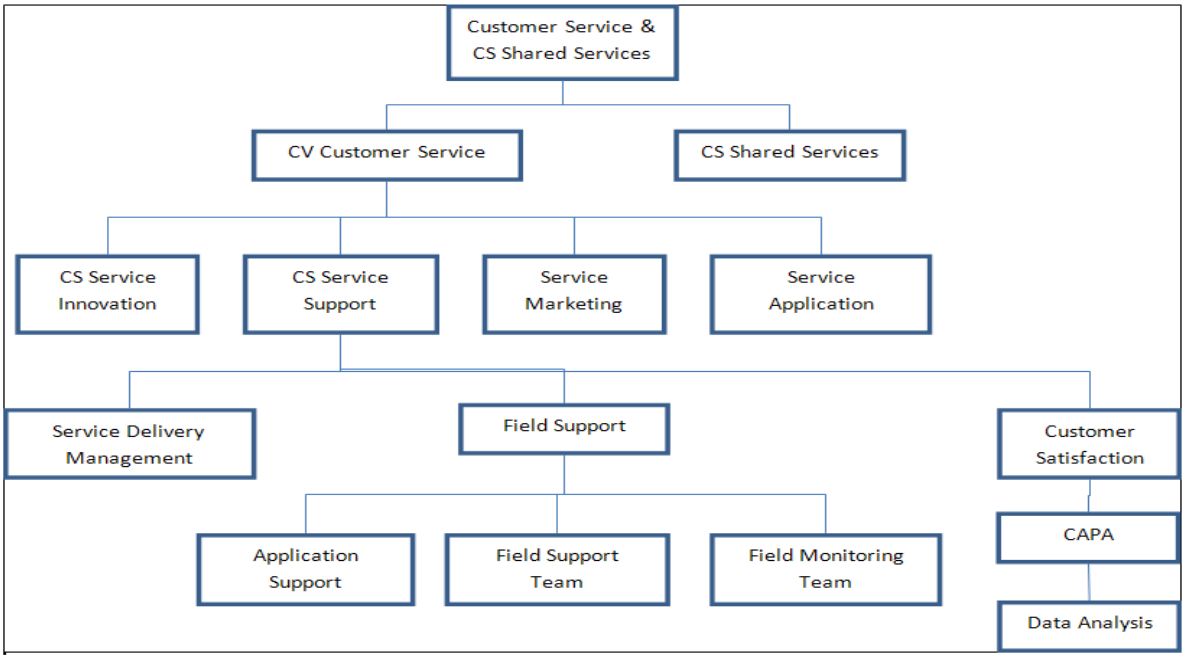

Figure 40 Philips Cardio/Vascular Customer Service Organigram

The Helpdesk has at the same time a number of specialists for each main component of the C/V system. They specialized in one or two areas while the zone technical specialists (ZTS) and Field Service Engineers (FSE) have a wide but not deep knowledge in more than one system component (See Figure 41).

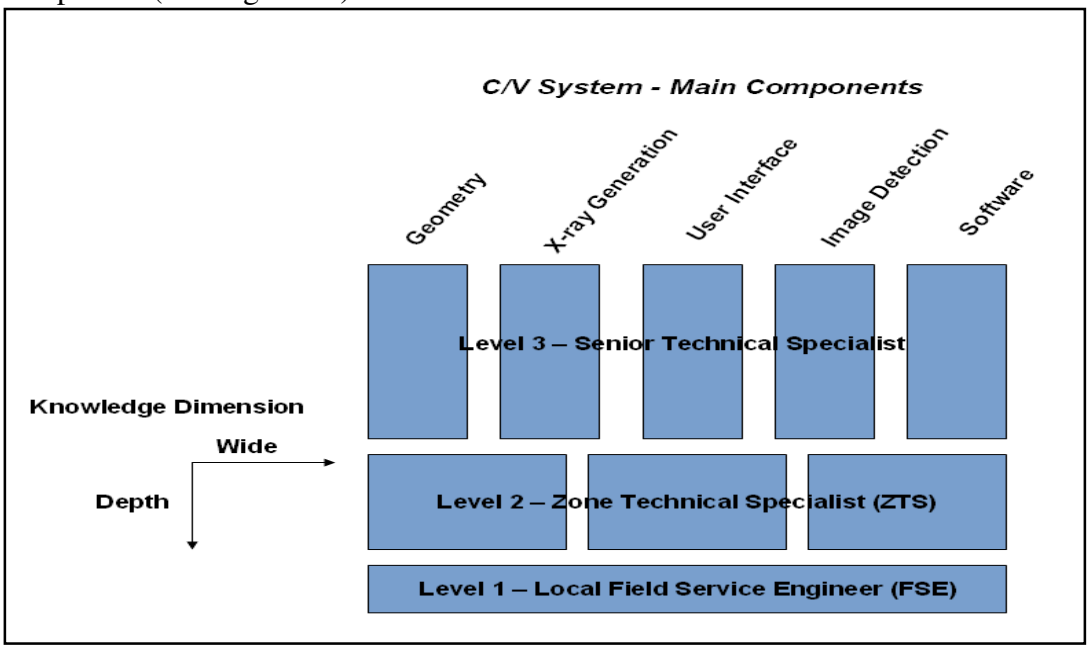

Figure 41 Knowledge Level in Customer Service

APPENDIX 2: PHILIPS CARDIO/VASCULAR PRODUCTS

Two are the product families in Philips Cardio/Vascular business unit (See Figure 42). One old family called Integris and a new one called Xper (See Figure 43). The former is not longer in production and only preventive and corrective maintenance is performed with these products. The latter is the currently product generation and they are normally named after their capability to perform cardio or vascular images. The difference is on the detector size (where the X-rays are captured); that is cardio detector size is smaller than vascular detector size. For instance, an Allura Xper FD10 system has been developed to provide an accurate, centralized, and sharp image of the heart compared to the Allura Xper FD20 which has a bigger detector to capture veins in their whole extension. There are also systems that possess two detectors. They can have the same size (Allura Xper FD10/10) or could be a combination (Allura Xper FD20/10).

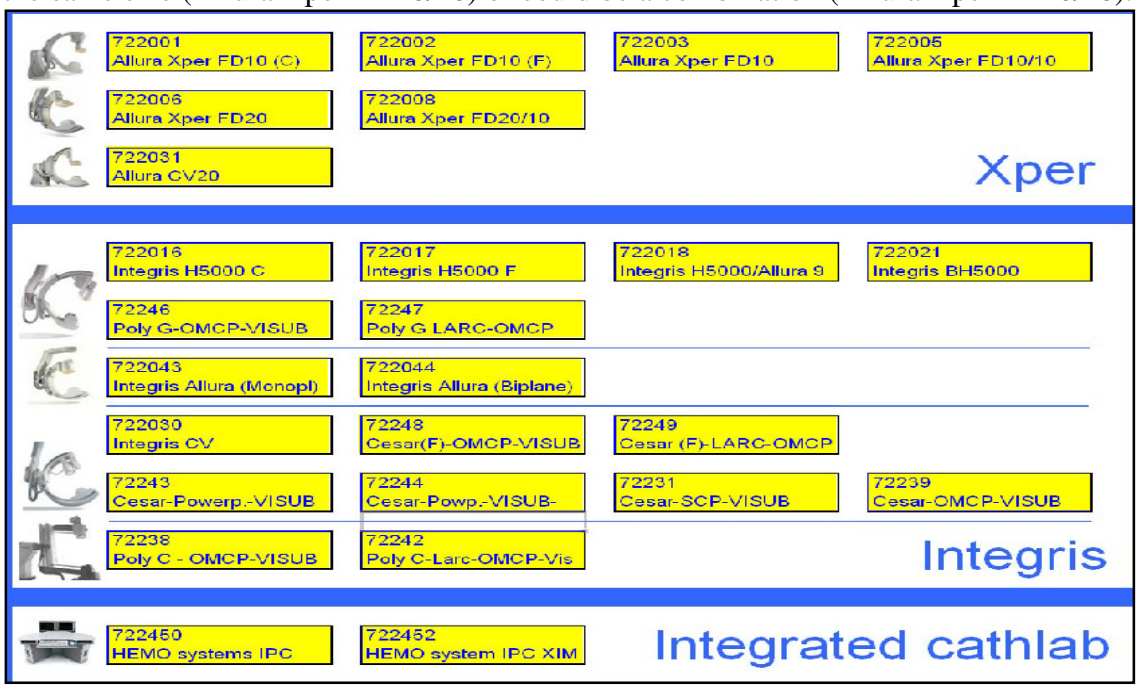

Figure 42 Philips Cardio/Vascular Products

Figure 43 Allura Xper FD20

APPENDIX 3: PROCESS DESCRIPTION

Call handling process

Here the call handling process is described in detail. This description will use figures show in chapter 4 as references.

The call handling process starts when a customer calls the call center in order to report an issue related to the Cardio/Vascular system. Sometimes, calls about non-technical issues related to Cardio/Vascular systems can also be received; for instance, service contract renewal, spare parts contract, and add-on packages. In this case, the operator will transfer this call to the area specialized on this kind of requests.

When a call reports a product-related issue, the operator (also called "call taker" in the Philips jargon) will require information about the possible problem, type of system and contact name.

The call taker or operator has three main responsibilities that are:

1. Handling the customer call which means creating a Clarify case, collecting related information, and transferring that the case to the remote support center (RSC). See Tier 1 band in Figure 11 (upper).
2. Planning and dispatching a field service engineer when is required. See Tier 1 band in Figure 11 (bottom)
3. Ordering spare parts when the request is receiving from RSC.

With the information obtained, the operator will create a Clarify CRM case (note that not all of the key markets have Clarify CRM, so that this situation in those markets might be different). Clarify is a customer relationship management (CRM) application that Philips have selected as their worldwide CRM tool. With a case created and the client still on-line, the operator can solve the case which rarely occurs because his lack of technical background or transfer the call to the Tier 2 also called remote support center (RSC). If the RSC operator, who is normally an experienced field service engineer, is available, he will try to solve the problem. Otherwise, a message as well as the Clarify case number is sent to the RSC operator to attend the case as soon as he can.

The RSC operator will, first, try to solve the problem remotely using the remote service network (RSN) connection that Philips Healthcare has for their medical systems.

The RSC operator will try to solve the reported issue using the following alternatives. The first alternative is to see whether the problem implies a spare part requirement; if that is the case, then an order is forwarded to Tier 1 to dispatch that part considering that the customer has a valid spare parts service contract (see en Figure 12, reference 2). However, when the case is reporting technical issues with the system, the RSC can try to solve the problem remotely by connecting to the system using the Philips remote service network (RSN). This step has three possible outcomes: first, the case is solved, the Clarify case is updated and the costumer is informed about it. Second, the case is not solved and a field service engineer is required (see in Figure 12, reference 5) or the third outcome is to transfer the case to tier 3 (see in Figure 12, reference 6) because specialized support is required.

If the problem needs local assistance, then the RSC operator will coordinate with Tier 1 to dispatch one local field service engineer (FSE) to solve it. The FSE is trained to perform 4 tasks: corrective maintenance, C/V system installation, field change order (FCO), and preventive maintenance. All of them except corrective maintenance are planned activities. Figure 14 shows FSE activities and it can also be appreciated the path that a FSE must follow if an unexpected issue has originated in the field or what the FSE has to do when the case has not been solved because of lack of time (Figure 14, reference 5).

If the FSE solves the problem, communication is sent back to RSC informing that the problem has been solved. However, if the problem has been not solved or further information is required to do it, then RSC will request support from Tier 3 also called the help desk. This communication must officially be made using a Clarify sub-case which is a portion of the case that contains only the information that is relevant to solve the problem. Tier 3 with that information will try to solve the problem, sometimes that information is not sufficient and request for more information is sent back to tier 2. When all the required information is available, Tier 3 will come up with an action plan that will send to Tier 2 to make it operational throughout the field service engineer or , if possible, remotely.

The information that Tier 3 uses to solve the cases is obtained from three main sources:

1. Personal experience and asking colleagues. The members of the help desk are former field services engineers with many years of experience and even though the equipments are becoming every time more complex, the principles behind these are the same.
2. Checking old HCS cases. Previous to the introduction of Clarify as their customer service application, all the cases in Tier 3 were stored in a Lotus Note application called HCS.
3. Using KNOVA and other documentations repositories. The use of these knowledge tools is not so frequently because, as it was argued for Tier 3 personnel, information is sometimes difficult to find.

If the case in this instance is solved, the solution is sent back to Tier 2 (see Figure 13, reference 7). Otherwise, either more information is required from Tier 2 or further support is required from Development.

Occasionally Tier 3 deals with problems that need detailed and specialized knowledge that can only be acquired in the development area. In this situation, a communication is established with the C/V development area to provide further assistance. If the problem is not solved at this stage, further alternatives might be provided to the customer as well as the key market, for instance, submit a technical escalation.

Technical escalation process

The objective of a technical escalation is to decrease customer dissatisfaction due to technical malfunctions in Philips equipment through effective mobilization of resources and timely communications. This process normally starts when a technical problem has not been solved using the call handling process. The unsolved issue can generate that the customer satisfaction decreases affecting the relationship between the client and Philips Healthcare. The sale & service district (SSD) manager of the area, where the hospital is situated, is the one authorized to initiate the technical escalation, also called VIPER (Visual Philips Escalation Resolution). The technical escalation is, first, handling locally between the local management and the zone technical specialist (ZTS) who is a technical member with vastly experience that provides support to the local field service engineers. An action plan is made to be implemented by the FSEs. If the case is solved, the medical system is monitored for some time to assure that the problem was indeed solved, after that the case is closed. However, if the case has not been solved and the customer anxiety is rising, the SSD manager can decide to take the case to level 2 where more resources will be available to solve the case. At this stage, the ZTS develops an action plan that contains regional support including the participation of the Sales & Service Region (SSR) security officer if the case is a security event issue. The solution of the escalation case at this point will be followed by monitoring and closing the case respectively.

However, there are technical escalations that at level 2 have not been solved because of lack of knowledge or resources. At this point, the ZTS has to decide if the case is elevated to level 3 or

another procedure is needed, for instance create a field problem report (FPR). If the ZTS decides that the case can be solved elevating it to level 3 escalation, then it is sent to the Program Management Group (PMG) problem manager who decides along with his work team what action plan can be developed to tackle this case. When the action plan has been made, it is sent to the ZTS who will decide if he applies the plan or one FSE can be made. The monitoring and closing of the case follow when the action plan has successfully applied. Otherwise, when not solution is currently available, the case remains in "workaround" status which means that future release must solve that particular case; meanwhile an agreement must be reached with the customer to inform him that the company is currently working on the solution.

Software applications in the customer service

The description of the knowledge flow map is presented. The idea of this map is to show where applications, that are a lot for a single process, are used inside the call handling process.

After the customer calls the call center, the first application used by the call taker is a telephone management application call *TPA-PE 7.1*. The call taker uses *Clarify CRM* to create a new case which is transferred to Tier 2 also called Remote Support Center (RSC). Over there, the remote connection with the systems is made through two applications: *Remote Service Network (RSN)* for new systems (XPER family) and *Navigator 3.1* for old systems (INTEGRIS family). If the RSC needs more resources, applications such as *In-Center* (documentation platform), *Radar*, and *Knova* (Knowledge database) are available. Otherwise, if the RSC needs to order spare parts, the *electronic spare part finder (e-SPF)* and *SAP* are used.

When RSC has to deal with log files, two applications are at this moment available: *Log Viewer 2.0* and *PROMise*. The former is a text editor that allows the user to look for exceptions (yellow highlight) or errors (red highlight) inside the log file that might have occurred in the C/V systems. The latter is an adaptation of the famous process mining tool called *PROM* developed by the University of Eindhoven. However, its utilization is not so widely among technical personnel. If the case cannot be solved remotely, a FSE will be sent to the field. A workforce planning software called *Click* is utilized for planning and dispatching FSEs to the field. This tool is used by Tier 1.

In situations where local resources (RSC and FSEs) are not able to solve the case, it is transferred to Tier 3 using a *Clarify Sub-case.* Also, some service requests arrived to Tier 3 via email and they are stored and handled in an application called HCS which is add-on built inside *Lotus Note*. When additional information is required for a given case, applications such as Radar, In-Center, Knova, Old HCS cases are consulted.

The tool used by the field service engineer when he is working on the field is called *Work order management & Performance Assurance* (WOMPA). At the moment only the module called *work order management (WOM)* is available. When a preventive maintenance needs to be done in one C/V system, FSE uses the *Electronic Maintenance Record* (EMR) to load information concerning to the last maintenance made as well as information about the maintenance that will take place.

This application modeling also called knowledge flow map has shown the different software tools used in the call handling process. Some applications developed by Philips personnel such as MS Access databases or graphical user interfaces (GUI) written in MS Visual Basic were left out of this modeling because they are local solutions that are not available in the different instances of the process. Right now, more than fifteen applications are used to manage the call handling process; Figure 16 shows this knowledge flow map where applications used in the call handling process are clearly identified.

APPENDIX 4: KNOVA

KNOVA is the official knowledge database of Philips Healthcare. It is a stand-alone application that can be accessed on-line or off-line. Its interface is shown in Figure 44 and its use is straightforward, just a keyword or a combination of keywords to obtain a result. Also the search can be made using a specific product and a document type. The feature called "Document Type" sorts out documents that come from different sources. It can be seen if the document comes from Research& Development or from the field as a result of technical feedback given by a FSE.

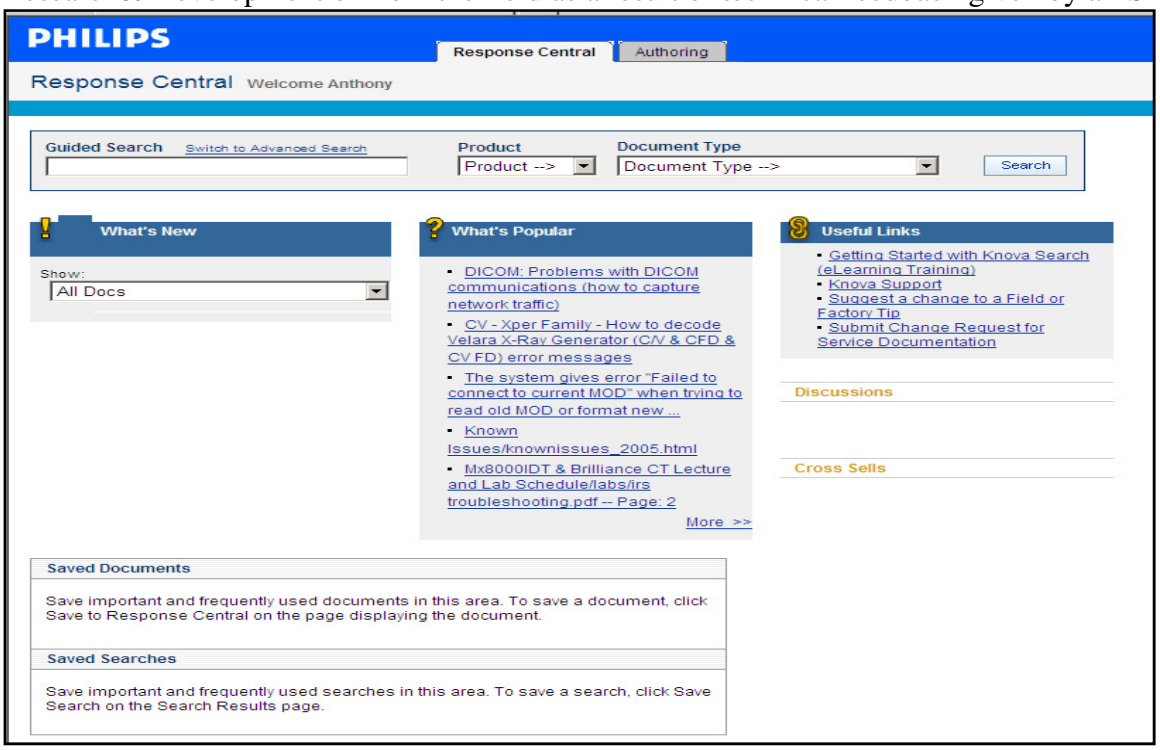

Figure 44 KNOVA Interface

The main complaint against this tool made by its users is the search reliability. That is finding what it is searching. Colloquial conversations about KNOVA with Philips personnel have always brought this point. They argued that they know that the information is there. However, when it is needed, finding it might turn into an endless task. Another common complaint to KNOVA comes from the authors who claim that uploading a solution has become a painful process that discourage them to engage actively in this knowledge process. It was mentioned in section 7.3.1 that submitting a solution to KNOVA can take days and a number of administrative steps that can assure information quality but, at the same time, may limit participation.

Figure 45 shows the results found for the Clarify Case Nr. 4874893. It was interesting to see that the first hit obtained by KNOVA makes reference to a similar issue reported two months ago earlier than the case here mentioned. It is not known if the technical personnel knew about it or if they used this information because the case' history log file does not contain any reference about that.

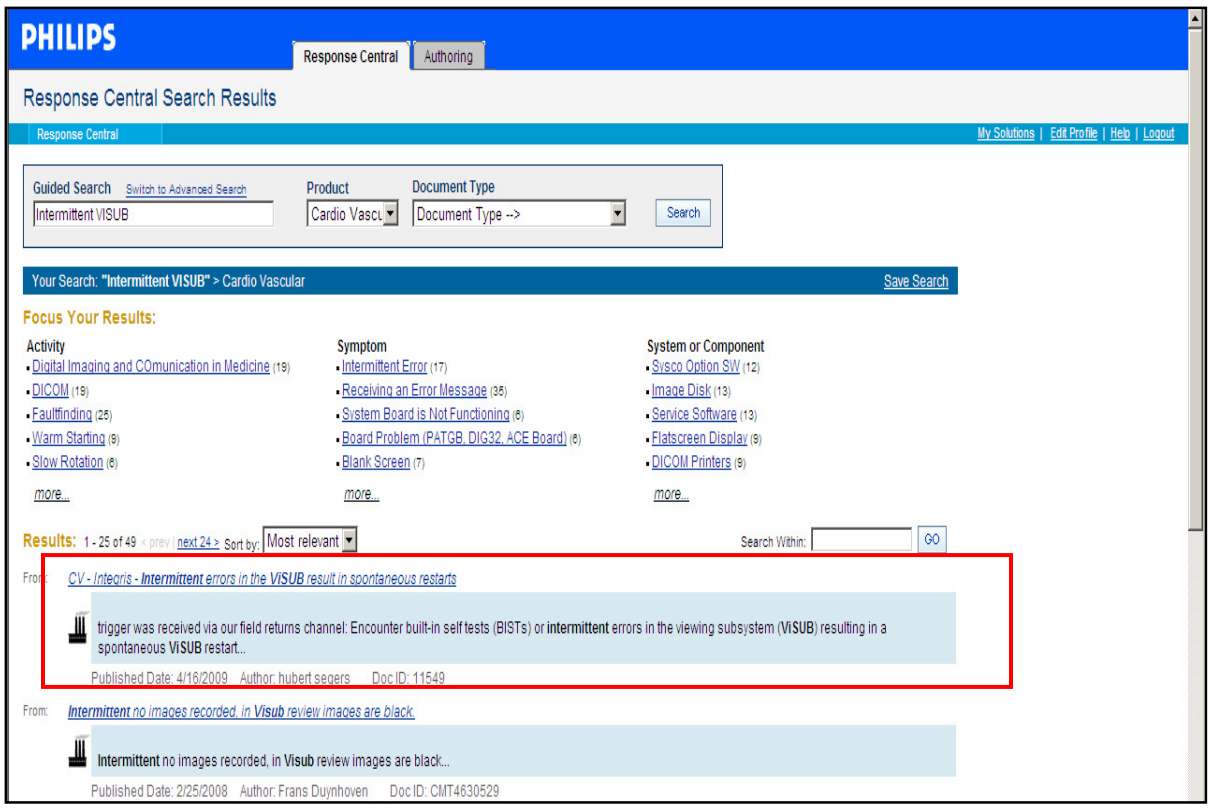

Figure 45 Search for case Nr. 4874893

Figure 44 shows the authoring tool used to write solutions or tips that can be shared among Philips personnel. This is the first step, after submitting the form, a process of verification and validation starts.

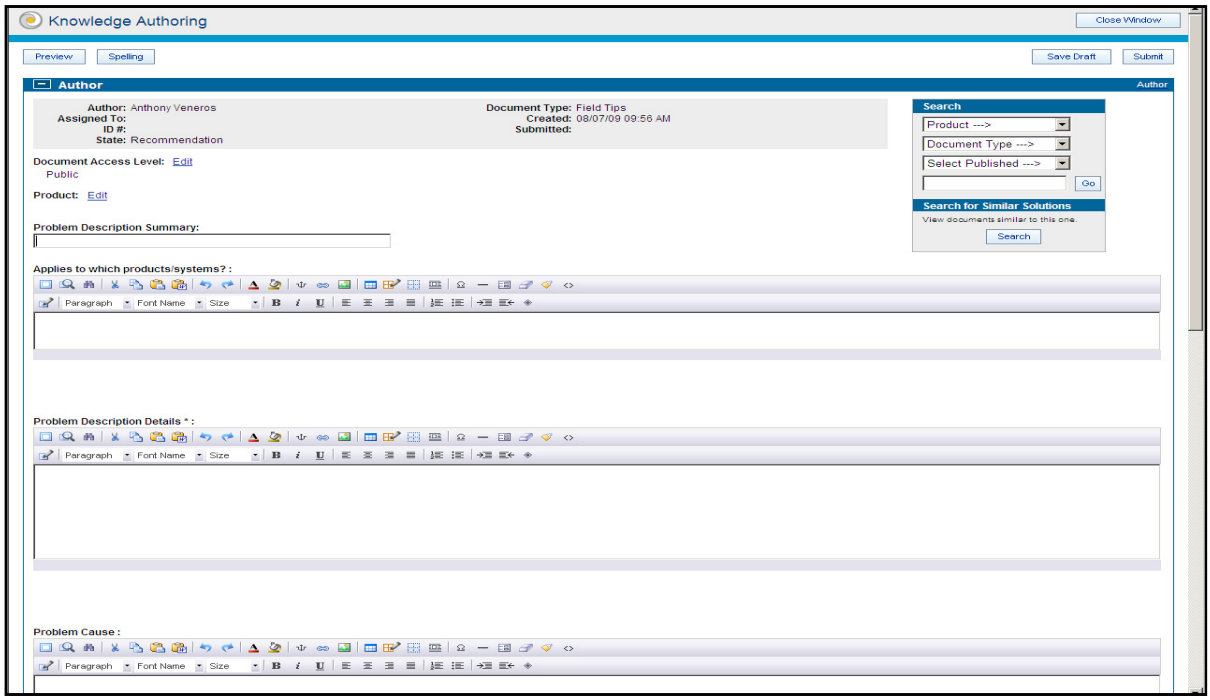

Figure 46 KNOVA Authoring tool

APPENDIX 5: CLARIFY CRM

Clarify is a Customer Relationship Management (CRM) application that provided a number of functionalities that helped companies deliver a quick and convenient experience each time their customers called. It includes features such as:

- Built-in problem escalation procedures
- Automated management of service level agreements (SLAs) and related contracts
- Real-time service request monitoring
- Parts ordering
- Activity history tracking and reporting
- "Knowledge Base" to see if anyone else has already solved this problem

In 2002, Clarify was acquired by Amdocs, a global technology development company with over $2 billion in annual revenues. Since this merger was completed, the Clarify CRM has evolved to become a fully-integrated customer relationship management package.

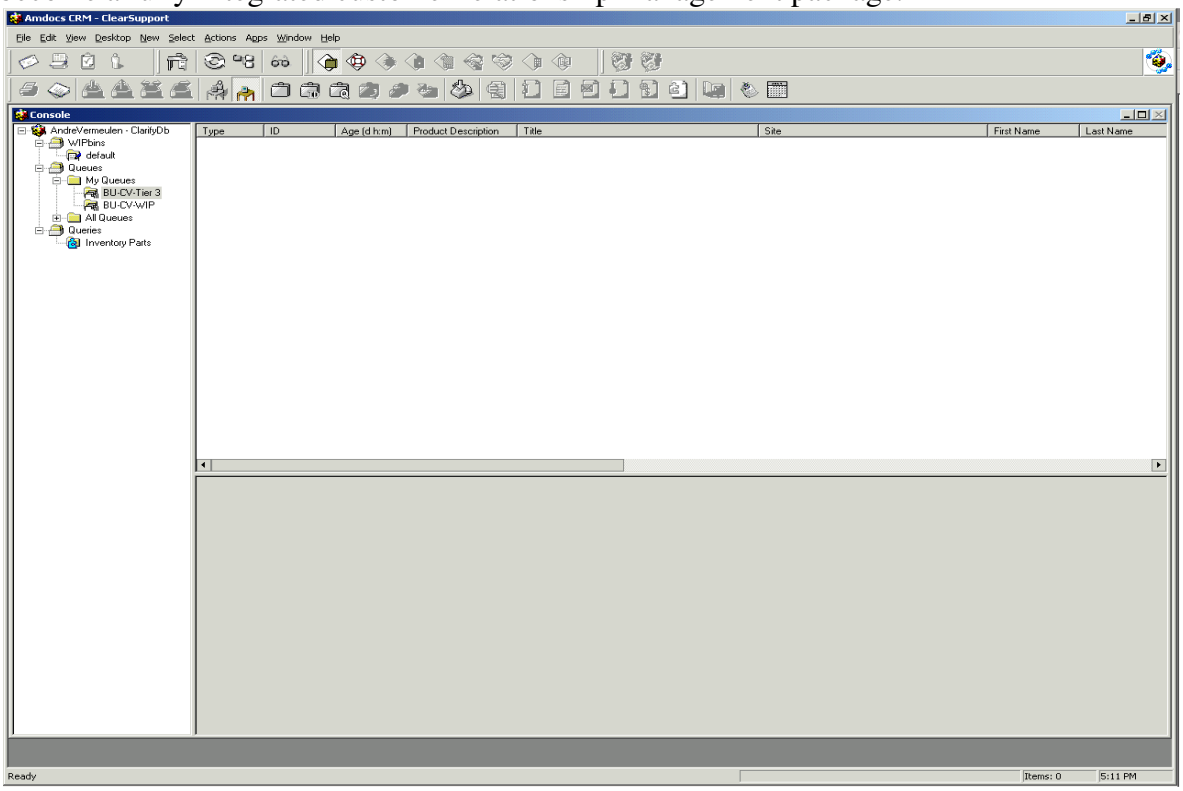

Figure 47 Clarify Interface

Figure 47 shows the Clarify CRM Interface. The left side contains the console with the queues. They store cases that arrive worldwide. Two queues can be appreciated, one is visible for the members of Tier 3(*BU CV- Tier 3*) and has available the cases that have not yet attended. The other queue (*BU CV- Tier 3)* has only cases that are assigned to the owner of the account.

Figure 48 gives a new case interface. The filling process normally starts with the addition of the contact and location information. They will bring automatically the product, family, and other details of the system that the customer is reporting. Features such as entitlement information, case priority, previous cases, call type, location, etc. provide customer service with a complete overview of the system reported.

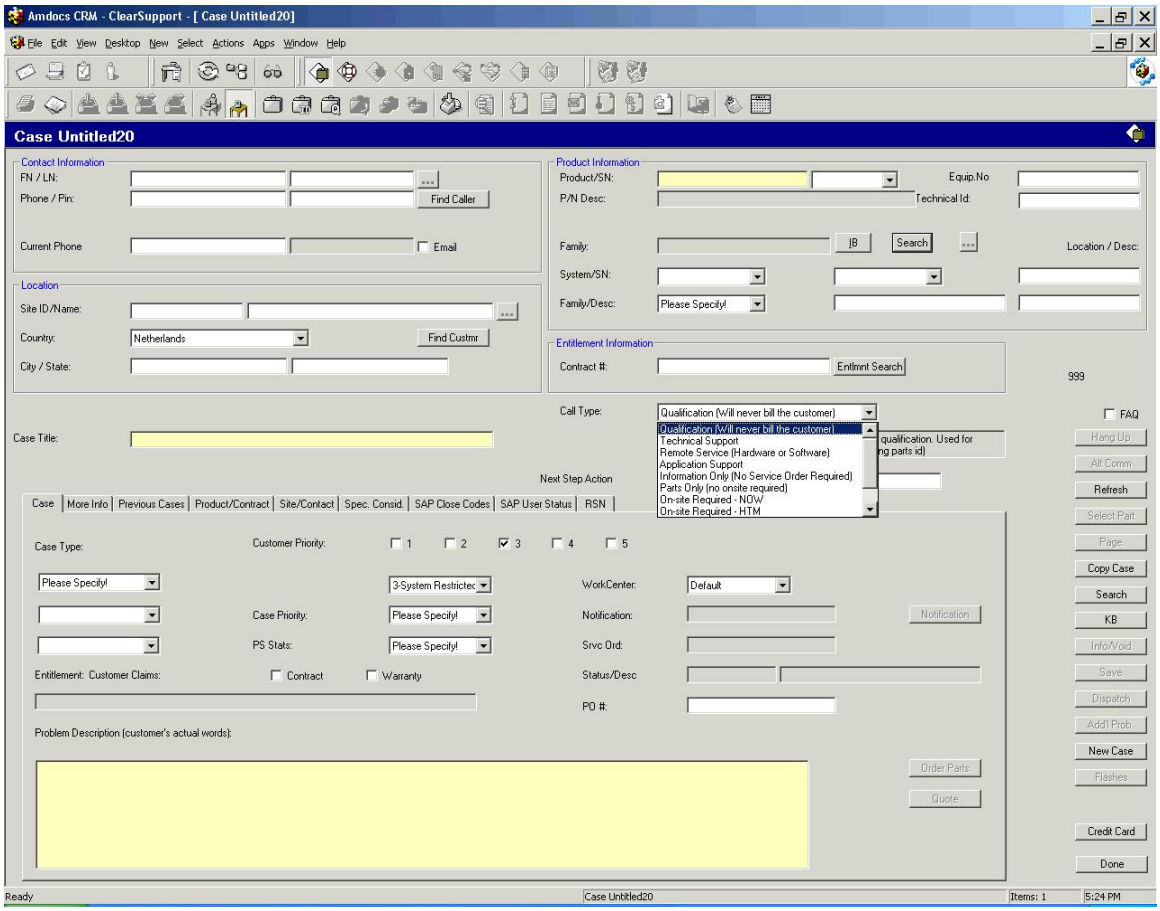

Figure 48 Clarify CRM Case

The remaining of this appendix will show the three main issues that users of Clarify CRM in Philips have more recalled. They were described in section 6.6.

The first one is accessing a case that has already been created. The only option available for the user is to know what the case is. If the user does not know the case ID, nothing else can be done in this window.

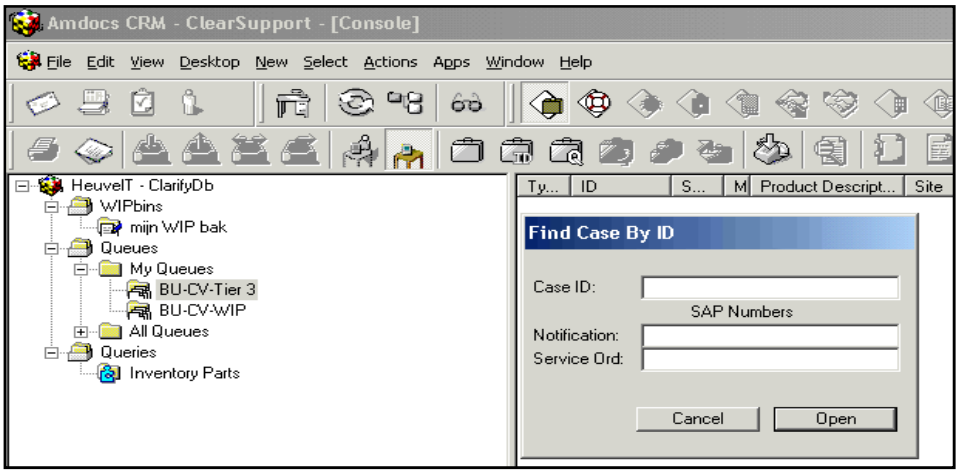

Figure 49 Find a case in Clarify CRM

An alternative option to access a case is using a query (see Figure 50) which is not precisely a quick and easy way to find information. It also requires that the user has a basic knowledge of query language.

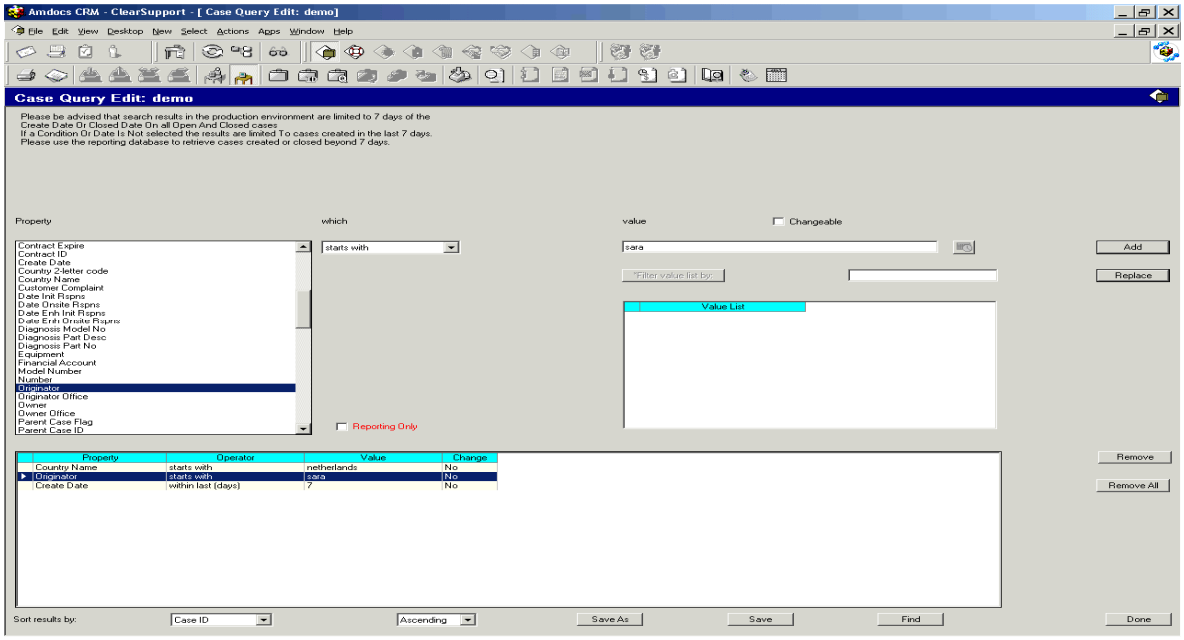

Figure 50 Query window in Clarify CRM

The last issue concerns to the mixed information that a case can store. It is possible to identify cases where the solution is stored with the issue reported in a way that is impossible for the user knows if the case is not completely read. Figure 47 shows this situation.

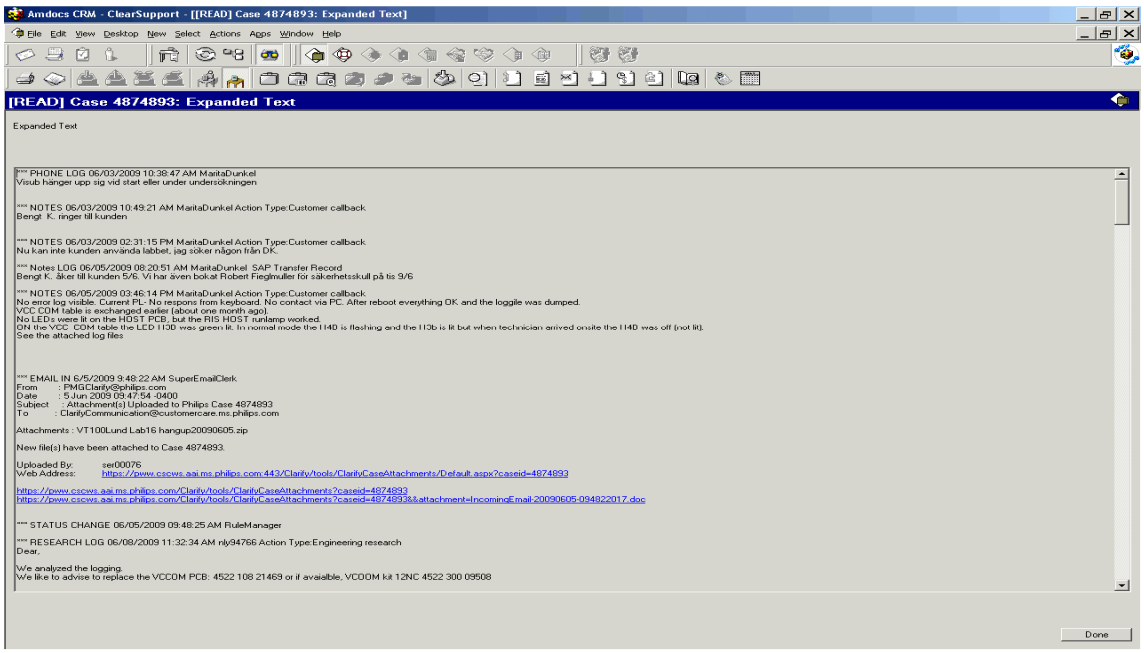

Figure 51 Case and solution stored in Clarify CRM

APPENDIX 6 HOW TO CREATE A SOLUTION IN CLARIFY CRM

The creation of a solution inside of Clarify CRM is given here. The advantage of storing an action plan or solution in this format is that it becomes available for other users that might run into the same problem. To solution form is accessed through the "*New Menu*" by clicking the "Solution" button. Figure 52 shows this step.

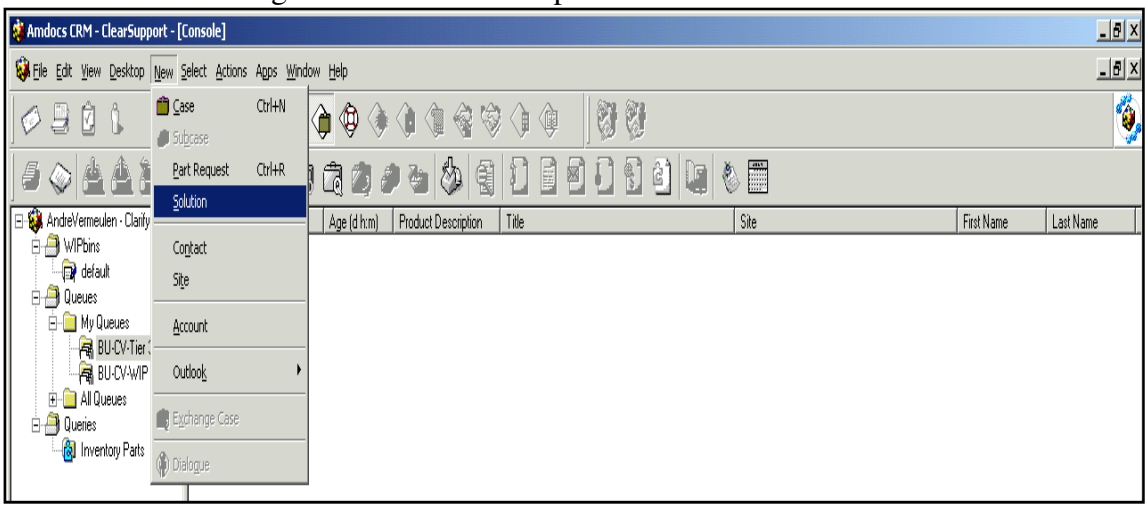

Figure 52 Create a new solution

Figure 53 shows a new solution form. It has three main fields: one for the solution title, another for the problem description and the other for the case resolution.

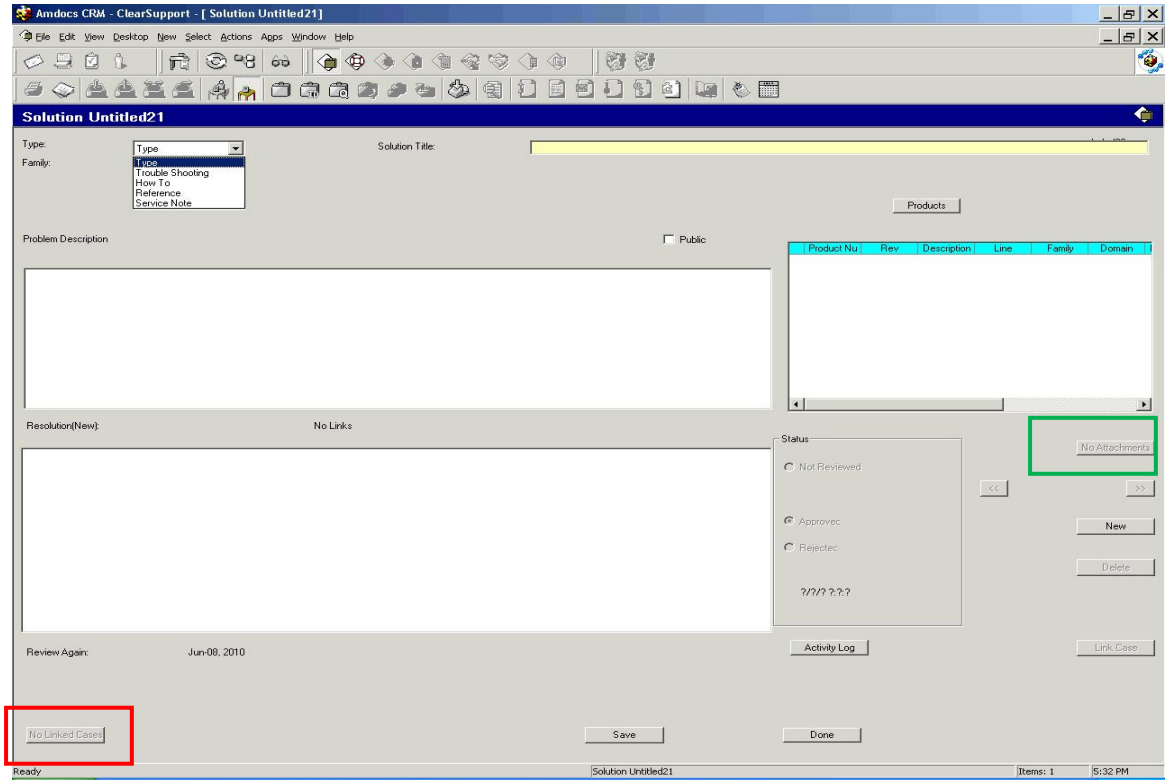

Figure 53 New Clarify solution

It includes options such as solution type (e.g. service note, how to, reference document, etc.), family class (e.g. cardio-vascular, nuclear medicine, healthcare information, etc.), and products that are affected by this solution. The red box in that figure shows the option to link cases that have already been solved using this solution and green box presents the option to attach files that can help to understand the solution.

Figure 54 gives a current solution stored in Clarify CRM. It includes one attachment (see green box) but at this moment no cases are linked to it (red box).

To have a better overview of the issue that this solution is addressed, it is necessary to add more information to the issue's description and also to the resolution field. In this particular case, the issue has already reported as a field change order (FCO), that is a problem reported or found in the field has received official support from the development area.

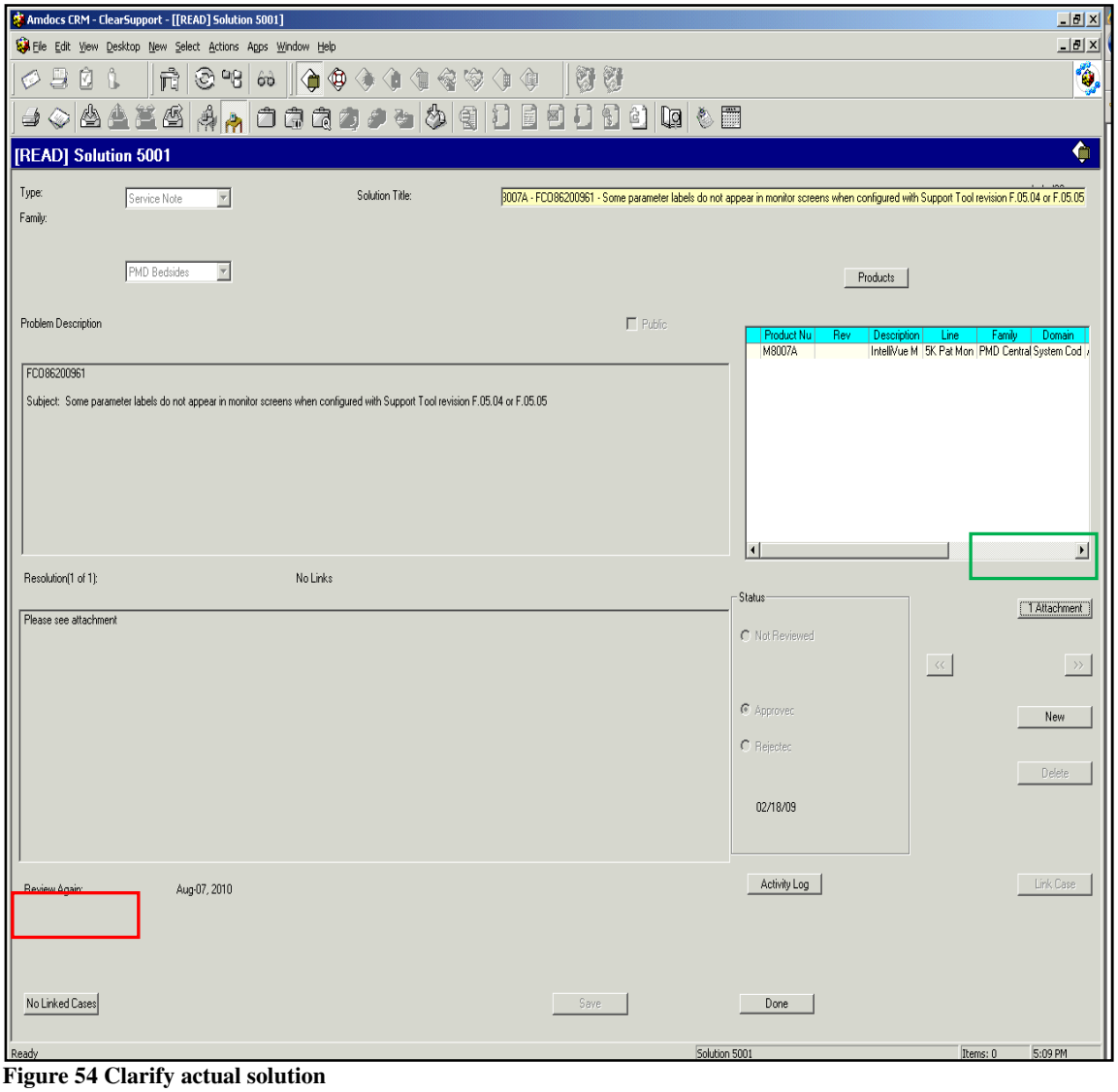

Figure 54 Clarify actual solution

APPENDIX 7: ELECTRONIC SPARE PART FINDER (e-SPF)

The electronic spare part finder (e-SPF) was developed with the intention to provide a quick access to any spare part that forms a Cardio/Vascular system. It is currently used mostly by field service engineers and technical personnel. Even though its use is not complicated, it requires a previous knowledge of the system to find the right part. The main screen of this on-line application for the C/V area is shown in Figure 55.

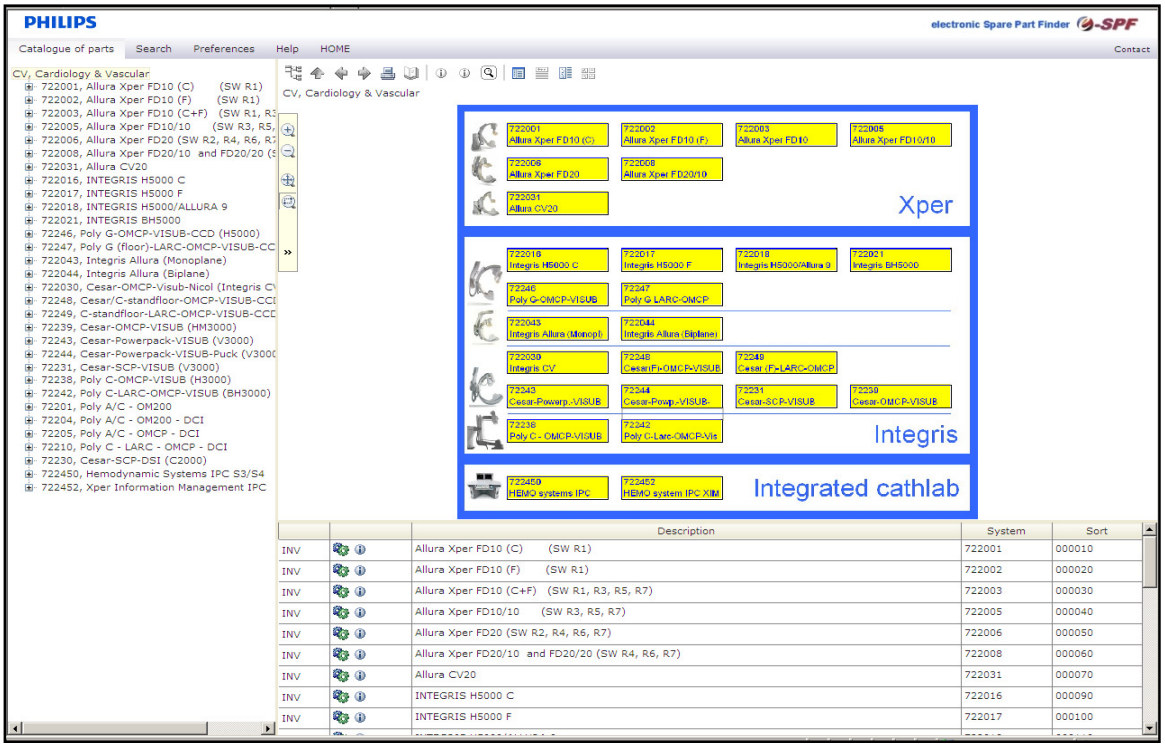

Figure 55 e-SPF Main Screen

To look for a spare part, one can go either drilling down by product or using the search option. At this moment, two families of product are available: Xper and Integris. As soon as a kind of system is clicking, a new screen appears with the releases available for that product. For instance, a click in the Allura Xper FD20 (left button in the second row in Xper family) brings a screen with the releases offered for that product (see Figure 56)

The left side of Figure 56 shows the top-down menu of the available products and the right side shows the system selected with its different releases. A click in any yellow box takes you to the detail of that system.

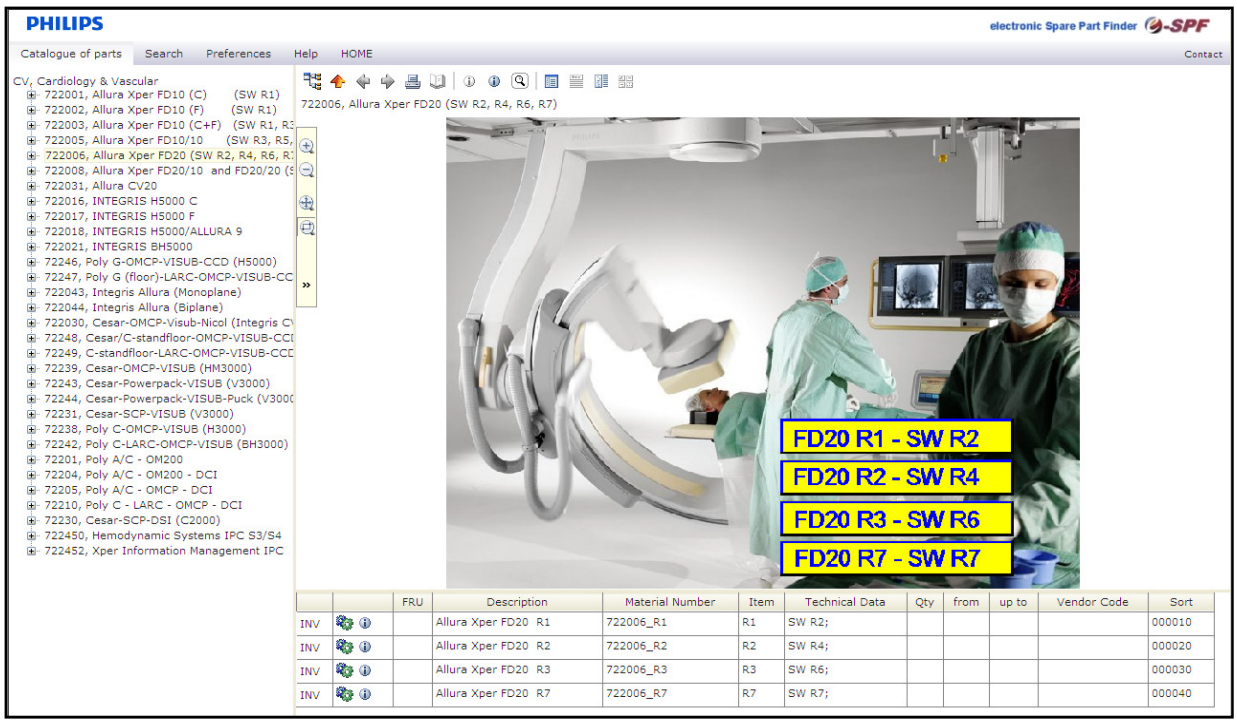

Figure 56 Xper FD20 spare part screen

Figure 57 presents the main components of the C/V arm. Each main part can be fragmented; the bottom side gives the components of that part with the material number also called "12NC" which is the code that field service engineers used to request a spare part.

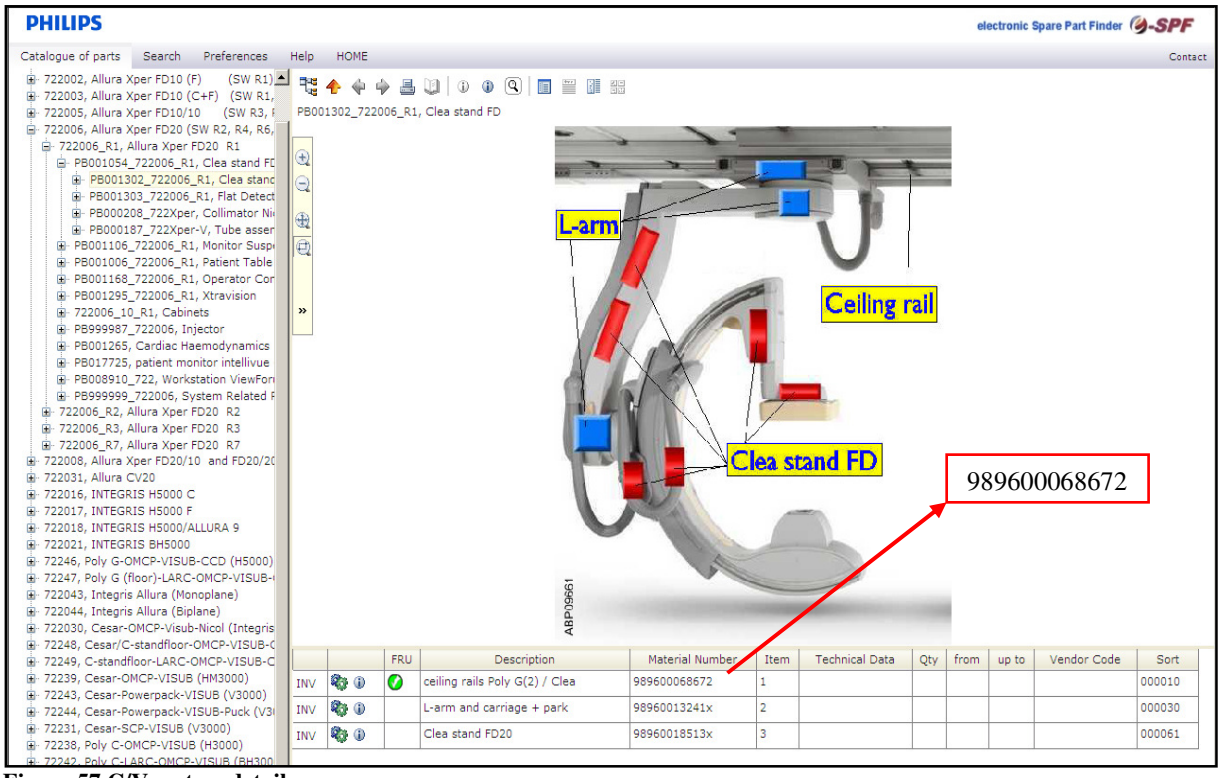

Figure 57 C/V system detail

The e-SPF has a search option available to look directly for the part based on the “12 NC” code. It also includes an advanced field search where the material description (12NC) can be combined with the vendor code and it allows the use of wildcards that facilities the search. Figure 58 shows this option with the search of product that his part number is known in advance.

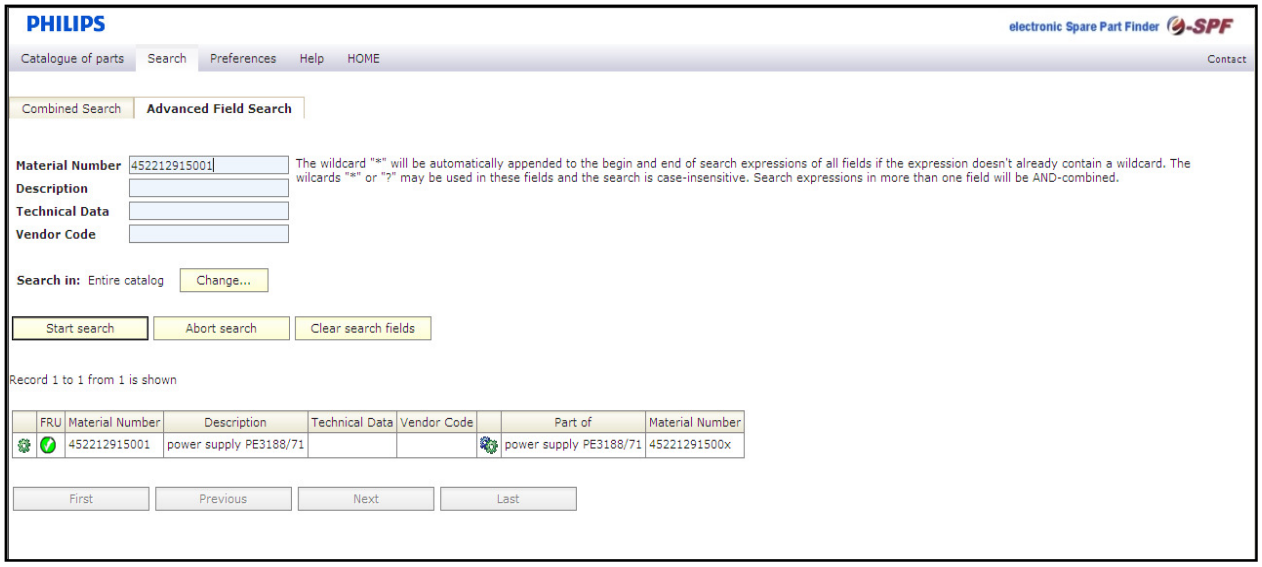

Figure 58 Search option in e-SPF

Figure 59 presents the search of one spare part using a wildcard. It can also be included more than one wildcard or make a combined search where the use of conditional such as “OR” or “AND” is allowed.

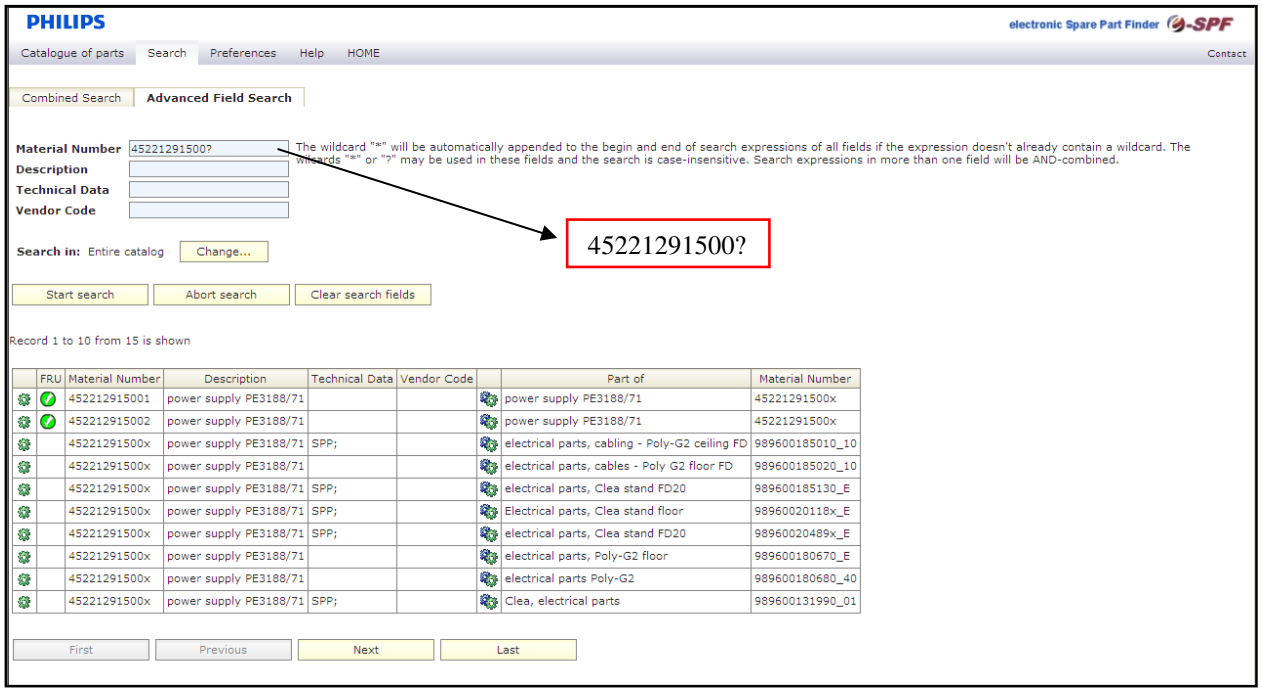

Figure 59 Search in e-SPF using wildcards

APPENDIX 8: DOCUMENTATION PLATFORM: In-CENTER

In-CENTER is the official Philips Healthcare documentation platform. Besides of official documents, it also offers a number of services that are using by technical and non-technical personnel. Figure 60 shows this website and, in the right side, a number of services and tools that can be accessed directly are shown. Tools such as *KNOVA*, *e-SPF*, *FPR view* (product complaint tool), *RADAR*, etc. are available. Moreover, services such as *PH Academy* where FSEs can sign up for training courses or *End-of-life List* where FSEs check whether a product is still on production are also accessible.

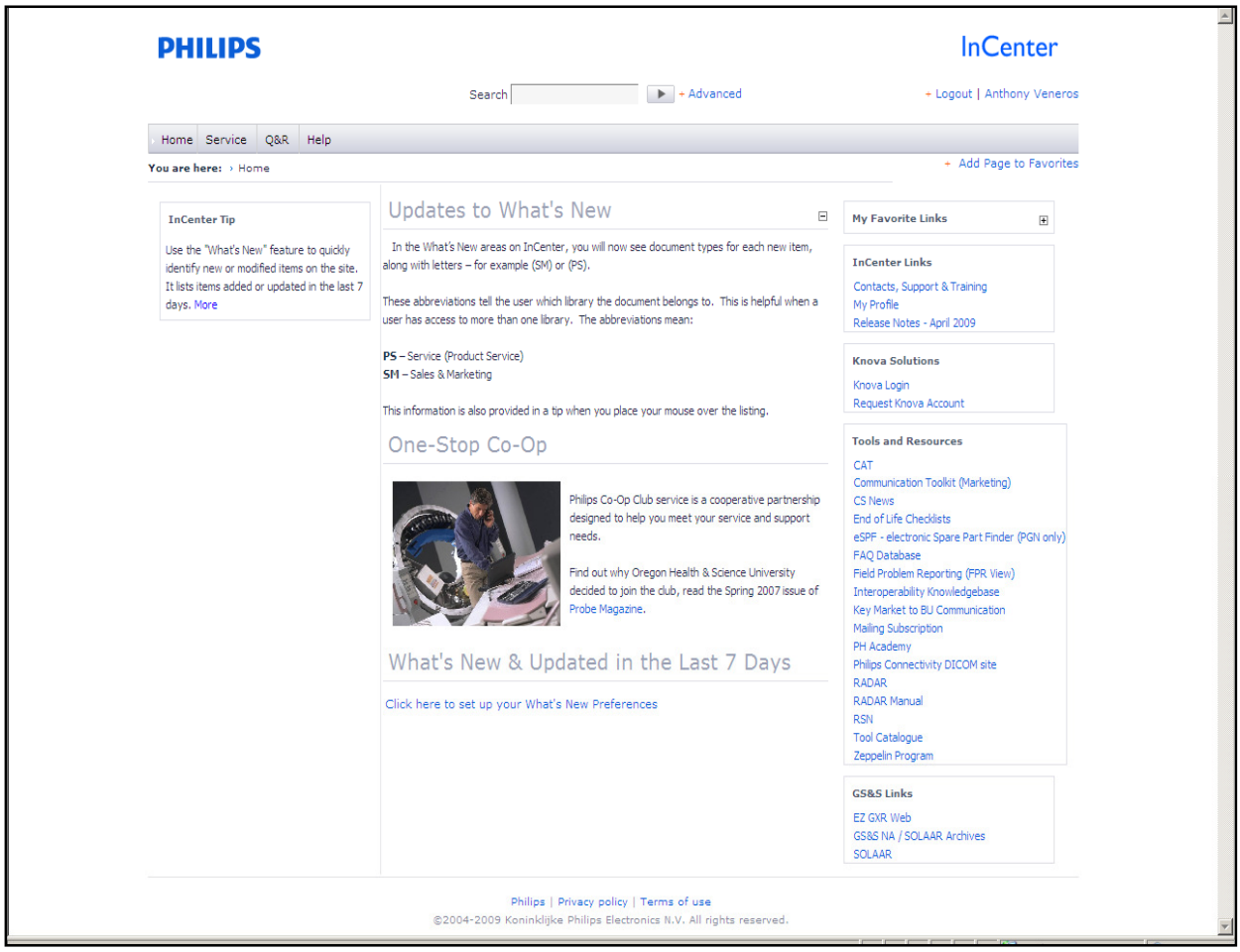

Figure 60 In-Center platform main interface

APPENDIX 9: HCS and VIPER

The technical escalation tool – VIPER

It was mentioned in section 4.3 that technical escalations are handled by only one tool. This is called VIPER (Visual Philips Escalation Resolution) and it is embedded in Lotus Note application. Figure 61 shows a Viper print screen. The case header contains the escalation number, escalation level, customer, equipment, and its current status. The three tabs (Details, Activity log, and Statistics) provide more information about the case.

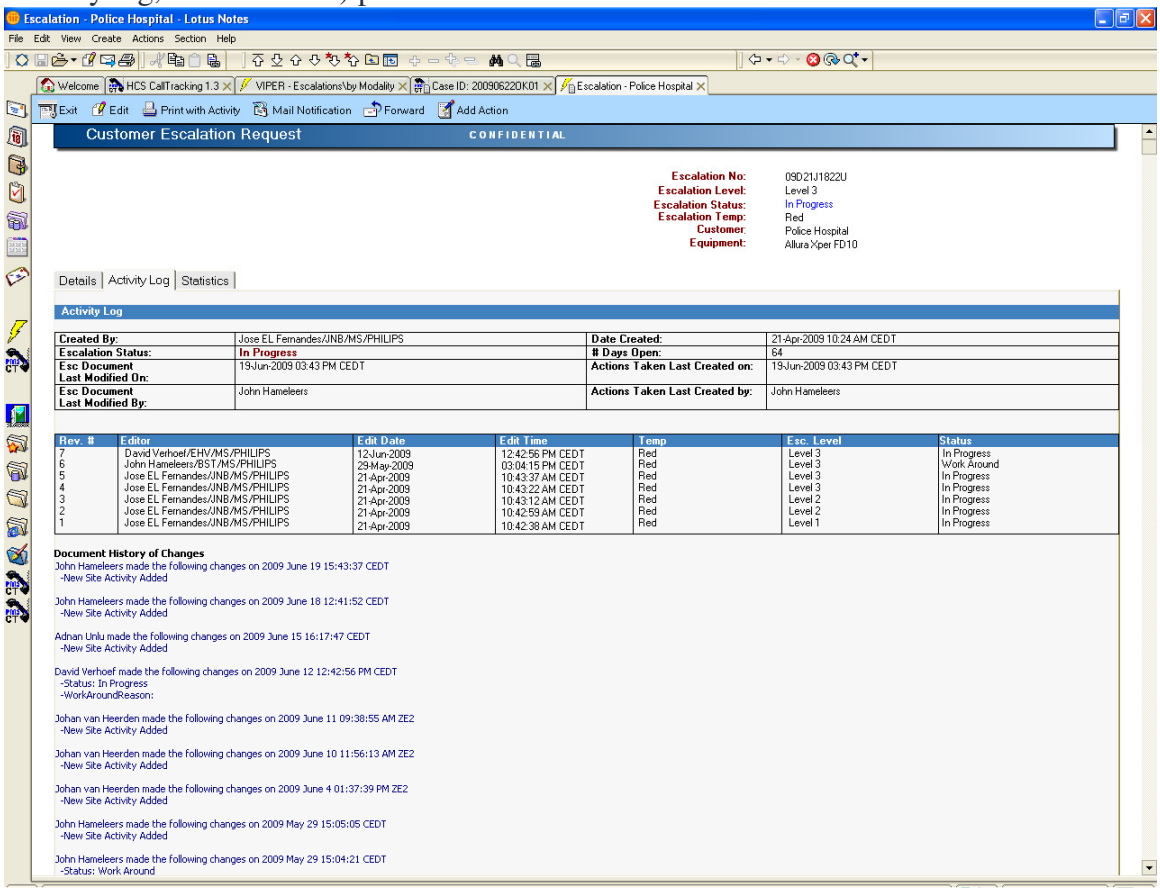

Figure 61 VIPER case example

A table with the most important case information gives any user critical insights. For instance, information about the last action taken, when it was taken, and # days open provides a clear overview to the user. Moreover, a table that summarizes the different actions taken in the system that has been reported offers the user with a simple but effective way to know the actual case situation. An example of that table is given in Figure 62.

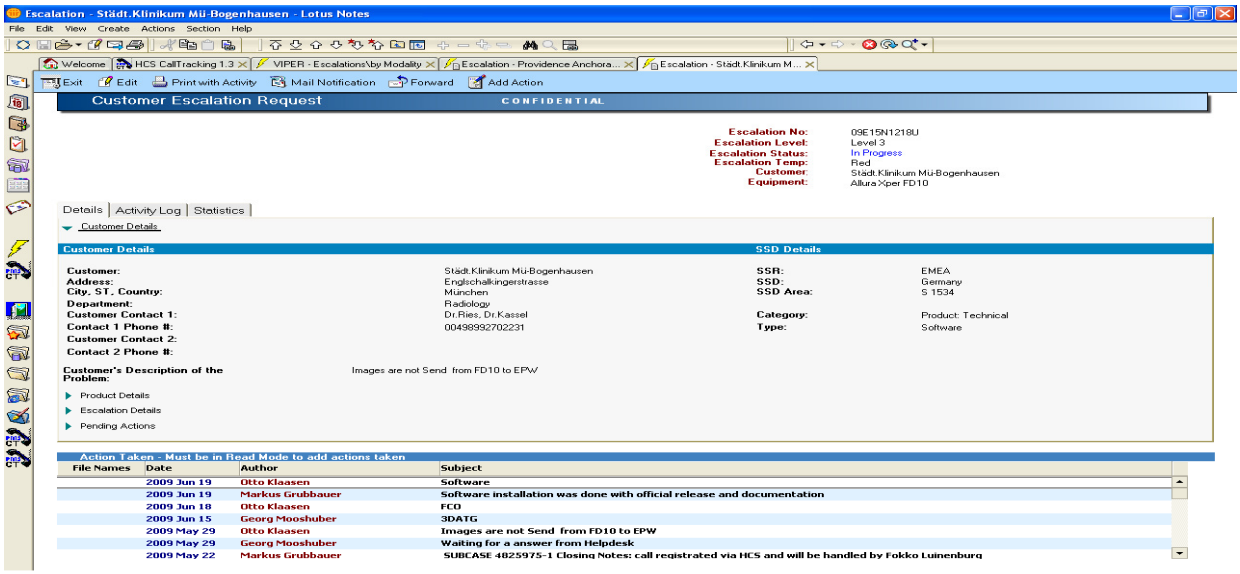

Figure 62 Actions taken in an escalation case

The other call handling tool – HCS

It was stated throughout this document that Clarify CRM is the official call handling tool. However, it was also cited that some instances of the customer service process are using another tool called HCS. This tool is also embedded in Lotus Notes and was the official call handling until the introduction of Clarify CRM. Figure 63 shows the call tracking application organized by year weeks. It is given the cases that occurred Monday of the week 26.

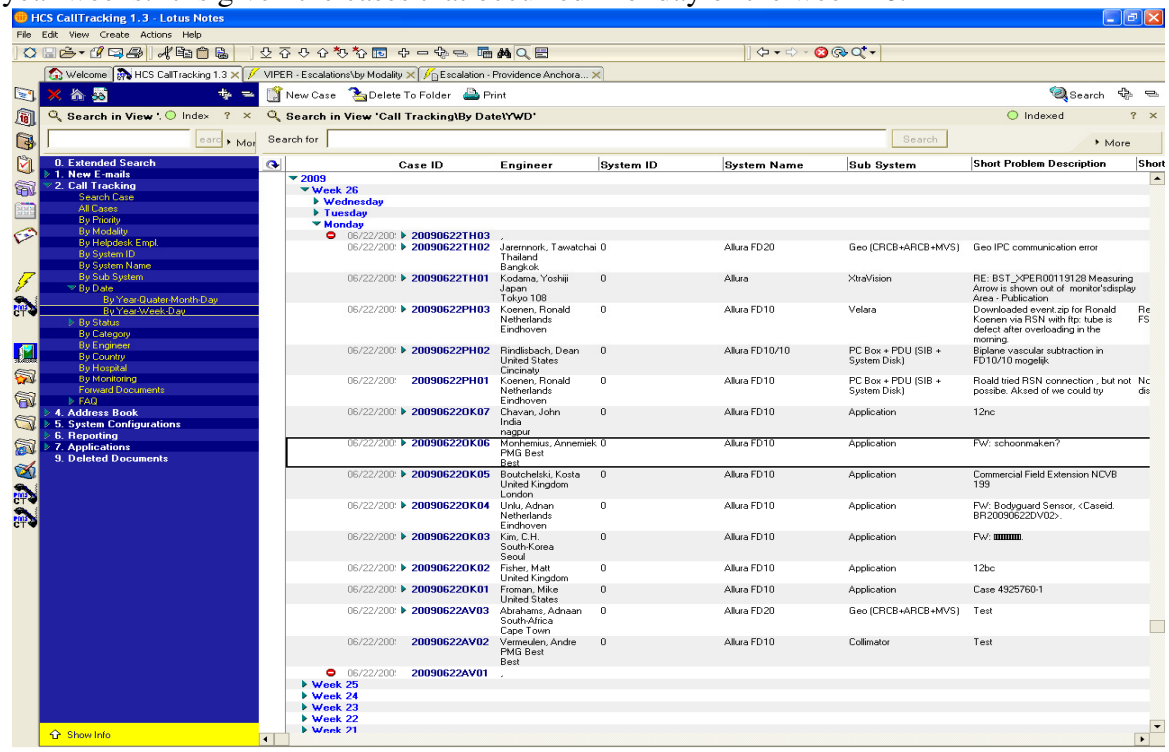

Figure 63 HCS call tracking application

Some of the HCS advantages claimed by the Helpdesk personnel can be seen in Figure 63. For instance, the *search option* plays a fundamental role in this tool. Moreover, the thread option (one message above the other) can be seen in Figure 64.

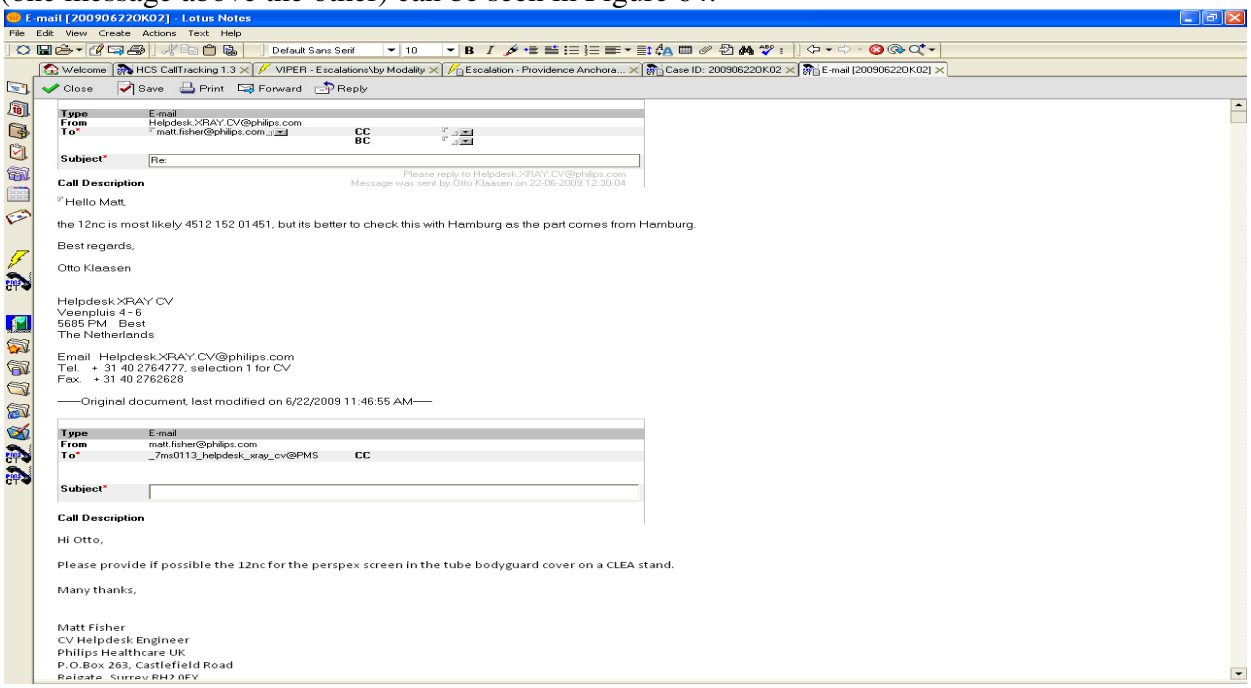

Figure 64 Message thread option in HCS

However, the disadvantages of this tool such as lack of case ownership or no distinction between the problem and solution can be appreciated in Figure 65 where the case is directed to Helpdesk but no one in particular and the solution is written in the same textbox as the problem.

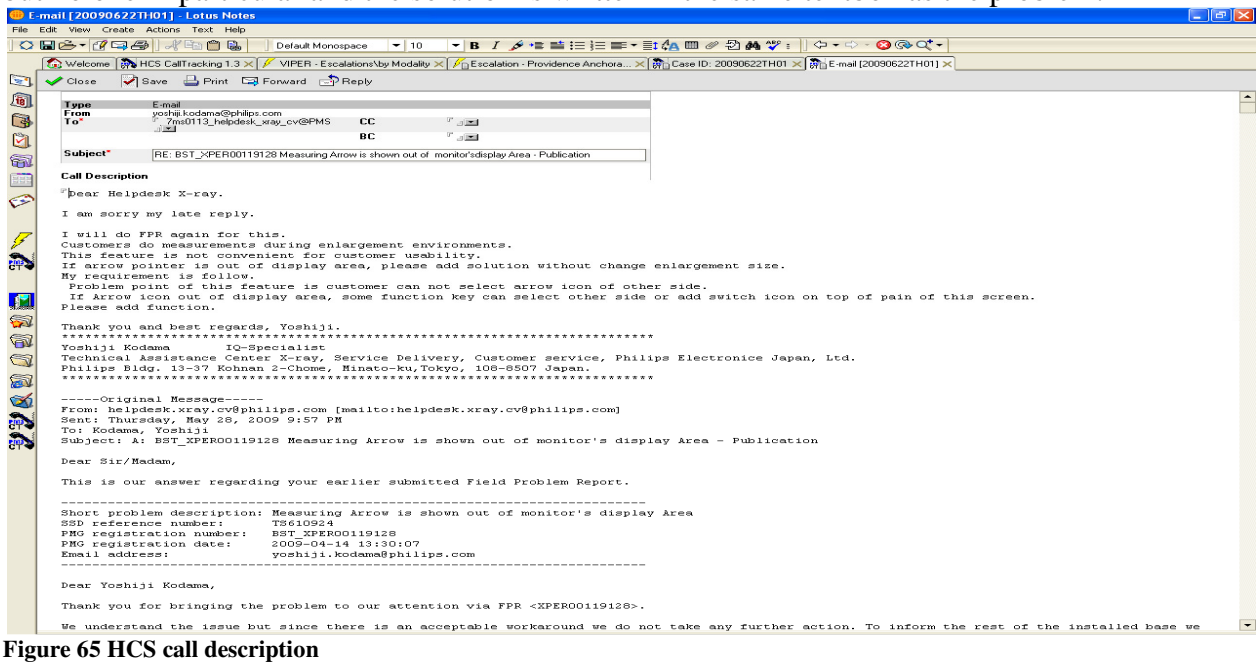

Figure 65 HCS call description

APPENDIX 10: FLOW CHART DESCRIPTION

The following is a brief explanation of the flow charts symbols used during the modeling phase. Figure 66 shows three columns: one with the graphical representation, another with the symbol name and the last one with the description of what the function of this symbol is.

Symbol	Symbol Name (Alternate Shape Name)	Symbol Description
	Terminator (Terminal Point, Oval)	Terminators show the start and stop points in a process. When used as a Start symbol, terminators depict a *trigger action* that sets the process flow into motion.
	Process	Show a Process or action step. This is the most common symbol in both process flowcharts and business process maps.
	Predefined Process (Subroutine)	A Predefined Process symbol is a marker for another process step or series of process flow steps that are formally defined elsewhere. This shape commonly depicts sub-processes (or subroutines in programming flowcharts). If the sub-process is considered "known" but not actually defined in a process procedure, work instruction, or some other process flowchart or documentation, then it is best not to use this symbol since it implies a formally defined process.
	Alternate Process	As the shape name suggests, this flowchart symbol is used when the process flow step is an alternate to the normal process step. Flow lines into an alternate process flow step are typically dashed.
	Decision	Indicates a question or branch in the process flow. Typically, a Decision flowchart shape is used when there are 2 options (Yes/No, No/No-Go, etc.)
	Data (I/O)	The Data flowchart shape indicates inputs to and outputs from a process. As such, the shape is more often referred to as an I/O shape than a Data shape.
	Document	Pretty self explanatory - the Document flowchart shape any process flow step that produces a document.
	Multi-Document	Same as Document, except, well, multiple documents. This shape is not as commonly used as the Document flowchart shape, even when multiple documents are implied.
	Preparation	As the names states, any process step that is a Preparation process flow step, such as a set-up operation.
	Display	Indicates a process flow step where information is displayed to a person (e.g., PC user, machine operator).

Figure 66 Flowchart symbols description [40]