APPLYING INDUSTRIAL MANAGEMENT
METHODOLOGIES TO HEALTHCARE

Considering opinions from healthcare organizations’ staff regarding potential problem areas

AMADOR GACIAS LLOBERA

Master of Science Thesis
Stockholm, Sweden 2012
APPLYING INDUSTRIAL MANAGEMENT METHODOLOGIES TO HEALTHCARE

Considering opinions from healthcare organizations’ staff regarding potential problem areas

Amador Gacias Llobera

Master of Science Thesis INDEK 2012:14 KTH
KTH Industrial Engineering and Management
Industrial Economics and Management
SE-100 44 STOCKHOLM
Abstract

The recent delicate economic situation has contributed to the fact that several of the existing industrial management techniques, initially conceived in order to improve manufacturing enterprises’ efficiency, have gained popularity not only within the industrial field, but also in the services sector. In that context, healthcare is facing a complicated situation on account of a reduction of resources and an increase of incoming patients. When applying existing industrial management techniques to healthcare, to consider the human factor may be of great assistance given the particular nature of organizations such as hospitals or clinics.

The purpose of this thesis is to firstly conduct a study of potential problem areas that could have a negative effect on healthcare organizations’ efficiency, specially taking into account the human factor. Then, the aim is to make considerations about how those problems could be addressed using industrial management techniques. Opinions from healthcare employees have been recompiled in a survey, regarding potential problems that might take place in their departments. The studied industrial management methodologies are Lean, Six Sigma and Theory of Constraints (TOC).

Results show that the most critical problems which are affecting to healthcare departments’ are related to the personnel and motivation fields. However, singular problems have also been
highlighted addressing other areas related to communication, information and operating & distribution issues.

This objective information yielded by the survey has been useful to identify concrete problematic situations from the lower levels of the system.

It is a fact that the hereby stated industrial management techniques did not congregate the desired characteristics by themselves to approach all the highlighted problems; but, once it was established what to focus on, they substantially matched the different issues when considering their individualities or when combining them in order to approach the needed improvements. That is why, when trying to apply industrial management methodologies to healthcare, organizations might save time and money by first addressing to the employees from the different involved departments.
Aplicant mètodes de gestió industrial a l’àmbit sanitari

Considerant opinions dels empleats dins el sector sanitari, respecte diversos problemes plantejats.

Amador Gacias Llobera

<table>
<thead>
<tr>
<th>Aprovat el dia</th>
<th>Tutor</th>
<th>Supervisor</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012-03-09</td>
<td>Terrence Brown</td>
<td>Martin Vendel</td>
</tr>
</tbody>
</table>

Empresa
- Contacte
- 

Resum

Amb la recent i delicada situació econòmica que ens afecta globalment, s’ha contribuït a què algunes de les diferents tècniques de gestió industrial, creades inicialment per a millorar l’eficiència de les empreses dins l’àrea de la manufactura, hagin guanyat popularitat no tan sols dins el sector industrial, sinó també dins el sector dels serveis. En aquest context, la sanitat està afrontant una complicada situació degut a una reducció dels recursos junt amb un increment dels pacients entrants. Alhora d’aplicar aquestes tècniques de gestió a l’àmbit sanitari, el fet de considerar el factor humà pot ser de gran assistència donada la particularitat d’organitzacions com ara podrien ser un hospital o una clínica.

El propòsit d’aquesta tesiés, primerament, portar a terme un estudí de les diferents situacions problemàtiques que podrien afectar negativament a l’eficiència dels centres sanitaris, tenint especialment en compte el factor humà. Seguidament, l’objectiu roman en considerar la manera en què aquests problemes podrien ser tractats utilitzant alguns dels mètodes de gestió industrial existents. Opinions de diferents treballadors dins la sanitat han estat recopilades mitjançant una enquesta, on s’hi ha plantejat possibles problemes que podrien ocurrir als seus departaments. Els mètodes de gestió estudiats són Lean, Six Sigma i Theory of Constraints (TOC).

Els resultats indiquen que els problemes més crítics que afecten als departaments sanitaris queden relacionats amb la motivació i amb la manca de personal. Tanmateix, problemes concrets han estat
també remarcats, al·ludint altres àrees relacionades amb problemes d’operacions i distribució, informació i comunicació.

Aquesta informació objectiva donada per l’enquesta ha estat útil alhora d’identificar els problemes específics, des dels nivells més inferiors dins el sistema.

És un fet que cap dels mètodes estudiats a aquesta tesi han reunit per si sols les característiques desitjables per a afrontar tots els problemes esmentats; malgrat, un cop s’establí quins eren els punts que devien ser tractats, aquestes encaixaren substancialment si es consideraven les individualitats d’aquests mètodes o bé es combinaven amb l’objectiu d’abordar les necessitades millors. És per aquest motiu que, quan s’apliquin mètodes de gestió industrial dins l’àmbit sanitari, les organitzacions podrien guanyar temps i diners adreçant-se primer als treballadors dels diferents departaments i nivells involucrats.
ACKNOWLEDGEMENTS

I would like to thank the INDEK department as well as to my supervisor Terrence Brown for their confidence since the very first moment, enabling this thesis to become a reality.

Furthermore, I would also specially like to manifest my gratitude to Dr. Martin Vendel for the inestimable support and guidance provided throughout the thesis’ development, whether academically or personal.

Much assistance has also been given by many of my familiars and friends, who gave a very helpful hand to me especially when I needed to spread the survey. Particularly, thanks to my mother for the big effort she made, as a nurse she is, in getting as many contacts as she could for my inquiry.

Finally, thanks to all the Erasmus colleagues I have made during this semester, who made my stay here in Sweden to become an even more unforgettable experience.

Tack så mycket Sverige!!!

Stockholm, February 2012

Amador Gacias

Contact: amador.gacias@hotmail.com
# TABLE OF CONTENTS

Chapter 1: INTRODUCTION ........................................................................................................................................... 7

1.1. Background .................................................................................................................................................................. 8

1.2. Purpose ..................................................................................................................................................................... 8

Chapter 2: LITERATURE REVIEW ........................................................................................................................................ 9

2.1. What is understood as healthcare management? .................................................................................................... 9

2.2. Manufacturing vs. services ....................................................................................................................................... 9

2.3. Industrial management methods to raise enterprises’ throughput .......................................................................... 10

2.3.1. Lean management .................................................................................................................................................. 10

2.3.2. Theory of constraints ............................................................................................................................................. 17

2.3.3. Six Sigma .............................................................................................................................................................. 19

2.4. Challenges implementing industrial techniques into healthcare ................................................................................. 22

Chapter 3: PROBLEM DESCRIPTION .................................................................................................................................. 25

Chapter 4: METHODOLOGY ................................................................................................................................................. 27

4.1. Qualitative method .................................................................................................................................................... 27

4.2. The Survey ................................................................................................................................................................. 27

4.3. Discussion process about the management techniques .......................................................................................... 31

Chapter 5: EMPIRICAL ANALYSIS ........................................................................................................................................ 33

5.1. Provenance of the data ................................................................................................................................................ 33

5.1.1. Type of center ......................................................................................................................................................... 34

5.1.2. Centers’ size ............................................................................................................................................................ 34

5.1.3. Involved departments ............................................................................................................................................ 35

5.1.4. Involved job positions ........................................................................................................................................... 36

5.1.5. Employees’ seniority within each dept ................................................................................................................... 36

5.2. RESULTS: Classified groups of problems ............................................................................................................. 37

5.2.1. Communication problems .................................................................................................................................. 37

5.2.2. Information problems ............................................................................................................................................ 38
LIST OF FIGURES

Fig. 1. Five core concepts for Lean thinking ................................................................. 11
Fig. 2. Example of a kanban card ................................................................................ 13
Fig. 3. Poka-yoke bridge for brake wire clamp mounting ............................................. 13
Fig. 4. Device to ensure labels attachment ................................................................. 14
Fig. 5. Common symbols used in VSM ................................................................. 15
Fig. 6. Future mapping from an ambulatory attention value stream ...................... 16
Fig. 7. Normal distribution shifted by 1.5 sigma .................................................. 19
Fig. 8. DPMO versus sigma level ........................................................................... 20
Fig. 9. DMAIC Process .......................................................................................... 20
Fig. 10. Involved types of healthcare center ............................................................. 34
Fig. 11. Size of the involved centers .................................................................... 34
Fig. 12. Involved job positions ............................................................................. 36
Fig. 13. Employees’ seniority within each department ........................................... 36
Fig. 14. Communication problems ....................................................................... 37
Fig. 15. Information problems ............................................................................. 38
Fig. 16. Motivation problems ................................................................................ 39
Fig. 17. Operating & distribution problems ............................................................ 40
Fig. 18. Personnel problems .............................................................................. 41
Fig. 19. Problems comparison (hospitals’ responses) ............................................ 42
Fig. 20. Problems comparison (other center’s responses) ..................................... 42
Fig. 21. Problems comparison (Physicians’ responses) ........................................ 44
Fig. 22. Problems comparison (nurses’ responses) ............................................... 44
Fig. 23. Nurses’ responses regarding personnel problems ..................................... 45
Fig. 24. Problems comparison (<5-years-of-seniority employees) ....................... 46
Fig. 25. Problems comparison (>5-years-of-seniority employees) ....................... 47
Fig. 26. Problems comparison (considering all involved employees) .................... 48
LIST OF TABLES

Table 1. Seven types of waste ............................................................................................................... 11
Table 2. Results indicators..................................................................................................................... 18
Table 3. Possible responses to the raised questions ............................................................................. 28
Table 4. Communication problems ....................................................................................................... 29
Table 5. Information problems ............................................................................................................. 30
Table 6. Motivation problems ............................................................................................................... 30
Table 7. Operating & distribution problems ......................................................................................... 30
Table 8. Personnel problems ................................................................................................................. 30
Table 9. Involved departments ............................................................................................................. 35
Table 10. Summary of conclusions ...................................................................................................... 58
CHAPTER 1:
INTRODUCTION

As in many other fields, healthcare has experienced a decreasing of resources on account of the recent economic crisis, which is still in the spotlight. Apart from this, departments in hospitals have experienced a severe increase of incoming patients over the last decade (Eitel, et al. 2008) as well as diseases have evolved to a higher level of complexity, causing the situation to converge to an overcrowding scene.

The demand and peaks of incoming patients have often been attributed the responsibility of this overcrowding, but it should be considered that within a huge organization as (for example) a hospital can be, there may probably exist several internal factors that are also a cause of it (Miró, et al. 2003). Thus, the focusing could be set to the internal systems and procedures that are daily conducted in healthcare organizations.

After a problematic situation is raised and an improving method is implemented, results will have to be provided so that they can be evaluated and compared with the ones from the initial situation. Those improving methods and tools could depend on the staffs who are applying them; thus, this human factor on the way to improving healthcare is a factor to consider.

In order to obtain data regarding this issue, some surveys to hospital personnel (Dornhorst, et al. 2005) (Blendon, et al. 2004) and to patients (Jarman, et al. 1994) have been done, regarding factors such as the quality of the service, the potential sources of the problems or the parameters that could be changed in order to improve the working life. In this study a survey is going to be conceived and delivered to healthcare organizations, trying to analyze the opinions from different departments’ staff regarding potential problematic situations.
1.1. Background

There is an importance in considering the employees opinion when applying improving measures; whether in service quality, reducing costs, raising throughput or diminishing stress level.

Studies focused on improvements in healthcare have commented the reluctance of nurses and physicians to be compliant when applying the new proposed methods (Proudlove and Boaden 2005), whereas some others (Welch, Jones and Allen 2007) state just the opposite behavior of the staff. Conflicts between departments have also been pointed when managing patients admission (Proudlove and Boaden 2005), as well as a general aversion to changes towards a newer, sustainable and efficient system (Cuatrecasas 2010). Hence, it would be called for to conduct a qualitative study which can obtain opinions from the staff about several potential problems that could occur in their departments; in order to obtain objective data about which are the most significant problems that employees have in common.

Some studies have surveyed hospital directors (Flannelly, et al. 2006) or department directors (Richards, Navarro and Derlet 2000); others have done the same addressing just physicians (van Walraven, et al. 1999), or in some cases just patients (Jarman, et al. 1994). This thesis work will present an inquiry to different healthcare departments’ employees, since their functions may be considerably interdependent.

1.2. Purpose

The main purpose of this project is to conduct a study of potential problem areas that could have a negative effect on healthcare departments’ efficiency, and make considerations about how those problems could be addressed using industrial management techniques$^1$.

The opinions of healthcare organizations’ staff have been recompiled in a survey, in order to obtain objective information about which would be the most critical problems that affect departments’ efficiency, as well as about how viable would it be in their centers to solve these problems.

The results of the survey have also been used to compare opinions between different employees, considering potential agreements or disagreements with the diverse problems stated in the inquiry, in order to obtain wider information about the highlighted issues.

$^1$ Lean management, Six Sigma, Theory of Constraints
2.1. What is understood as healthcare management?

Healthcare management can be understood as the area of knowledge (and also the practices) that deals with financing, organization, operation and evaluation within the healthcare sector; with the aim to improve populations’ health (Lamata 1998).

As it has been said, this branch of management is associated to the healthcare sector; therefore, its goals comprises the study, introduction and managing of the healthcare policies, health systems, health services, health organizations and institutions, health centers (hospitals, clinics, specialized centers, etc.) and other mechanisms such as health transportation and communications.

2.2. Manufacturing vs. services

Over the past decades, brisk work has been done in order to improve industrial processes and the quality of the resulting products. On account of that fact, several techniques have been able to show their ability to improve those processes.

The issue of how useful it would be to apply some of these techniques in a try to improve healthcare systems has been heavily discussed, with a clear division of opinions (Young, et al. 2004). Thus, it may be useful to know about the general parameters that are used to differentiate manufacturing and service operations (Roy 2005):

- Tangible and intangible nature of output: Manufacturing outputs are tangible products, whereas services are more like an experience to the customer.

- Consumption of output: Tangible products are consumed over time by customers, but consumed immediately when referring services.
• Nature of work (jobs): Equipment is mostly needed in manufacturing processes, whereas more labor is used in services jobs.

• Degree of customer contact: There is no customer interaction with the production process in manufacturing industries; but the contact is direct with the customer in services sector, who often participates in the creating process.

• Measurement of performance: In the manufacturing sector, it is usual that significant investments are made in sophisticated measuring methods for production and resource consumption; in contrast to the simpler methods used in services sector.

Although the presence of all these differences and peculiarities between industrial manufacturing and healthcare, it has been proved that applying industrial procedures to improve the quality of healthcare services is not a preposterous idea (Ben-Tovim, et al. 2007) (Miró, et al. 2003).

2.3. Industrial management methods to raise enterprises’ throughput

Below, some established industrial management techniques that may be valuable when being applied to healthcare will be presented, as well as their main characteristics and principles. To take into account all the existent industrial management techniques was beyond the scope of this thesis, but it has been hereby considered that the most popular ones are Lean and Six Sigma. Given the differences that Lean and Six Sigma have with Theory of Constraints, which has also been used in several types of organizations (Palacios Álvarez 2010), this last methodology has also been hereby considered.

2.3.1. Lean management

Lean thinking appeared by the hand of Taiichi Ohno, Kihiro Toyoda and others from Toyotas enterprise who, after looking at the situation of the manufacturing industry sector in the 1940’s, considered what should be done to create a better system, and invented the Toyota Production System (TPS), where Lean management is conceived\(^2\). Later on, the methodology would be developed and released all over the world by Womack and Jones (1990).

The five core principles of lean thinking are shown in figure 1:

\(^2\) Adapted from Lean Enterprise Institute (www.lean.org) [13 October 2011]
The term value stands for what the customers are paying for, the reason why an amount of money is spent by them. Obviously, to add as much value as possible in the proper way will demand a profound knowledge about the needs of customers.

The whole path that has to be taken in order to get the value that customers want comprises which is called the value stream. The goal of lean is to deliver value to the product or service in every single corner of that path, which would mean with no waste. Therefore, this waste is understood as every activity that does not add value to that product or service. On the table below, the seven basic types of waste in lean thinking are presented:

Table 1. Seven types of waste

<table>
<thead>
<tr>
<th>TYPE</th>
<th>EXAMPLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overproduction</td>
<td>Projects or reports that are finally not executed</td>
</tr>
<tr>
<td>Over processing</td>
<td>Too much complex administrative processes</td>
</tr>
<tr>
<td>Inventories</td>
<td>Unnecessary patient admissions in hospitals</td>
</tr>
<tr>
<td>Transporting process items</td>
<td>Unnecessary shifts between departments</td>
</tr>
<tr>
<td>Employees shifts</td>
<td>Large daily displacements because of bad organization</td>
</tr>
<tr>
<td>Waiting times</td>
<td>Doctor waiting to attend a patient</td>
</tr>
<tr>
<td>Reprocessing</td>
<td>Wrong treatment to a patient in a healthcare center</td>
</tr>
</tbody>
</table>

---

3 Adapted from Introduction to “Lean Thinking” (2006), McCarron B., [Online], Available: [http://www.cipfanetworks.net/fileupload/upload/Lean_briefing1912007311331.pdf](http://www.cipfanetworks.net/fileupload/upload/Lean_briefing1912007311331.pdf) [18 October 2011].

4 Source: Lean management en los procesos de servicios (Lluís Cuatrecasas, 2010)
It could be said the flow is one of the critical parameters of lean management. In lean enterprises and organizations, work flow should not be interrupted a single moment, since it makes the processes to be done quicker.

One of the main differences between lean enterprises and the “old minded” is that the second ones tend to produce in a massive way, trying to get profit from the economies of scale. Somehow, those organizations are pushing their products to the market, whereas lean enterprises just do the opposite; the market is the one who pulls products and services from the very beginning.

Once the last four principles have been applied, a way towards perfection has been set. Once lean thinking is implemented, the operating becomes faster, and mistakes and waste points are easily identified.

However, eliminating each one of the seven types of waste may not be trivial. Hence, lean management comprises several tools that are used for different purposes. Below, a list of common lean tools will be briefly presented.

- Kanban.

Kanban is a Japanese word that means “sign board” (Zidel 2006). Nevertheless, the signal may adopt any form (i.e. a painting, a sound, a light, an empty box). The Kanban technique uses signals to inform operators (and supervisors) about the quantities to be produced, as well as the moment when the product has to be produced. The information let employees quickly know when to start producing, or when to stop (Gross and McInnis 2003). The aim is to introduce these visual tools without making a significant investment.

Some of the ideas for a successful Kanban implementing would be (Gross and McInnis 2003):

- Size the kanban to current conditions
- Adapt signals’ size to allow flow
- Make kanban signals visual
- Train the operators to run the kanban system
- Develop a phased improvement plan to reduce kanban quantities
**Poka-Yoke**

The term poka-yoke means “mistake proofing”, and it is a technique that was invented and developed by Shigeo Shingo, with the aim of achieving zero defects and eliminating quality control inspections (Shimbun 1988).

Errors may simply occur or either be about to occur. Thus, poka-yoke devices have the goal of preventing errors or making them obvious to the operator so that they don’t take place. Nevertheless, if any abnormalities occur, the system has to be able to carry out feedback and action immediately (Huang, Mak and Maropoulos 2010).

Figures 3 and 4 present some examples of poka-yoke devices and their functionality:

---

5 Source: A lean guide to transforming healthcare: how to implement lean principles in Hospitals, Medical Offices, Clinics and other Healthcare Organizations (Zidel 2006)

6 Source: Modern approaches to manufacturing improvement: the Shingo system (Robinson 1990)
This method raises a working culture that permits to work in a clean, secure and well organized atmosphere. This goal is achieved by the implementation of several practices, visual controls and standardized procedures (Amaro Jr 2006).

The system is composed of five phases (Miranda Rivera 2006), under the name of five Japanese words that have to be complied by organization’s staff, to improve the overall efficiency.

- **Seiri** (sorting): Eliminate what is not useful; to work supplied with only needed tools or devices.
- **Seiton** (Straightening or organizing): Setting things in order and close to the working place, to easily identify and reach out what is useful to work.
- **Seiso** (Sweeping or systematic cleaning): Maintaining the workspace clean and tidy. At the end of each shift, the area has to be cleaned and all the equipment has to be restored to its place.
- **Seiketsu** (standardizing): The goal of this phase is to standardize the three previous ones, in order to sort, organize and clean always in the proper way.
- **Shitsuke** (review or self-discipline): After establishing the other S’s so that they become the new way of operating, the standards have to be maintained and reviewed.
• **Value Stream Mapping (VSM)**

VSM is a powerful tool to get a visual representation of how a process works. Womack and Jones (2003) define the value stream as *the set of all the specific actions required to bring a specific product through the three critical management tasks of any business: the problem-solving task running from concept through detailed design and engineering to production launch, the information management task running from order-taking through detailed scheduling to delivery, and the physical transformation task proceeding from raw materials to a finished product in the hands of the customer.*

The system uses diverse standardized symbols in order to make the map more understandable to any reader. Some examples are presented in figure 5:

![Common symbols used in VSM](image)

**Fig. 5. Common symbols used in VSM**

One goal is to enable management to visualize processes, pinpoint existing problems and focus the direction of system’s transformation (Keyte and Locher 2004). Thus, there may be maps that provide a representation of current work being done, whereas there may be others that present the Lean tools that should be applied to the current state map (Tapping, et al. 2009). An example of a (healthcare) value stream map is presented below:

---

7 Source: *Lean maintenance: reduce costs, improve quality, and increase market share* (Smith and Hawkins 2004)
Fig. 6. Future mapping from an ambulatory attention value stream\(^8\)

Most VSM exercises are done on paper, which is posted generally on a common area wall (Tapping, et al. 2009).

\(^8\) Source: Applying Value Stream Mapping to a healthcare study case. A system approach. (Rubiano O., González H. and Micán R. 2010)
The Theory of Constraints (TOC) was invented and released by Eliyahu M. Goldratt. It is a scientific methodology that initially was given the aim to optimize production in the industrial field, but finally has been applied to several types of organizations (Palacios Álvarez 2010).

The improvements of this theory are achieved following the idea that there are two core parameters: the goal that it is wanted to achieve and the constraints that prevents it to be reached (González G, Ortegón M. and Rivera C. 2003). TOC intends to figure out where the constraints are, known as bottlenecks, assuming that the level of productivity is as powerful as the weakest part of the system.

There may be several types of constraints that hinder the productivity and performance of businesses. The most common (González G, Ortegón M. and Rivera C. 2003) are listed below:

- **Manufacturing constraints**: They are obstacles to the production capacity, so the demand cannot be handled properly.
- **Market constraints**: They are found when the attended part of the market is not enough to fulfill the capacity of the company.
- **Constraints of materials**: They appear when the supply, either both the quality and availability of the materials, prevent to satisfy demands.
- **Logistics constraints**: Problems on the working methods that prevent the processes flow appropriately.
- **Policies constraints**: Manners of acting, measuring, monitoring and either the habits from employees that lead the system to a lack of productivity.

TOC has three basic operative indicators that facilitate the monitoring of the results (Palacios Álvarez 2010):

i. **Throughput (T)**: The velocity which the company creates incomes from sales.

ii. **Inventory (I)**: All the money inverted on those items that are intended to sell or, at least, become part of the product or service.

iii. **Operating expenses (OE)**: The amount of money spent in converting the inventory into throughput.

Thus, to calculate results indicators from the operative ones, the formulas below should be calculated:
Table 2. Results indicators

<table>
<thead>
<tr>
<th>U= T-OE</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROI= U-I</td>
</tr>
</tbody>
</table>

[U= Profit; ROI= Return on the investment]

The correct actions that should be taken would be those that varied one of the next three parameters, without hindering the other ones:

- Increment of the throughput
- Reducing the inversion and inventories
- Reducing operating costs

A key part of TOC is composed of the five focusing steps that should be done, according to the principles of this theory (Dettmer 1997).

**Step 1.** Identify the system constraint: The weakest link of the chain has to be found, and also its precedence (whether physical or a policy).

**Step 2.** Decide how to exploit the constraint: What can be done to get the most out from the constraint without bringing significant changes to it?

**Step 3.** Subordinate everything else: Once the first two steps are done, it will be necessary to adjust the resting parts of the system so that the constraint operates to its maximum effectiveness. Then, the results of the actions must be evaluated, and if the studied parameter is not a constraint any more, the fourth step can be skipped; otherwise, there is still a critical bottleneck so step 4 will be needed.

**Step 4.** Elevate the constraint: Once at this step, it is highly recommended to make sure that the constraint cannot be broken with the first three steps, since “elevating” the constraint means that any kind of action should be taken to break the constraint (whether time, energy, money, etc.).

**Step 5.** Go back to step 1: It is a must to go back to the first step and start the cycle again, in the search of next constraints that obstruct the company’s performance.

---

9 Source: La teoría de restricciones aplicada al desarrollo de software (Palacios Álvarez 2010)
2.3.3. **Six Sigma**

Six Sigma (6σ) was created and introduced by Motorola in 1987 with the main goal of improving processes and eliminating defects (Pyzdek and Keller 2010). After a decade from the initiative, hundreds of companies had implemented Six Sigma methodologies aiming to diminish costs and improving quality (De Feo and Barnard 2005).

In quality terms, Six Sigma has the challenging goal of achieving 3.4 defects per million opportunities (DPMO), where defect opportunities are understood as any failure in the process that is critical to the customer. That is to say nearly every single produced unit would accomplish the specifications.

![Graph 1](image.png)

**Fig. 7. Normal distribution shifted by 1.5 sigma**

Graph 1 shows the Normal Distribution, under the quality parameters stated by Six sigma. The upper and lower specification limits (USL, LSL) represent the 6σ distance from the mean (μ). As it can be seen, the unlikeliness of the values staying near 6σ from the mean is very high. This methodology assumes a 1.5σ shift of the mean so that it can be guaranteed that the specification limits are not outpaced even if that mean suffers any displacement to the left or to the right (Tennant 2001).

---

10 Source: Uptake and success factors of Six Sigma in the financial services industry (Heckl, Moormann and Rosermann 2010).
Below, defect rate versus sigma level is presented:

![DPMO vs. sigma level](image)

**Fig. 8. DPMO versus sigma level**

One of the particularities of Six Sigma is that several improvement specialists (with different and specific trainings) are used in order to achieve goals (Linderman, et al. 2003). They are known as Project Champions, Master Black Belts, Black Belts, and Green Belts.

Green Belts work for improvement issues in part-time, and are given basic training because they only provide support on improvement the projects. These projects are lead by Black Belts, who dedicate full-time to them and usually receive one month of training. Master Black Belts are given still more lessons and training about the matter, and usually develop the function of internal instructors. To end with, Project Champions take the role of identifying the strategically important goals to achieve and providing resources (Linderman, et al. 2003).

To achieve the challenging goal stated by Six Sigma, one of the methodologies used is a five steps process called DMAIC (pronounced “Duh-may-ick”). This is the acronym for the phases that represent the improvement process: Define, Measure, Analyze, Improve, Control.

![DMAIC Process](image)

**Fig. 9. DMAIC Process**

Below, the function and deliverable tasks for each phase will be listed (George, et al. 2005):
a) **DEFINE**: The purpose of this initial procedure is to reach an agreement on the goals, target and scope for the specific project.

Tasks that may be delivered:
- A finalized project charter
- List customer’s needs and expose how this project will affect them
- Mapping and diagramming processes (high-level)
- Plans for the completed project (including documents such as Gantt charts or risk analysis)
- Results from the project launch meeting

b) **MEASURE**: The aim is to understand the whole process and to assemble as much reliable data as possible, which will be used to underline the problems.

Tasks that may be delivered:
- Actual and developed value stream map
- Reliable data from the monitoring of the critical inputs and outputs, which will be considered for defects, variation and process flow analysis
- First measures of process capability, such as sigma quality level
- Refining and revising goals
- Implement a capable measuring system

c) **ANALYZE**: The purpose of this step is to identify the factors that affect the critical inputs.

Tasks that may be delivered:
- Documenting possible causes considered in previous analysis
- Identifying the work that adds value, as well as the non-profitable work
- Calculate the efficiency of the process cycle

d) **IMPROVE**: In this step the goal is to prove the selected solutions and learn from them, implementing and executing them in full-scale.

Tasks that may be delivered:
- Giving evidence that the solutions selected to affect critical inputs are also causing effects on the critical outputs
- The result of a stable and predictable process, satisfying customers.

e) **CONTROL**: On this last phase, the purpose is to finalize the project and hand it off to the customer, making sure the procedures to maintain the improvements are understood.

Tasks that may be delivered:
- Updated data and charts, as well as documenting the improving process
- A monitoring process for the implemented solution
- Extra documentation such as further recommendations
2.4. Challenges implementing industrial techniques into healthcare

Several challenges may have to be faced in order to successfully implement industrial techniques into the healthcare sector.

Although the benefits from Lean to industries (whether manufacturing or services) seem to be clear, it has been stated that it may be a challenge to apply its principles to the healthcare sector, as well as hard to resource proposals for the improving process (Young, et al. 2004). Thus, what is certain is that the switch demands hard work to companies as a whole.

Difficulties are also found when identifying customers and processes that contribute to the value stream in a healthcare setting, as well as when selecting an appropriate terminology for the whole implementation of newer methods (Proudlove, Moxham and Boaden 2008).

Relating TOC with healthcare, the bottlenecks on this sector may not be obvious. Despite that fact, it has been shown that this methodology might be useful to improve patient care (Wolstenholme 1999). A key factor required by TOC is to introduce an efficient method to quantify, measure and monitor critical constraints, but in healthcare this may become even a more challenging goal (Eklund 2008).

Despite constraints’ ambiguity in healthcare, one point of view when applying TOC is that “there will be a bottleneck; the decision is where you want it” (Young, et al. 2004).

The three major challenges when implementing Six Sigma in the services sector have been pinpointed (Thakkar, Deshmukh and Kanda 2006) (Operations Management Roundtable 2002):

On the one hand, service focused environments struggle with metrics identification. This is a critical parameter to be managed, since in Six Sigma projects there is a count of the process defects as a prime measurement. Besides that, if customers’ variability is too wide, a proper segmentation of the responses cannot be conducted.

On the other hand, non-manufacturing firms face difficulties with creating cultural change and creating Six Sigma Leaders. A significant reluctance from the employee can appear when trying to create and integrate new behaviors in order to reach the objectives.
The third challenge is that non-production focused environments fail to capture the benefits of Six Sigma application. Cost savings that 6σ must show are difficult to document to some companies, since it may not be trivial to demonstrate the value of the implemented strategies. To give time to the projects and to have patience until progress can be noticed is compulsory for the employees.

However, all improvements introduced in enterprises (regardless of the methodology applied) are unlikely to be maintained unless they become part of a clear strategic direction for the organization (Proudlove, Moxham and Boaden 2008), which would also be a significant challenge to face.
CHAPTER 3: PROBLEM DESCRIPTION

As mentioned in chapter 1, the main purpose of this work is to conduct a study of potential problem areas that could have a negative effect on healthcare departments’ efficiency, and make considerations about how those problems could be addressed using industrial management techniques.

Since the human factor is significant when applying changes and new methods in healthcare, the opinions of healthcare organizations’ staff have been recompiled in a survey, in order to obtain objective information about potential problematic situations that might take place in their workplaces.

The following initial research question will be stated as:

(1) Which are the problems that affect more critically to departments’ efficiency in healthcare organizations?

Apart from the affection level, it is also convenient to consider the difficulty that would exist when approaching solutions to these situations. Hence, the second research question is:

(2) From the employees’ point of view, which would be the difficulty level to solve those problems?

As stated in the literature review, several industrial management techniques were conceived within the manufacturing sector to improve enterprises’ throughput, but it has been stated that it could also be appropriated to implement them in the services sector as well (Ben-Tovim, et al. 2007) (Miró, et al. 2003). Therefore, according to the information obtained from the first two questions, a final question will be raised:

(3) Regarding the results from questions (1) and (2), which of the management methodologies stated in this thesis could be more suitable when considering potential solutions to increase healthcare organizations’ efficiency?
CHAPTER 4: METHODOLOGY

This chapter firstly presents the methodology according to which the study has been conducted. Then, the main characteristics of how this method has been applied will be presented.

4.1. Qualitative method

In order to obtain the necessary data to find responses for the research questions, a qualitative study has been conducted. The usage of this kind of tool will permit to understand the situation deeper since it has been stated that qualitative methods are more appropriate when dealing with words, rather than numbers (Saunders, Lewis and Thornhill 2009). Another fact that has been crucial when selecting this type of method has been that the questions presented require more an opinion from the respondents rather than numerical or standardized data.

Since the aim was to get as many respondents as possible within the healthcare sector in a short period of time, an online survey has been selected as the tool to collect the necessary information.

4.2. The Survey

After deciding to use this online tool, several steps have been taken into account (Connaway and Powell 2010) (Groves, et al. 2009). The main phases are presented below:

- Selecting the sample

According to the research questions, the sample has had to comprise different healthcare organizations. Within those different centers, several departments have been taken into account since the research questions are also referred to their effectiveness. The information has come from the employees who are working in all the involved depts.
Since the more responses the better results, the size of the sample has not had have a maximum limit, but temporal. That is to say, the data has been collected continuously during a limited period of time (approximately 2 months) due to time limitations.

To maximize the number of respondents, the inquiry has been elaborated in four different languages: Swedish, English, Catalan and Spanish.

- Preparation of the inquiry

The survey has been made using an online tool powered by Google Docs. It starts with a first part where several short questions are made to the respondents, regarding basic information about the organizations where they work and also about their working positions.

After that, a group of potential problems that could take place in healthcare organizations is presented. From each of those problems, two questions are made to the respondents:

a) “How much does it affect to the overall efficiency of your department?”

b) “How easy would it be, from your point of view and in your Dept., to find a solution to this problem?”

To both questions a) and b), five possible responses are available:

<table>
<thead>
<tr>
<th>How much does it affect to the overall efficiency of your department?</th>
<th>How easy would it be, from your point of view and in your Dept., to find a solution to this problem?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very significant</td>
<td>Very hard</td>
</tr>
<tr>
<td>Significant</td>
<td>Hard</td>
</tr>
<tr>
<td>Not so significant</td>
<td>Not so hard</td>
</tr>
<tr>
<td>Insignificant</td>
<td>Easy</td>
</tr>
<tr>
<td>I don’t know</td>
<td>I don’t know</td>
</tr>
</tbody>
</table>

The survey ends with two personal and subjective questions and also with three others asking for any comments about the survey and also for any other possible collaborators. The links to the complete surveys are listed in Appendix 1.
• **Sending the surveys and collecting the data**

For the releasing of the surveys, the main used tool has been the e-mail due to its capacity of sending the information easily, quickly and with no geographical barriers. Therefore, an effort has also been put in order to obtain the employees’ e-mail addresses.

Many of the e-mails have been obtained from the author’s personal contacts, who are currently healthcare employees. The rest of the respondents have been obtained by emphasizing to those personal contacts about the key function that inquiry responses have in this thesis, explaining to them which is the aim of the project and making sure that this information will be transferred to their other possible contacts and so on.

At the time of collecting the responses, *Google Docs* manages all the incoming data and files it into a spreadsheet, which enables an easier analysis of the results. The complete analysis, including graphics and tables, has been done using the program *Excel*, by *Microsoft*.

As it has been stated, the inquiry raises several problematic situations that could occur in healthcare organizations. Those specific situations have been raised on account of the recommendations of several professionals in the sector (mostly nurses and physicians) as well as from the author’s point of view. When a significant list of concrete potential problems was obtained, they have been classified into different groups according to their characteristics. Finally, the representative name of each group has been decided. The tables below present the five final considered groups of problems and all the concrete situations that are included in each of them.

**Table 4. Communication problems**

<table>
<thead>
<tr>
<th>COMMUNICATION PROBLEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Shortage of communication with patients</td>
</tr>
<tr>
<td>• Shortage of communication during the change of shifts</td>
</tr>
<tr>
<td>• Shortage of communication between departments</td>
</tr>
<tr>
<td>• Shortage of daily communication between staff at the same department</td>
</tr>
<tr>
<td>• Shortage of personnel meetings</td>
</tr>
<tr>
<td>• There are department meetings, but they are not very useful</td>
</tr>
<tr>
<td>• Shortage of communication with patients</td>
</tr>
</tbody>
</table>
Table 5. Information problems

INFORMATION PROBLEMS

• Shortage of information about patients
• Information overload
• Low usage of the information
• Shortage of knowledge when using new tools or devices, or when applying a new methodology introduced at the Department
• Lack of mentoring for junior doctors or nurses
• Limited use of Information Technologies (IT)
• Information is not properly updated

Table 6. Motivation problems

MOTIVATION PROBLEMS

• Lack of motivation or reluctance of department’s staff to bring about changes

Table 7. Operating & distribution problems

OPERATING & DISTRIBUTION PROBLEMS

• Low organization of materials, such as medical and sanitary equipment, drugs...
• Logistic problems with materials supply
• Bad layout of spaces and areas
• Shortage of standardized processes
• Obsolete machinery/devices

Table 8. Personnel problems

PERSONNEL PROBLEMS

• Lack of available employees during demand peaks
• Permanent shortage of personnel resources

Further on in Chapter 5, an analysis of the responses will be conducted on the basis of each one of the groups.
4.3. Discussion process about the management techniques

Once the results from the survey have been obtained and analyzed, a discussion has been conducted as well as conclusions have been made, relating those findings with the different characteristics from the industrial management techniques that have been hereby studied.

The related comments and conclusions have been obtained departing from objective data coming from real healthcare employees; but, at the same time, they have also had subjective connotations and always from the author’s point of view.

That subjective side of the work has not only been called for at the time to raise possible actions that could be implemented, but also at the time to consider potential further research questions.
CHAPTER 5: EMPIRICAL ANALYSIS

In this chapter, graphical findings coming from the surveys have been presented, and an analysis has been conducted regarding the different cases’ results. Some introductory charts and tables about the provenance of the data have been submitted before the results are analyzed.

5.1. Provenance of the data

First of all, it has to be said the respondents of the survey (101 employees in total) come from different countries, and although the intention was to get a similar number of responses from both Sweden and Spain, in the end the vast majority of the collaborating respondents have been Spanish employees (94%). The rest come from Sweden (4%), Mexico (1%) and the USA (1%). Despite not being representative data regarding the respective countries, non Spanish responses have also been considered because they also uttered useful information.

The inquiry stated several questions in order to make it possible to obtain basic information about the respondents. This part has been divided into five main blocks: Type of center, centers’ size, involved departments, involved job positions and employees’ seniority. 11

11 The percentages presented in the following charts may not sum exactly 100% due to the rounding of them into only one decimal digit.
5.1.1. **Type of center**

In figure 10, the different involved types of healthcare centers are presented in a pie chart.

![Fig. 10. Involved types of healthcare center](image)

As the chart states, the main source of data comes from Hospitals (73.3%), followed by Primary Care Attention centers (20.8%). Occasional responses come from clinics (3%), mutual companies (2%) and ambulatory-care centers (1%).

5.1.2. **Centers’ size**

The size of the involved centers has been split in four groups, depending on the total number of employees.

![Fig. 11. Size of the involved centers](image)
Figure 11 indicates that just over half of the responding centers (58.4%) employ more than 1000 employees, whereas the other half comprises centers with less than 1000. Within this second half, the most representative group is referring to centers with less than 100 employees (26.7%).

5.1.3. Involved departments

The diverse involved departments are listed in the table below (sorted from highest to lowest participation in the survey):

<table>
<thead>
<tr>
<th>DEPARTMENT</th>
<th>PARTICIPATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>MICROBIOLOGY</td>
<td>10,9%</td>
</tr>
<tr>
<td>EMERGENCY</td>
<td>9,9%</td>
</tr>
<tr>
<td>PRIMARY CARE</td>
<td>6,9%</td>
</tr>
<tr>
<td>MEDICAL APPOINTMENTS</td>
<td>6,9%</td>
</tr>
<tr>
<td>ADMISSION</td>
<td>6,9%</td>
</tr>
<tr>
<td>OBSTETRICS &amp; GINECOLOGY</td>
<td>6,9%</td>
</tr>
<tr>
<td>PREVENTIVE MEDICINE</td>
<td>5,9%</td>
</tr>
<tr>
<td>SURGERY</td>
<td>5,9%</td>
</tr>
<tr>
<td>NONSPECIFIED</td>
<td>5,9%</td>
</tr>
<tr>
<td>INTERNAL MEDICINE</td>
<td>5,0%</td>
</tr>
<tr>
<td>FAMILY MEDICINE</td>
<td>4,0%</td>
</tr>
<tr>
<td>PULMONOLOGY</td>
<td>3,0%</td>
</tr>
<tr>
<td>OCCUPATIONAL RISK PREVENTION</td>
<td>3,0%</td>
</tr>
<tr>
<td>ENDOCRINOLOGY</td>
<td>2,0%</td>
</tr>
<tr>
<td>OPHTHALMOLOGY</td>
<td>2,0%</td>
</tr>
<tr>
<td>INFECTIOUS &amp; PENITENTIARY MEDICINE</td>
<td>2,0%</td>
</tr>
<tr>
<td>RADIOLOGY</td>
<td>2,0%</td>
</tr>
<tr>
<td>TRAUMATOLOGY</td>
<td>1,0%</td>
</tr>
<tr>
<td>OCCUPATIONAL HEALTH</td>
<td>1,0%</td>
</tr>
<tr>
<td>LEADERSHIP/MANAGEMENT</td>
<td>1,0%</td>
</tr>
<tr>
<td>REHABILITATION</td>
<td>1,0%</td>
</tr>
<tr>
<td>EXTRACTION LABS</td>
<td>1,0%</td>
</tr>
<tr>
<td>OTOLARYNGOLOGY</td>
<td>1,0%</td>
</tr>
<tr>
<td>PATHOLOGICAL ANATOMY</td>
<td>1,0%</td>
</tr>
<tr>
<td>IMMUNOLOGY</td>
<td>1,0%</td>
</tr>
<tr>
<td>ODONTOLOGY</td>
<td>1,0%</td>
</tr>
<tr>
<td>PEDIATRICS</td>
<td>1,0%</td>
</tr>
<tr>
<td>LIFE SUPPORT</td>
<td>1,0%</td>
</tr>
</tbody>
</table>
5.1.4. Involved job positions

The different working positions from the respondents are presented in figure 12:

![Involved Job Positions](image)

Fig. 12. Involved job positions

Half of the workers who responded the inquiry are physicians (53.5%). The other significant sector is represented by nurses (33.7%), and the other groups are identified as clerks (5.9%), technicians (3%), wardens (1%) and midwives (1%).

5.1.5. Employees’ seniority within each dept.

The working experience within the respective department has also been monitored. Figure 13 presents the results:

![Employees' Seniority within Each Dept.](image)

Fig. 13. Employees’ seniority within each department
Two main equitable groups could be made from the results on the figure above: Employees with less than five years of experience in their dept. (10.9% + 35.6%) and employees with more than five years of experience (12.9 + 35.6%).

5.2. RESULTS: Classified groups of problems

From subchapters 5.2.1 to 5.2.5 the responses of the collaborating employees will be presented in charts, regarding each of the groups of problems that have been stated in chapter 4.2. For more information regarding the specific problems within each group, please refer to Appendix 2.

5.2.1. Communication problems

![Communication Problems Chart](image)

Figure 14 shows the opinions from employees regarding the problems related with communication issues. Those are (chapter 4.2) mostly related to the shortage of communication between employees or either between the employees and the patients, as well as to departments’ meetings. In aggregated terms, nearly all of them (about 80%) think that those problems affect, as the most, not so significantly to their departments. In case that intention from the organization existed to improve those problems, more than half of the respondents would not see it as a challenge.
Although, from a global point of view, communication don’t seem to be much critical to healthcare organizations’ employees, it is important to note that particular problems have been rated as critical ones to the efficiency of departments. This is the case of the stated problem in the inquiry “Shortage of communications between departments” (see Appendix 2). Nearly 40% of the involved employees consider this specific problem affects from significantly to very significantly to their departments; and 60% of them think that it would be from hard to very hard to solve the situation. As an additional comment, several of the surveyed workers specified a shortage of personal contact between departments on account of the extensive integration of informatics and IT systems in healthcare.

It is also a remarkable fact that, whereas shortage of communication between departments seem to be critical to employees, the results of the survey postulate that there is practically no shortage of daily communication between staff at the same department (only 15% of the respondents considered a significant affection to their depts. efficiency).

5.2.2. Information problems

The figure above presents the results related to information problems. Despite the fact that, similarly to the last case, three quarters of the respondents don’t attribute the problems as considerably important from a global perspective, there also exists a concrete situation that has been highlighted.

Shortage of knowledge when applying new tools or devices (or when applying a new methodology introduced at the dept.) has been stated as a critical problem by the respondents (Appendix 2). About the 40% answers that the problem affects from significantly to very significantly to their
departments, as well as the 65% think it would be hard or very hard to get solutions. Furthermore, respondents posed that the problem becomes more critical when addressing senior and long-term employees, which may represent an important part of the staff.

This is significant information since industrial management methodologies that could be introduced in healthcare organizations are being studied in this thesis, whilst employees are rating this issue as an important one to their departments.

5.2.3. Motivation problems

Figure 16 presents the responses from employees regarding motivation problems. Those are related to the lack of motivation or either the reluctance from the staff to bring about changes in their departments.

In this case it can be seen that the opinions are not as spread as in the other cases, most probably because this group is composed only by one problematic situation. More than 40% of employees think that a lack motivation is seriously affecting to their departments; and 60% are convinced that this is a hard or very hard situation to improve. Given the importance of motivation within the working team in any organization, this result will definitely be a fact to consider.
5.2.4. Operating & distribution problems

Regarding the operating & distribution problems, figure 17 exposes the results from the survey. Even though just over 70% of the respondents think those are not critical problems for their departments, the opinions are considerably dispersed all over the grid. Regarding the five different situations embraced by this group (see chapter 4.2), two of them have been highlighted as relevant by the involved employees.

On the one hand, the problem “Obsolete machinery/devices” has been pointed as significant or very significant to their departments’ throughput by 45% of workers, whereas around the same percentage consider it as hard or very hard to solve.

On the other hand, the problem “Bad layout of spaces and areas” has been rated by about half of the employees as a significant problem or more. About as many believe it would be a challenge to improve the situation.
5.2.5. Personnel problems

Problems related with organizations’ personnel are presented in figure 18. The first outstanding result is that more than 15% of the respondents postulate that those are very significant and very hard to solve at the same time, apart from the 20% saying they are both significant and hard to solve. In other words, this is the most critical group of problems from employees’ point of view, closely followed by motivation problems.

Personnel problems group is composed of two specific situations: “Lack of available employees during demand peaks” and “Permanent shortage of personnel resources”. Although in both situations there are more than a half of the respondents referring a significant or very significant affection to their departments, the lack of available personnel during demand peaks has been pointed as slightly more critical. As could be expected, a majority considers potential solutions to the problems as a big challenge.

5.3. RESULTS: Problems comparison

In this chapter, responses from the collaborating employees have been compared, not only regarding the different groups of problems stated in the survey but also making a comparison between different existing groups of respondents (chapter 5.1). The colored points appearing on the following graphs represent the average rating which has been given to each one of the problematic groups. The most relevant results have been analyzed from sub-chapters 5.3.1 to 5.3.5.
5.3.1.  *By type of center*

Most of the responses come from hospitals, but some differences have been outlined between them and the rest of the types of organizations.

a) Hospitals

![Problems comparison (hospitals' responses)](image1)

*Fig. 19. Problems comparison (hospitals’ responses)*

b) Other involved centers

![Problems comparison (other center’s responses)](image2)

*Fig. 20. Problems comparison (other center’s responses)*
Regarding information and operating & distribution problems, there barely exist differences between different types of centers. Indeed, that similarity has been found in nearly all the comparisons and studied cases. This particularity could exist due to the fact that the information and operating procedures may eventually be similar regardless of the healthcare organization’s type, as well as to the existing standards and protocols that have to be applied.

Communication problems seem to affect slightly more to hospitals than other centers, most probably because 60% of the involved hospitals from the inquiry have more than 1000 employees, whereas from the other kinds of organizations, only the 5% employ more than 1000 people.

Results also show that, for people not working in hospitals, motivation problems are slightly more critical than for hospitals employees. The same happens for personnel issues with the particularity that, for those problems, a considerable variation is appreciated in the difficulty-to-solve axis. This raises that hospital workers consider those problems, affecting in the same grade to their depts., as easier for them to solve than it would be for employees in other healthcare organizations such as Primary Care, Clinics or Mutual centers.

5.3.2. By type of employee

Within the different job positions that have participated in the inquiry, two main groups can be mentioned: physicians and nurses. Together, they represent nearly the 90% of the respondents; hence, the following comparison will only take those two groups into account (for additional information about others, see Appendix 3). Anyway, it has also to be said that physicians have participated significantly more than nurses (53,5% against 33,7%).
a) Physicians

PROBLEMS THAT MAY AFFECT DEPTS. EFFICIENCY FOR PHYSICIANS

<table>
<thead>
<tr>
<th>Affection to the department</th>
<th>Very significant</th>
<th>Significant</th>
<th>Not so significant</th>
<th>Insufficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>I don’t Know</td>
<td>Easy</td>
<td>Not so hard</td>
<td>Hard</td>
<td>Very hard</td>
</tr>
</tbody>
</table>

**Fig. 21. Problems comparison (Physicians’ responses)**

b) Nurses

PROBLEMS THAT MAY AFFECT DEPTS. EFFICIENCY FOR NURSES

<table>
<thead>
<tr>
<th>Affection to the department</th>
<th>Very significant</th>
<th>Significant</th>
<th>Not so significant</th>
<th>Insufficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>I don’t Know</td>
<td>Easy</td>
<td>Not so hard</td>
<td>Hard</td>
<td>Very hard</td>
</tr>
</tbody>
</table>

**Fig. 22. Problems comparison (nurses’ responses)**
An initial comment when observing the responses is that, among all other employees, physicians gave the least importance to operating & distribution problems. The same actually occurs with information and communication issues, but to a lesser extent.

In contrast to that first observation, nurses not only give much more importance to each one of the groups of problems when comparing it with physicians, but also are the only employees who consider communication problems as affecting more than information ones to their departments (both groups have usually been the least regarded by employees).

Referring to motivation and personnel problems, differences have been found between physicians’ and nurses’ position. A clear disagreement exists between the two groups of workers: physicians pose that motivation problems are more critical to their departments than personnel ones, whereas nurses consider just the opposite.

Furthermore, this difference is glaring when referring to personnel problems to the point that nurses describe them as they are affecting even more than significantly to their departments, while considering potential solutions as big challenges. Given the singularity of the result, differences within the two situations stated in “personnel problems” (chapter 4.2) have been analyzed for the nurses’ case:

![Nurses' opinion regarding personnel problems](image-url)
Although similar results were obtained, nurses consider that permanent shortage of personnel resources is affecting slightly more significantly to their departments rather than punctual lacks of available workers during demand peaks. This finding might show a belief from this concrete sector of the staff that better situations won’t be possible without firstly increasing the number of employees in their departments.

5.3.3. By seniority\textsuperscript{12} within each dept.

At the time of comparing opinions between different groups of employees, their level of seniority within the specific department has also been used as a differentiating factor.

a) Less than 5 years of seniority

<table>
<thead>
<tr>
<th>Affection to the department</th>
<th>PROBLEMS THAT MAY AFFECT DEPTS. EFFICIENCY: EMPLOYEES WITH LESS THAN 5 YEARS OF SENIORITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very significant</td>
<td></td>
</tr>
<tr>
<td>Significant</td>
<td></td>
</tr>
<tr>
<td>Not so significant</td>
<td></td>
</tr>
<tr>
<td>Insignificant</td>
<td></td>
</tr>
</tbody>
</table>

\begin{figure}[h]
  \centering
  \includegraphics[width=\textwidth]{problems_comparison.png}
  \caption{Problems comparison (<5-years-of-seniority employees)}
\end{figure}

\textsuperscript{12} Meaning the number of years they have worked within their present department
b) More than 5 years of seniority

The separating line between both groups has been fixed in 5 years so that the responses come from equitable groups of respondents (this way they nearly have the same number of participants each), apart from considering that this is time enough for employees to change any opinions regarding department’s issues.

Differences between communication, information and operating & distribution problems are barely substantial.

Eventually, when it comes to motivation and personnel problems there are also remarkable differences between juniors and seniors within healthcare departments. Newly incorporated workers in a department consider that the main affecting problem is related to personnel issues, whereas senior employees pose that this is not as critical as motivation problems.

In other words, results seem to confirm what could have been expected: The more time working in a department, the less motivation from the employees to accomplish their missions or reach their goals. This is another singular finding to consider, since introduced changes or new industrial methodologies that intend to bring about improvements in the system require an effort to be put and permanent motivation from all the employees.
5.3.4. **Totals**

Below, a final results comparison will be presented, considering this time all the collaborating employees who responded the survey.

![Problems Comparison Diagram]

**Fig. 26. Problems comparison (considering all involved employees)**

As it has been noticed during the previous analysis, among the different groups of problems coming from the survey there have been two specific ones that have been more remarkable than the others: motivation and personnel problems. Aside from that, it is also an issue that the groups related to communication, information and operating & distribution problems have been situated in very similar zones from the resulting grids regardless of the employees who responded.

In overall terms, problems related to either the lack or shortage of personnel in healthcare departments have been labeled as the most critical by the employees, nearly followed by motivation problems. The less-critical-group label could be given to communication problems.

Figure 27 presents in a graphical manner the global percentages of employees who considered any of the problems as affecting from significantly to very significantly to their depts., as well as being from hard to very hard to get solved. This is in order to compare any significant relations that could exist between the “grade of affection” and the “difficulty to solve” of the different groups:
It is outstanding that, independently from the type of problem, employees always consider that the undesirable situation is more being a challenge for the department to solve the problem rather than affecting to its efficiency. This might be a singular finding to be deemed since it could be interpreted as a discouraged mentality from the employees to approach the necessary measures to improve the system.

Other singular findings have also been obtained from the survey. It has been found that more than 82% of the surveyed employees had never heard of any of the hereby stated management techniques to improve organizations’ efficiency. Furthermore, only around 20% of the respondents were convinced about the willingness of their superiors to receive and consider improvement proposals.
CHAPTER 6: DISCUSSION AND CONCLUSIONS

Now when the results have been analyzed, a discussion has been made about the relevant findings from previous chapters, whilst attempting to find concluding responses to the research questions stated in Chapter 3. The first two research questions have been consistently answered on account of the objective data obtained; but, when approaching the third question, there may appear many different opinions, which obviously opens debating possibilities. Due to that fact, the discussion in this chapter will be especially focused on the last research question.

A few suggestions, for further research, will also be given.

6.1. Back to the research questions

(1) Which are the problems that affect more critically to departments’ efficiency in healthcare organizations?

As the results have displayed, there are two main problem areas that stay in the spotlight: personnel issues and problems related to the staff’s motivation.

The most critical ranked group (personnel problems) can be divided into two specific situations which were presented in the survey: “Lack of available employees during demand peaks” and “Permanent shortage of personnel resources”. Results yielded that, in overall terms, around half of the employees marked both problematic situations as impacting from significantly to very significantly to their depts.; but around 7% more of them considered in the end this is more a temporary lack than a permanent issue. This might be interpreted as an existing belief from the staffs that the efficiency of the system could be improved without a compulsory increase of the manpower (despite punctual discordances from the nurses’ sector regarding this issue).

Furthermore, a remarkable comment coming from one of the surveyed employees says: “In general, the demand peaks are predictable and nothing is being done to prevent this situation of the services”.

Besides, several workers referred summer season as the most critical one, year after year (94% of the respondents come from Spain, especially from Mallorca and Barcelona). Those assertions should definitely be considered and, at the same time, raise one question: What should be done to prevent it? This can be understood as a periodic problem. Hence, it could be associated with forecasting methods. Although they are not referred in this work, a further study on the field should be conducted in order to ensure the significance of this issue and the best tools that could be helpful (i.e. statistical packages).

Aside from that, although the specific problems embraced in communication issues have been perceived (in aggregated terms) as the least critical when affecting departments’ efficiency; there is one specific situation marked as particularly significant by employees. The daily communication between employees in the same department is not an issue but the “Shortage of communication between departments”.

Concrete situations have also been pointed out within the stated groups of problems referring information and operating & distribution issues. About the information part, the main problem converges into a “Shortage of knowledge when applying new tools or devices (or when applying a new methodology introduced at the dept.)”. From the concrete feedback received from employees, this problem becomes even more significant when referring senior and long-term employees, which are usually an important sector within the staff (according to the respondents). Therefore, potential solutions should take this fact into account.

Referring to operating & distribution problems, the main issue ends up in two specific situations. The first one regards a “Bad layout of spaces and areas”, and the second one refers an “Obsolete machinery/devices” situation.

(2) From the employees’ point of view, which would be the difficulty level to solve those problems?

More than half of respondents believe it would be from hard to very hard to set solutions to the personnel problems, whereas nearly the 45% perceive the same levels of difficulty for motivation issues. One particularity that has been found states that workers from different centers consider personnel problems are affecting approximately in the same grade to their departments; but, when it comes to the level of difficulty, it would be easier for hospitals’ staff than it would be for employees in other healthcare organizations such as Primary Care, Clinics or Mutual centers. This might be due to the fact that, unlike the other centers, the majority of hospitals are huge institutions and they obviously have more resources than a clinic or a mutual center might have. However, a first factor to study here would be the size of the demand in each of the cases, for a proper evaluation.
About the “Shortage of communication between departments”, 60% of the employees think that it would be from hard to very hard to solve the situation; and the same result is found when referring to the “Shortage of knowledge when applying new tools or devices (or when applying a new methodology introduced at the dept.)”.

Regarding the situations within the Operating & Distribution problems, around 45% of the surveyed staff consider it would be from hard to very hard to improve the “Obsolete machinery/devices” situation, whilst even more (half) of the employees believe that setting solutions for the “Bad layout of spaces and areas” would also be a challenge.

It seems to be that a majority of the respondents see critical problems as significant challenges when referring the difficulty-to-solve of the undesired situations. This might be attributed to a shortage of knowledge about the existing techniques that might be helpful if applied to healthcare. Indeed, results confirmed that more than 82% of the surveyed staff had never heard of any of the hereby stated management techniques.

(3) Regarding the results from questions (1) and (2), which of the management methodologies stated in this thesis could be more suitable when considering potential solutions to increase healthcare organizations’ efficiency?

The first two research questions have raised six critical problematic situations. The following discussion will be structured around them:

- **Personnel**

Regarding the manpower problem area, it could be classified as a high-level issue since its origins may come from many different sources. That is why, rather than a specific tool, a several-steps process might be applied here from the beginning in order to break down the problem into more approachable issues.

As a subsection about several-steps processes, not only is a fact that to study all the existent industrial management techniques was beyond the scope of this thesis, but neither to conduct an extensive and profound study of the hereby stated methods.

Starting from this point, the study has analyzed Lean more focusing on its characteristic management tools, whereas Six Sigma has been more focused on its different step’s process. This does not mean that Lean is lacking of standardized processes (it has the plan-do-check-act cycle, known as PDCA) nor Six Sigma is lacking of management tools (i.e. fishbone and Pareto diagrams or Critical to Quality (CTQ)), but it has been hereby considered that the DMAIC process was more detailed and complete than PDCA (i.e. it does not specify how to analyze data).
Regarding *Theory of Constraints* (TOC), its five steps process is a key part to be done when applying the method (Dettmer 1997), so it was obviously considered as well. Thus, there are in the end two different stepped processes in this thesis that may be considered when approaching high-level issues: *DMAIC* and TOC’s *five steps*.

Back to personnel problems, TOC’s *five steps* process is profoundly focused to the constraints a system may have, whilst the human nature of the issue is not likely to be easily handled as a tangible constraint itself. Then, after the previous considerations and subsections, the *DMAIC* process embraced by Six Sigma will be considered as more useful when approaching personnel problems in healthcare organizations.

However, one of the difficulties that could appear here when introducing the statements from *DMAIC* is that the delivering of the service may be affected by external variations (not like in manufacturing processes), due to the continuous interaction between different patients and the involved personnel. On account of this variance, a peculiar characteristic could be useful if added to the *DMAIC* process: Cyclicity. That is to say, looping back periodically to the early phases of the process, in accordance to the varying requirements. This would be, in the end, a distinctive feature of Lean’s and TOC’s own processes that could complement the *Six Sigma*’s one.

- **Obsolete machinery or devices**

Systems’ efficiency problems are also commonly attributed to the obsolescence of machinery or devices, and the results of this thesis converge to the same conclusion. On the one hand, the increasingly complex medical problems which require more and newer resources are a reality (Welch, Jones and Allen 2007). On the other hand, an important number of comments from the inquiry indicated that the delicate global economic situation is severely hindering this situation to get solved. Besides, one remarkable comment from an employee stated that “*Sometimes, the most sophisticated devices don’t simplify the work. For those machines used by lots of different employees, it would be called for to maintain things simpler. For example, we have this problem with Electrocardiography devices (EKG)*”.

Therefore, after the last comments it should be specially considered if the process being done by those machines or devices represent a real constraint to the system or not. Since it is clear that, within the studied techniques, TOC is the one which approaches this issue more profoundly; it could be selected here as the most contributing one. Despite bottlenecks in healthcare may not be obvious (Wolstenholme 1999), in this case the issue could be more focused on the technical part (machinery/devices). Hence, the introducing of measuring and quantifying methods to monitor the potential constraints would be easier, which is a key factor to successfully implement TOC (Eklund 2008).
Motivation

Shortage of motivation is another issue that should be handled starting from a high-level view, because of the same reasons as in personnel’s case. Lean thinking has been discussing about this topic as one of the key problems to approach (Young, et al. 2004), since the morale of a workforce may be somehow abstract and tightly related to the human factor itself. Hence, the empirical nature of the industrial methodologies in this thesis may imply an ambiguous selecting process of which method should be applied regarding motivation problems.

It has been stated that the DMAIC process by Six Sigma should be the most suitable one when approaching issues from a high-level view, but there also exist some contrarieties here. One obstacle to this could be that “non-production focused environments fail to capture the benefits of Six Sigma application” (Operations Management Roundtable 2002). Cost savings that Six Sigma must show are difficult to document to some service oriented companies, since it may be not trivial to demonstrate the value of the implemented strategies (Sehwail and DeYong 2003). Thus, to give time to the projects and to have patience until progress can be noticed is compulsory for the employees. In contrast to that, the difficult-to-solve conception from the respondents could suggest that patience and encouragement might not be sufficient.

Another particularity of motivation problems is that the group is in the end composed of one single situation in the survey, which addresses a reluctance of departments’ staff to bring about changes. Once the issue has been conceived as critical to departments, it would be helpful to include more specific situations in the inquiry, regarding motivation problems. This way, a better analysis could be conducted when trying to identify potential sources of the problem, because the subjective nature inhered in the morale of a workforce may definitely raise the possibility to many interpretations.

Therefore, and agreeing with the last statements, to solve problems related to the motivation of the employees may be an even bigger challenge than it has been hereby noted.

After the last considerations, it would be convenient to conduct an additional specific study focused on motivation issues which are affecting healthcare organizations before making any decisions about which would be the more suitable industrial methodologies to be applied in this case.

Communication between depts. & Bad layout of spaces and areas

About this issue, several of the surveyed employees have blamed the lack of personal contact between departments on account of the extensive introduction of the informatics and IT systems in healthcare. One obvious proposal to this might be to increase personnel meetings, but results
state that only around 20% of respondents think there is a shortage of personnel meetings. Thus, the problem might then remain on the meetings themselves, but results provide that only around 21% of respondents believe that department meetings could be more useful. This might indicate that the solution should not be heavily focused to personal contact between employees.

Many of the processes that take place in healthcare organizations use to involve different departments along their progress. Thus, this shortage of communication between departments could come from an unsatisfied need of information due to an incomplete view of the whole process which “connects” the departments. Given the limited time that employees probably have to get the information, a visual tool which quickly gave the needed information would be recommendable. Within the studied ones, there are two tools which clearly meet those requirements: Kanban and Value Stream Mapping (VSM).

If the problem was more related to on a shortage of communication between departments about material issues, Kanban would be more suitable since its main goal is to use signals to inform operators and supervisors about the timing and the quantities of the needed production (see figure 2). Since the aim of Kanban is to introduce those visual tools without making significant investments, it would be economically easier to attempt a trial implementation to observe if improvements are achieved or not.

If the problem was more related to the delivering process of the service, VSM would be more convenient because its aim is to provide a visual representation of how is a whole process working (see figure 6). Since Most VSM exercises are done on paper, which is posted generally on a common area wall (Tapping, et al. 2009), all the involved departments should then be able to get wider and greater information about the system to an extensive level. Nevertheless, it should first be checked which are the specific topics not being properly communicated between departments, as well as the compliance level of employees when taking the visual tools into account.

Keeping in mind last considerations, if VSM is applied on a real plan of the different areas within the organization together with scenario simulations, the pointed problem “Bad layout of spaces and areas” would also be approached since the information would be extended to the spatial dimension of the departments.

Results might also establish a significant connection between motivation and communication problems on account of the stated fact that only about 20% of the surveyed employees were convinced about the predisposition that their superiors would have to receive and consider improvement proposals from themselves. Hence, apart from the noted shortage of communication between departments, there could also exist a clear shortage of communication
between the different hierarchical levels that, in the end, might considerably harm employees’ motivation. Furthermore, this shortage of connections between hierarchical levels could also be one of the reasons why employees consider critical problems more as a challenge than an affecting issue to their departments.

- Shortage of knowledge when applying new tools or devices (or when applying a new methodology introduced at the dept.)

On the one hand, this pointing from staffs might come due to the already committed mistakes by employees during the diverse procedures. Regarding the studied techniques, Six Sigma is here more oriented to avoiding technical defects of resulting products from the whole process than to human and conceptual errors that may be at the same time being conceived and delivered to the customer. About TOC, one kind of constraints recognized by the method is labeled as Policies constraints. Those embrace the different manners of acting, measuring, monitoring and either the habits from employees that lead the system to a lack of productivity (González G, Ortegón M. and Rivera C. 2003). This would be clearly related to the potential proceeding mistakes coming from employees; but, once the type of constraint has been identified, TOC uses several operative indicators which are strongly focused to tangible facts, which would considerably hinder a successful implementation.

Finally, Lean comprises a specific tool which could be helpful given its focusing to employees’ proceedings within a process. Poka-yoke devices have the concrete goal of preventing errors or making them obvious to operators so that they do not take place (see figures 3 and 4). Hence, this could be the most suitable tool to approach this issue in case it became a fact in the organization.

On the other hand, the problem might come from a shortage of information about the new tool or methodology itself, introduced at each department. Indeed, more than 82% of the surveyed employees had never heard of any of the hereby stated management techniques. As stated in subchapter 2.3.3, one of the singularities of Six Sigma when compared with the other methods is that several improvement specialists (with different and specific trainings) are used in order to achieve goals (Linderman, et al. 2003). The dedication to improvement projects can vary depending on each of the specialists, which also include internal-instructor roles. On account of that fact, the Six Sigma philosophy could fit this requirement incorporating a specialist team concretely dedicated to improvements, which was also in charge of ensuring that all the involved employees were being continuously and properly instructed. Furthermore, results state that this problem becomes more critical when addressing senior and long-term employees, which may represent a significant part of the staff. Thus, a special attention should be given to that sector.
Nevertheless, it has been stated that non-manufacturing firms face difficulties with creating cultural change and creating Six Sigma Leaders (Operations Management Roundtable 2002). It makes sense to postulate that reluctance from employees may appear when trying to integrate new behaviors in order to reach the objectives, especially given the findings hereby related to employees’ motivation. Since this would represent an important obstacle to overcome, it might be convenient to limit the specialist leader’s role to an instructor’s one, just focused on the cultural guidance and the implementation of the new tools or methods.

At this point it may be noticed that, when recommending the hereby presented management methodologies, they have been taken into account more by parts or singular characteristics rather than as a whole technique, always in accordance to problems’ requirements. It has been considered that, this way, the human factor would be consistently taken into account since critical problems would be highlighted from the lower hierarchic levels of the work force to the higher ones, ensuring to a greater extent that when improvements are approached, a real effort will be put to achieve clear goals.

Concluding, the considered management methodologies that could be more suitable when trying to increase healthcare organizations’ efficiency regarding the results from (1) and (2) are:

<table>
<thead>
<tr>
<th>Issue</th>
<th>Considered method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personnel problems</td>
<td>Six Sigma - DMAIC process (cyclical)</td>
</tr>
<tr>
<td>Obsolete machinery or devices</td>
<td>Theory of constraints (TOC)</td>
</tr>
<tr>
<td>Motivation problems</td>
<td>Further studies needed to make proper conclusions</td>
</tr>
<tr>
<td>Communication between depts.</td>
<td>Lean – Kanban / VSM</td>
</tr>
<tr>
<td>Bad layout of spaces and areas</td>
<td>Lean - VSM</td>
</tr>
<tr>
<td>Shortage of knowledge when applying</td>
<td>Lean - Poka-yoke /</td>
</tr>
<tr>
<td>new tools or devices</td>
<td>Six Sigma - Specialist Instructors</td>
</tr>
</tbody>
</table>
However, supporting Proudlove, Moxham and Boaden (2008), it is a fact that all improvements introduced in enterprises (regardless of the methodology applied) are unlikely to be maintained unless they become part of a clear strategic direction for the organization, which also represents a significant challenge to face.

As a final note, several comments in the inquiry came from employees working in recently built hospitals and centers. Most of their feedbacks were positive regarding several of the hereby stated critical problems. In the end, although there is still a lot of work to do, healthcare may encouragingly be on the good way towards excellence.

6.2. Suggestions for further research

Some of the findings or characteristics of this work might raise potential areas for further research. The main ones are presented below:

- As stated in the conclusions, it would be convenient to conduct an additional specific study focused on motivation issues which are affecting healthcare organizations, in order to make more consistent decisions about which would be the most suitable methodologies to be applied there.
- The results provided by the survey are mostly representing Spanish employees. Thus, it would be called for to extend the study to a more international level, to identify potential differences that could exist between different countries or continents.
- The aggregated participation in the survey reached the significant number of 101 participants, but collaborations varied depending on the different departments and working positions. In order to achieve an even greater significance of the data, the number of participants could not only be increased but also managed so that each of the different depts. and work positions had the same representation in the results.
- In the end, the surveyed collaborators have been physicians or nurses nearly in 90% of the cases. Obviously, there are several other work positions from other hierarchic levels that could be considered in order to expand the scope of the results.
- Another suggestion would be, as noted in the conclusions, to make a study of the potential periodicity of the demand peaks in the different healthcare departments, in order to see if a forecasting method could help to improve the situation.


APPENDIX 1:
ONLINE SURVEY

I. English

https://docs.google.com/spreadsheet/viewform?formkey=dHdlb09aS2NGaEwxT0JhNzJrWVZaZFE6MQ#gid=0

II. Swedish

https://docs.google.com/spreadsheet/viewform?formkey=dHpqWUhDUGFUR0duMUloLWo2WE1PNWc6MA#gid=0

III. Catalan

https://docs.google.com/spreadsheet/viewform?formkey=dFhBWGh4MHlSajJHaVhNREtHcXdESHc6MA#gid=0

IV. Spanish

https://docs.google.com/spreadsheet/viewform?formkey=dG1Kem5sNWVvdnBlcGZ0SXdjUUIuUHc6MA#gid=0
APPENDIX 2:

EMPLOYEES’ RESPONSES TO THE SPECIFIC PROBLEMS WITHIN EACH OF THE GROUPS
I. Communication problems

**Shortage of communication with patients**

<table>
<thead>
<tr>
<th>Affection to the department</th>
<th>Difficulty to solve the problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very significant</td>
<td>1.0%</td>
</tr>
<tr>
<td>Significant</td>
<td>6.0%</td>
</tr>
<tr>
<td>Not so significant</td>
<td>22.8%</td>
</tr>
<tr>
<td>Insignificant</td>
<td>14.9%</td>
</tr>
<tr>
<td>I don’t Know</td>
<td>4.0%</td>
</tr>
</tbody>
</table>

**Shortage of communication between departments**

<table>
<thead>
<tr>
<th>Affection to the department</th>
<th>Difficulty to solve the problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very significant</td>
<td>1.0%</td>
</tr>
<tr>
<td>Significant</td>
<td>6.9%</td>
</tr>
<tr>
<td>Not so significant</td>
<td>22.8%</td>
</tr>
<tr>
<td>Insignificant</td>
<td>6.9%</td>
</tr>
<tr>
<td>I don’t Know</td>
<td>1.0%</td>
</tr>
</tbody>
</table>

**Shortage of communication during the change of shifts**

<table>
<thead>
<tr>
<th>Affection to the department</th>
<th>Difficulty to solve the problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very significant</td>
<td>1.0%</td>
</tr>
<tr>
<td>Significant</td>
<td>6.9%</td>
</tr>
<tr>
<td>Not so significant</td>
<td>22.8%</td>
</tr>
<tr>
<td>Insignificant</td>
<td>6.9%</td>
</tr>
<tr>
<td>I don’t Know</td>
<td>1.0%</td>
</tr>
</tbody>
</table>

**Shortage of daily communication between staff at the same department**

<table>
<thead>
<tr>
<th>Affection to the department</th>
<th>Difficulty to solve the problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very significant</td>
<td>1.0%</td>
</tr>
<tr>
<td>Significant</td>
<td>2.0%</td>
</tr>
<tr>
<td>Not so significant</td>
<td>25.7%</td>
</tr>
<tr>
<td>Insignificant</td>
<td>24.8%</td>
</tr>
<tr>
<td>I don’t Know</td>
<td>1.0%</td>
</tr>
</tbody>
</table>
Affection to the department

**Shortage of personnel meetings**

- Very significant
- Significant
- Not so significant
- Insignificant
- I don't know

**Difficulty to solve the problem**

- Easy
- Not so hard
- Hard
- Very hard

- 19.8%
- 12.9%
- 5.9%
- 2.0%
- 12.9%
- 11.9%
- 4.0%
- 2.0%
- 1.0%
- 1.0%
- 2.0%
- 1.0%

**There are department meetings, but they are not very useful**

- Very significant
- Significant
- Not so significant
- Insignificant
- I don't know

**Difficulty to solve the problem**

- Easy
- Not so hard
- Hard
- Very hard

- 21.8%
- 19.8%
- 10.9%
- 4.0%
- 12.9%
- 10.9%
- 13.9%
- 4.0%
- 2.0%
- 2.0%
- 1.0%
- 1.0%
- 2.0%
- 1.0%
II. Information problems

**Shortage of information about patients**

- **Affected to the department**
  - Very significant: 5,0%
  - Significant: 24,8%
  - Not so significant: 10,9%
  - Insignificant: 2,0%
  - I don’t know: 1,0%

- **Difficulty to solve the problem**
  - Easy: 16,8%
  - Not so hard: 7,9%
  - Hard: 5,9%
  - Very hard: 1,0%

**Information overload**

- **Affected to the department**
  - Very significant: 20,8%
  - Significant: 5,9%
  - Not so significant: 28,7%
  - Insignificant: 2,0%
  - I don’t know: 1,0%

- **Difficulty to solve the problem**
  - Easy: 16,8%
  - Not so hard: 7,9%
  - Hard: 5,9%
  - Very hard: 1,0%

**Low usage of the information**

- **Affected to the department**
  - Very significant: 30,7%
  - Significant: 15,8%
  - Not so significant: 11,9%
  - Insignificant: 2,0%
  - I don’t know: 2,0%

- **Difficulty to solve the problem**
  - Easy: 20,8%
  - Not so hard: 5,0%
  - Hard: 2,0%
  - Very hard: 1,0%

**Shortage of knowledge when using new tools or devices, or when applying a new methodology introduced at the Department**

- **Affected to the department**
  - Very significant: 28,7%
  - Significant: 11,9%
  - Not so significant: 21,8%
  - Insignificant: 5,9%
  - I don’t know: 2,0%

- **Difficulty to solve the problem**
  - Easy: 20,8%
  - Not so hard: 5,0%
  - Hard: 1,0%
  - Very hard: 2,0%
Limited use of Information Technologies (IT)

- Very significant: 3.0%, 3.0%
- Significant: 18.8%, 6.9%
- Not so significant: 27.7%, 8.9%
- Insignificant: 13.9%, 10.0%
- I don't know: 1.0%

Difficulty to solve the problem

- Easy: 1.0%
- Not so hard: 1.0%
- Hard: 1.0%
- Very hard: 1.0%

Information is not properly updated

- Very significant: 3.0%, 3.0%
- Significant: 14.9%, 7.9%
- Not so significant: 25.7%, 10.9%
- Insignificant: 14.9%, 4.0%
- I don't know: 1.0%

Difficulty to solve the problem

- Easy: 1.0%
- Not so hard: 1.0%
- Hard: 1.0%
- Very hard: 1.0%

Lack of mentoring for junior doctors or nurses

- Very significant: 2.0%, 2.0%
- Significant: 7.9%, 5.0%
- Not so significant: 24.8%, 8.9%
- Insignificant: 16.8%, 10.9%
- I don't know: 5.0%

Difficulty to solve the problem

- Easy: 2.0%
- Not so hard: 5.0%
- Hard: 4.0%
- Very hard: 2.0%
III. Motivation problems

IV. Operating & Distribution problems
V. Personnel problems

- Lack of available employees during demand peaks
- Permanent shortage of personnel resources

Difficulties to solve the problem

Affection to the department

Very significant
Significant
Not so significant
Insignificant
I don't know
Easy
Not so hard
Hard
Very hard

- 4.0% 2.0% 3.0% 11.9%
- 24.8% 10.9%
- 3.0% 1.0%
- 6.9% 5.0% 2.0% 1.0%
- 19.8% 5.9% 6.9% 4.0% 2.0% 1.0%
APPENDIX 3:

ADDITIONAL PROBLEMS COMPARISON
I. Comparison by centers’ size
II. Comparison regarding other involved employees (not nurses nor physicians)