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Process Improvement in the Long-Term Care Setting

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Master in Management of Services and Technology

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Resumo

O sector da saúde é um sector em constante mudança, evoluindo a um ritmo bastante acelerado. Os Cuidados Continuados Integrados são uma das áreas emergentes, devido ao envelhecimento da população e ao aumento da esperança média de vida. O aumento da procura destes serviços levará a uma crescente escassez da sua disponibilidade, resultando num esforço contínuo para continuar a aumentar a eficiência dos processos, encontrando o seu valor acrescentado e os desperdícios inerentes.

Lean Thinking é uma filosofia desenhada para responder a esta necessidade, tendo já sido implementada na área da saúde. Mesmo vastamente aplicada às áreas da produção e logística inerentes à saúde, a literatura revela a falta de aplicação à área dos Cuidados Continuados Integrados.

Este projeto pretende avaliar os benefícios que surgem da melhoria de processos, utilizando abordagens e ferramentas do *Lean Thinking*, na UCCI Almada. Esta unidade tem registado operar na sua capacidade máxima.

Com o objetivo de melhorar os processos da UCCI Almada, em particular os processos nos quais estão envolvidos os Auxiliares de Saúde Médica, este projeto estuda os atuais procedimentos da unidade, apresentando os mapas "*As-is*" dos processos, assim como os desperdícios a eles associados e as oportunidades de melhoria. Apresenta propostas de melhoria, tal como mapas "*To-be*" dos processos, e avalia o resultado esperado da sua implementação, tendo em conta os KPIs tempo, distância e paragem do processo. Espera-se que estas propostas de melhoria ajudem a guiar a UCCI Almada no processo de restauração da continuidade do fluxo da cadeia de valor.

Palavras-chave: melhoria de processos, Lean Thinking, cuidados de saúde, cuidados continuados integrados

Abstract

The healthcare industry is an ever-changing sector, evolving at a fast pace. The Long-term care is one of the emerging areas, due to the ageing population and increased life expectancy. The raising demand will lead to an increasing shortage of the availability of these services, resulting in an ongoing effort to keep increasing process efficiency, finding its' value and eliminating the inherent waste.

Lean thinking is a philosophy tailored to meet this need, having been implemented in healthcare over the years. Even if broadly used in the manufacturing and logistics areas, research shows a lack of application in the Long-term care setting.

This project aims to assess the value that arises from process improvement, using Lean Thinking tools and approaches, in UCCI Almada. This is a Long-term care unit operating at full capacity over the past years.

With the purpose of improving the UCCI Almada's processes, in which the Direct Health Providers are involved, this project explores the current procedures, delivering "As-is" process maps, the waste associated to them and the opportunities for improvement. It delivers proposals of improvement, providing To-be process maps and evaluates the expected outcome of its implementation, regarding the KPI's time, distance and process break. These improvement proposals are expected to guide UCCI Almada's in the process of restoring the correct flow of the value stream.

Keywords: process improvement, Lean Thinking, healthcare, long-term care

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List of abbreviations

ACSS-DRS – Administração Central do Sistema de Saúde - Departamento Gestão da Rede de Serviços e Recursos em Saúde
DHP – Direct Health Providers
GDP – Gross Domestic Product
INE – Instituto Nacional de Estatística
KPI – Key Performance Indicator
LTC – Long-Term Care
LTCM Long-term care and maintenance
LTV – Lisbon and Tagus Valley
NNLTC - National Network for Long-term Care
NNVAA – Necessary Non-Value Adding Activity
NVAA – Non-Value Adding Activity
OECD – Organization for Economic Co-operation and Development
RIE – Rapid Improvement Event
RNCCI – Rede Nacional de Cuidados Continuados Integrados
TPS – Toyota-Production-System
UCCI – Unidade de Cuidados Continuados Integrados
VAA- Value Adding Activity
VSM – Value Stream Mapping

1. Introduction of the project

In this chapter, a brief context of this project will be provided, starting with the problem statement (1.1). In section 1.2 the research question this project targets to answer will be defined, followed by the identification of the general and specific objectives (section 1.3). In chapter 1.4, it is briefly exposed the methodology applied throughout the project, followed by the scope of the research (section 1.5). Finally, in section 1.6, the structure of the project will be presented.

1.1 Problem Statement

In Portugal, the ageing of the population has been an increasing concern in the health policy arena over the past years. According to the last census of Statistics Portugal (INE, Instituto Nacional de Estatística, 2011), the percentage of population aged 65 and above has increased from 16.35% in 2001 to 19.03% in 2011, which can be explained mainly due to the growth in average life expectancy. Regarding the proportion of elderly over younger people (aged below 14), it increased from 102.23 to 127.84 (in the same period of time), meaning that for every 100 young people, there was 127.84 elderly. In 2017, INE released a projection for 2080, which stated that the ageing issue will only worsen, increasing this proportion to 317 elderly people for every 100 young people (INE, 2017).

With this clear tendency of ageing population, increasing the long-term care offers available for elderly people was necessary. Long-Term Care (LTC) is defined by OECD (Organisation for Economic Co-operation and Development) (2011) as *"the care for people needing support in many facets of living over a prolonged period of time"*.

In the past, the responsibility of dependent people that need LTC lied mainly in the family (informal care givers - "*Cuidadores*"). In 2014, the estimated number of people delivering this type of care was 12,5% of the Portuguese population, being mainly delivered by women (Simões et al., 2017). In the same year, the ratio of women to men care givers was 1,6 (INE, 2016). But with the growing percentage of female employment, which increased from 39.42% in 2001 to 43.87% in 2011 (INE, census 2011), there was a need to provide other alternatives.

Within these circumstances, in 2006, with the Decree-Law 101/2006 (Ministry of Health, 2006), the National Network for Long-term Care (NNLTC) (*Rede Nacional de Cuidados Continuados Integrados*, RNCCI) was created. This network resulted in a shift in the responsibility of caregiving to day centers, nursing homes and residences, where elderly people can benefit from services such as activities, meals, daily hygiene, laundry and help with the medication (Simões et al., 2017). The NNLTC provides different typologies of institutionalization, which includes convalescence (short-term recovery, until 30 days), medium-term care and rehabilitation (30-90 days stay) and long-term care and maintenance (LTCM) (stays longer than 90 days). It also provides day care for people that don't need to be admitted overnight (Simões et al., 2017). According to the Portuguese Social Security website, the

NNLTC also provides the option of Care Givers Rest *(Descanso do Cuidador)* (maximum of 90 days per year), where the informal care giver can hospitalize the dependent person for a short period of time, in order to rest (Social Security, 2020).

The demand for these services, in Portugal, surpasses the offer. According to the Central Administration of the Health System (*Administração Central do Sistema de Saúde - Departamento Gestão da Rede de Serviços e Recursos em Saúde,* ACSS – DRS) report (ACSS, 2018), in the end of 2018, 690 patients were waiting for a vacancy in Lisbon and Tagus Valley (LTV), which represents 43,3% of the number of people waiting nationwide (1593).

The institutionalization typologies where most patients were waiting for a vacancy was LTCM, registering 46,6% of the people waiting for a vacancy in NNTLC. The occupancy rate of this institutionalization typology was, in the same year, 98%, both nationwide and in LTV.

With the understanding of the Portuguese context, we can reach two conclusions: that this type of services will always be essential, and that their demand will continuously increase in the next years (Simões et al., 2017). Accordingly, this raising demand will lead to an increasing shortage of the availability of these services, resulting in the need to progressively improve the efficiency of the processes.

This is a concern for many LTC units in Portugal, such as it is the case of *UCCI* (*Unidade de Cuidados Continuados Integrados*) *Almada* – this is a LTC unit located in Almada comprising the long-term care and maintenance institutionalization typology. It also provides the service of care givers rest. It offers 7 rooms in private healthcare and 33 through the NNLTC. This LTC unit has been reporting a constant occupancy rate of 100% which makes it crucial to have a continuous review of its processes, to ensure its maximum efficiency, without compromising its efficacy. In order to achieve this goal, this unit must focus on waste elimination from its complete value stream. UCCI Almada shows to have a particular concern with the processes performed by the Direct Health Providers (DPH) (*Auxiliares de Ação Médica/Saúde*), representing these processes the focus of this project.

1.2 Research Question

Within the context presented above, the research question this project aims to answer is the following: "How to improve the UCCI Almada direct health providers processes, in order to make them more efficient?"

1.3 Objectives

This project intends to emphasize the potential benefits that process improvement methodologies and approaches used in healthcare can bring to LTC services.

The main objective will be, consequently, to improve the processes of a long-term care facility, UCCI Almada, in particularly the processes of the direct health providers.

In order to achieve this goal, the following specific objectives will be addressed:

- Map and analyze the UCCI Almada DHPs processes;
- Identify which activities are value-adding and which are not, from the perspective of the health providers of the facility;
- Identify which processes are creating waste, thus being able to be improved;
- Propose potential improvement solutions that will lead to greater value creation and waste reduction;
- Implement, when possible, the solutions found or deliver improvement proposals to solutions that cannot be implemented;
- Measure the improvement that can be achieved with the different proposals, by comparing the efficiency of the processes in the beginning with the improved ones;
- Deliver final recommendations.

1.4 Methodology

In order to select the most suitable structure of research, three distinct aspects should be taken into consideration: the research question, the range of control over the events and the focus on contemporary events rather than exclusively historical ones (Yin, 2014).

This masters' thesis is considered a project based on a case study since, according to the same author:

- Answers to a "how" or "why" research question;
- The focus of the study is on contemporary events;
- The researcher has almost no control over the events.

The research steps that will lead to the achievement of the objective of this project are the following:

- Map and characterize the current processes ("As-is") of the morning shift direct health providers (DHP);
- Identify improvement opportunities, by detecting the processes that have associated wastes;
- Propose improvement solutions;
- Implement and assess the solutions proposed;
- Recommendations.

1.5 Scope

This project will be carried out in a Long-Term Care facility, UCCI Almada.

Being the purpose of this project the improvement of process efficiency, there was a need to understand where improvement was most needed. After contacting with the Clinic Director, the processes that require a deeper analysis, and therefore will be studied, are the morning shift direct health providers processes.

1.6 Project Structure

The structure of this project is divided in the following chapters:

Chapter 1: Introduction of the project, where the context of the research will be provided, the research question, the objectives, the methodology to be followed and the scope.

Chapter 2: Literature Review that includes the methodologies and approaches with potential use in solving the topic proposed by this project.

Chapter 3: Definition of the adopted methodology, comprising the research steps to be followed and the data collection and tools selection used in each step.

Chapter 4: Case study characterization, including the setting where the LTC unit in study is inserted, as well as a description of the unit. Application of the research steps to the unit, focusing on the description of the current processes, the identification of the wastes inherent to them, and the presentation and assessment of the improvement proposals that aim to eliminate the wastes found.

Chapter 5: Conclusions.

2 Literature Review

This chapter presents the literature review that will support the research developed within the scope of this project. The databases used in this research were Science Direct, Elsevier, B-on and Google Scholar, using the keywords *process improvement*, *lean thinking*, *lean service* and *healthcare* (individually and considering different combinations).

Firstly, being the research question of this project related to process improvement in the healthcare sector, a brief introduction to process improvement will be presented, followed by a review of the methodologies and approaches used in this process. Coherent with the objective of this project, the best suiting methodology will be explored by defining its concept, purpose and tools used throughout its' implementation. Finally, its' applicability in the healthcare setting is presented.

2.1 Process Improvement

In this subchapter, a brief introduction to the concept of process and the difference between process improvement and process redesign is presented in subsection 2.1.1. In subsection 2.1.2, process improvement will be described in detail, followed by some methodologies and approaches used to conduct this task (2.1.3).

2.1.1 Process Improvement vs Process Redesign

According to Broutos and Cardella (2016: 2), a process is *"a sequence of linked tasks or activities that, at every stage, consume one or more resources (...) to convert inputs (...) into outputs (...)."*. A process describes, in other words, each of the steps and links between sectors of an organization that are involved in the process of delivering a product or service to a consumer (Earl, 1994).

Every activity carried out inside a company can be deconstructed into a process, which leads to the believe that, despite the size of the company, the way they conduct their processes is the key to success. Transforming its processes into more effective and efficient ones will support the company's' path of creating competitive advantages (Harrington, 1991; Broutos and Cardella, 2016).

With this being said, it is clear the relevance that every company gives to maintain their processes updated. When taking into consideration this task of improving operational performance, and depending on the degree of improvement required, different activities can be conducted such as process redesign (also referred by some authors as process reengineering) and process improvement (Adesola and Baines, 2005).

Process redesign is defined by Harmon (2014: xxxii) as "*a major effort that is undertaken to significantly improve an existing process or to create a new business process. Process redesign considers every aspect of a process and often results in changes in the sequence in which the process is done, in employee jobs, and in the introduction of automation*".

Process improvement is defined by Broutos and Purdie (2014: 46) as *"an ongoing effort to improve processes, products, and/or services in order to meet new goals and objectives such as increasing profits and performance, reducing costs, or accelerating schedules".*

Just concerning these definitions, it is possible to understand not only the similarities between each other, but also the differences that they imply.

Davenport (1993) pointed to the fact that these two methods converge in their objective: the improvement of the company's performance. To reach this objective, both methods involve substantial cultural and organizational changes. They are time consuming, making them unsuitable for problems that require fast answers.

The same author also stated that although these approaches might be similar to some extent, they diverge in several aspects, mainly on the path they follow to reach the objective. In process reengineering, processes are not only improved, but reinvented. Companies that choose to reengineer their processes should understand they are facing a radical change. It is a clean start, meaning that every existing process can be replaced by a new and improved way of doing things. On the other hand, process improvement strives for improving the already existing processes. In this approach, the purpose is not to create new processes, but finding a way of turning the existing ones more efficient and effective. It is more of an incremental measure, rather than a radical one. The way success is evaluated in each approach is another aspect that differentiates these methods. Improvement projects are recognized as a success when accomplishing 10 percent of improvement per year. Process reengineering will not even be considered if the improvement required is less than 60 percent. (Harrington, 1998).

Keeping these differences in mind, it is possible to understand in what scenario should we apply process reengineering or process improvement. For the purpose of this study, which aims to improve the already existing processes of a healthcare unit, the most suitable approach will be process improvement.

2.1.2 Definition of Process Improvement

As described above, process improvement is the task of ameliorating the existing processes in a given organization, converting them to more efficient and effective ones. This task supports the organizations' ability to increase its productivity, while decreasing its obsolete activities. Only companies that pursue the path of process improvement are able to stay competitive. Processes tend to degrade with time, making it necessary for every organization to reevaluate its processes and understand where improvement is required (Broutos and Cardella, 2016; Tamás, 2017). By conducting this task of process improvement, companies gain control over their processes, making it much easier to implement new and improved business decisions (Harrington, 1991).

In order to understand where process improvement is required, first, organizations should comprehend its processes. It might appear obvious for everyone that this step is necessary, but organizations tend to believe their processes are well written and stipulated. Still, it is not uncommon to

find companies with no updated documentation about the processes, making it mandatory to map them before starting the task of improvement (Broutos and Cardella, 2016).

Broutos and Cardella (2016: 36) define process mapping as a *"step-by-step description of the actions taken by workers as they use a specific set of inputs to produce a defined set of outputs. The resulting process maps depict the inputs, the performers, the sequence of actions the performers take, and the outputs of a work process, usually combining both words and simple graphics"*. It is a straightforward method of displaying every process in a "standard way", making it easier to comprehend and analyze how activities are being conducted and which interactions occur in each process. Its purpose is to deliver a tool that simplifies the evaluation and aids the path for continuous improving, rather than delivering a specific solution for process improvement (Savory and Olson, 2001).

After having the processes mapped, it is important to decide which improvement methodology to adopt. In the past few years, numerous approaches and methodologies for process improvement have emerged, making the decision-process more complex. Thawesaengskulthai and Tannock (2008) stated that the choice of methodology frequently came from managers, instead of being the result of a planned process of selection. It is necessary to comprehend the organization and the context in which the process improvement is being undertaken, and to adjust the decision based on the objectives and contingencies found.

2.1.3 Methodologies and Approaches

Different methodologies have been used by several authors to tackle de process improvement challenge, as displayed hereafter.

Optimization

Optimization aims to find the optimal solution for a given problem. In other words, the purpose of this methodology is to maximize or minimize an objective function (Williams, 2013). It can be seen as an automated way of improving the processes, using quantitative measures of performance (Vergidis et al., 2008). Process optimization is used mainly when targeting cost and lead time reduction, although it has a wide variety of applications in different management areas, with the objective of maximizing efficiency and optimizing the companies' processes (Zhou and Chen, 2003; Vergidis et al., 2008).

Bhattacharjee and Ray (2014: 357) stated that in healthcare, optimization is mainly use in the following topics: location and layout of healthcare facilities, capacity planning, staff and resources scheduling, and appointment scheduling. According to the same authors, optimization has been used to address many different issues such as modelling a blood collection system (Alfonso et al, 2012), develop a decision process model for outpatient scheduling (Patrick, 2012) or finding the optimal reorder point for a vaccine, in order to minimize vaccine wastage (Dhamodharan and Proano, 2012).

Bertsimas et al. (2016) referred that by using mathematical optimization, in the prostate cancer screening scope, they obtained significantly better results than several previously published screening strategies.

Simulation

This methodology is used to create a computer model based of real and /or planned events. It aids the company in understanding and forecasting how will the performance fluctuate under given circumstances and scenarios. The performance of these events is studied by running the model (conducting a simulation experiment) and analyzing how it behaves when certain inputs are changed (Vergidis et al, 2008; Tamás, 2017). A simulation experiment is defined by Carson and Maria (1997: 118) as "*a test or a series of tests in which meaningful changes are made to the input variables of a simulation model so that we may observe and identify the reasons for changes in the output variable(s)*".

According to Uriarte et al. (2017), simulation has been used by several authors with the purpose of healthcare improvement. In this paper, the authors applied discrete event simulation in order to understand the current processes of an emergency department in Sweden, with the final objective of reducing patients waiting times.

Chemweno (2016) used simulation to model the cerebrovascular accident patients entire care pathway, allowing bottlenecks to be found and corrective measures to be taken.

Carson and Maria (1997) stated that simulation models are often too complicated and costly, since in many experiments the amount of inputs in a simulation experiment is too high and sometimes the inputs selected are inadequate to study the performance. To solve this problem, a different methodology was introduced – Simulation-Optimization.

Simulation-Optimization

Simulation-Optimization is the combination of Simulation and Optimization and has been considered the most important simulation techniques by many authors. It aims to minimize resources spent while maximizing the information obtained in a simulation experience (Carson and Maria, 1997).

As an example of its' application in Healthcare, Ahmed and Alkhamis (2009) used Simulation Optimization in order to establish the optimal number of healthcare providers necessary in an emergency department to maximize patient throughput and reduce patient time in the system.

This approach was also used by Fairley (2018), in order to reduce the patient clog in the post-anesthesia care unit, which will lead, consequently, to fewer delays in operating rooms.

Lean

Lean is a very well-known philosophy used in process improvement. This approach targets waste reduction that was created by misconducted processes. In other words, its purpose is to improve the processes of value adding activities, while detecting the non-value adding ones and eliminating them, thus focusing more on their core activities and creating more value (Song et al., 2009). In order to help the company in this process, this approach takes in consideration five principles – value, value stream, flow, pull and perfection (Womack and Jones, 2003). The expression "Lean" is applied since lean production, when compared to other production systems, is the one that uses the least amount of resources to achieve its objectives (Randnor and Boaden, 2004; Wickramasinghe et al, 2014).

This philosophy has been used in the Healthcare sector for several years now. Weiss et al. (2017) applied several lean tools to an academic medical center which resulted in improved efficiency.

Chiarini and Cherrafi (2017) applied lean tools to a public hospital in order to reduce transportation and waiting times.

Six Sigma

This methodology focuses on statistical control of errors and defects (Harmon, 2014; Sabale and Thorat, 2019). The goal is to control the number of errors in a product, keeping it lower than the level of 3.4 defects per 1 million sample. This accounts to a quality rate of 99.9997%. Moreover, Six Sigma helps companies reduce the variability of their processes (Pinjari et al., 2017; Sabale and Thorat, 2019).

Six Sigma projects usually follow a DMAIC approach which stands for *D*efine the project issues and/or the consumers expectations, *M*easure existing performance and the crucial parameters of quality, *A*nalyze data collected in the measure stage, comparing it to the expectations and identify improvement opportunities, *I*mprove the processes, by implementing validated improvement opportunities and *C*ontrol the processes, making sure the quality level is achieved (Harmon, 2014; Pinjari et al., 2017; Sabale and Thorat, 2019).

Taner et al. (2007) registered using Six Sigma in order to decrease the number of repeated laboratory tests being made due to procedural errors in the first attempt.

This methodology was also used by Al-Qatawneh et al. (2019), to improve the healthcare logistics of a hospital in Jordan.

Lean Six Sigma

Lean Six Sigma (similar to Simulation Optimization) is the combination of the two methodologies: Lean and Six Sigma.

This methodology focuses on the reduction of process variability, while increasing efficiency. In order to accomplish this objective, Lean Six Sigma applies the DMAIC approach, using Lean tools in each step. By doing so, it becomes easier to understand the opportunities for improving, in addition to

having a better understanding of the problems causing lack of quality or higher levels of variability (Pinjari et al., 2017).

Bhat et al. (2020) explored different applications of Lean Six Sigma in healthcare. The authors stated that by applying this methodology to the out-patients Medical Records Department of a hospital, they were able to improve the sigma level from 0.38 to 3.11, as well as reducing the average cycle time, waiting time and number of patients in queue. The same authors reported that Lean Six Sigma was used to improve the performance of the in-patient Medical Records Department, by reducing the process time, leading to no inventory, nor work-in-process of medical records.

As the objective of this project is to explore which processes of a LTC facility can be revised and improved, by understanding the wastes associated to them and finding possibilities to reduce or even eliminate the waste, it is possible to conclude that the Lean approach is the one that will be more helpful in accomplishing this objective.

2.2 Lean Thinking

In the following subsections, a brief introduction to Lean Thinking, as well as its' main characteristics will be address (2.2.1). Firstly, the principles of Lean Thinking will be approached (2.2.2). Afterwards, the concept of waste is going to be given, followed by the types of waste identified in this philosophy (2.2.3). Following that, some tools used in Lean will be described (2.2.4).

2.2.1 Concept and Historical Review

Lean philosophy can be traced back to 1980s, when the Toyota-Production-System (TPS) was being used in the Japanese car manufacturing industry (Hines et al, 2004; Liker and Morgan, 2006). But it only caught the attention of the rest of the world when Womack and Jones published the book "The Machine that Changed the World" in 1990. In this book, the authors created the expression "lean", to define the manufacturing process used in TPS (Stone, 2012). "Lean" means doing more with less (Randnor and Boaden, 2004).

When this concept was firstly introduced in 1990, it was exclusive to the car manufacturing industry, expanding itself to manufacturing/production in the end of that decade. In the beginning of XXI century, with the rapid development of the service sector, which represents a large portion of the global economy GDP (Gross Domestic Product) - 65% in 2018 (WorldBank website, 2020), this philosophy extrapolated to every business sector (Stone, 2012; Hines et al, 2004; Holweg, 2007; Cheng et al. 2015; Ramori, 2019).

Lean started as a process-centric model, with little regard to the sociotechnical aspect of a firm (Wickramasinghe et al, 2014). But with its extension to services, the necessity of broadening its vision inside the company was strong. In the service sector, people are considered to be one of the most

valuable assets of the company, meaning that their involvement in lean activities is highly recommended (Antoni, 1996; Bowen and Youngdahl, 1998; Swank, 2003; Hines et al, 2004; Bonaccorsi et al, 2011).

The application of this philosophy has brought great benefits in many service industries, such as public services (Radnor and Boaden, 2008; Lukrafka et al., 2020), infrastructures (Åhlström, 2004), banking industry (Song et al., 2009), building and construction services (Song et al., 2009), education (Åhlström, 2004; Scremcev et al., 2018), hospitals (Åhlström, 2004; Liker and Morgan, 2006; Cheng et al., 2015; Chiarini and Cherrafi, 2017) and the hospitality sector (Tortorella et al., 2019).

2.2.2 Principles

The five principles of Lean introduced by Womack and Jones (2003) are the following:

Value

The objective of this first principle of Lean Thinking is the attempt of defining value specifically. According to Womack and Jones (2003), value is created by the company, but consumers are the only ones that can define it. This definition only matters when expressed in terms of a specific good or service. With this being said, the analysis that needs to be done in order to accomplish this objective is what does and what does not add value. In order to establish what does and what does not add value, it is necessary to identify the value adding procedures.

Value Stream

The next principle in Lean Thinking is finding the whole value stream for each product. The value stream is the set of each explicit action necessary to carry a specific good or service. In other words, the objective of this set is mapping all activities involved in the companies' processes (Wickramasinghe et al., 2014). By defining the value stream, three types of activities that are happening throughout the value stream might be found (Hines and Rich, 1997; Hines and Taylor, 2000; Womack and Jones, 2003 and Bonaccorsi et al, 2011):

- Value adding activities (VAA) – activities that the consumer considers that are adding value to the product or service;
- Necessary non-value adding activities (NNVAA) – activities that in the consumers perspective do not add any kind of value to the product or service, but that are important in the process. Although they cannot be eliminated, the aims should be to simply them;
- Non-value adding activities (NVAA) – activities that do not add value to the product or service delivered, nor are necessary in the process. These activities are considered waste and should be eliminated immediately after being discovered.

Flow

After getting rid of non-value adding activities and mapping the value adding ones, there is a need for making the remainder flow. The two previous principles are efforts to eliminate waste, while flow regards the creation of value (Womack and Jones, 2003). The purpose of this step is redesigning the processes to achieve a continuous flow and avoid bottlenecks, as well as the eliminate the idea of separate departments and "batch thinking" (Womack and Jones, 2003; Wickramasinghe et al., 2014).

Pull

The fourth principle of Lean Thinking states that companies should be oriented to supply consumers what they demand, instead of trying to push products to them. Lean systems allow changes to products to occur while they are already in production, making it easier to follow shifting demands. By doing so, there is no need to try to predict demand, produce in large batches or warehousing large quantities of products. What companies need to do is exactly what consumers ask for (Womack and Jones, 2003).

Perfection

The fifth and final principle is Perfection. Organizations that have now accomplished (1) a precise definition of value, (2) identified every activity that does and does not add value by mapping the value stream, (3) achieved a continuous process flow and (4) allow customers to pull demand, producing only products that consumers actually want, begin to understand that (5) perfection is not something unrealistic.

By continuously improving the steps above, it becomes easier to eliminate any type of waste generated, leading to a more efficient production (Womack and Jones, 2003).

These principles should be used in every company that aim at following the lean philosophy, from manufacturing companies to service-based ones. Although they can be applied to both sectors, some authors found it necessary to embrace other principles that they found essential when adopting Lean in service industries. Leite and Vieira (2015) summed up paper from authors such as Bowen and Youngdahl, Swank, Sánchez and Pérez, Ahstrom, Womack and Jones, Sarkar and Bicheno, related to what they named "Lean principles for services".

As an example, Leite and Vieira (2015) collected Jones (2006) principles, which resume to: (1) Specify what creates and what does not create value from the customers' perspective; (2) Identify all the steps needed to design, order and produce the service along the flow to focus on losses that do not add value; (3) Make those activities that create flow without interruptions, return or fragments; (4) Do only what is driven by the consumer and (5) Strive for perfection, continuously improving services and value stream.

According to Spagnol et al. (2013), these principles can be applied to healthcare, where the value identified by the consumer is a cure for an illness or a relieve of pain. The same authors referred that in

the healthcare setting, the value stream is known as patient flow, and that "*it not only relates to physical goods like drugs, pharmaceuticals, medical devices and health aids, but also to all phases of their treatment from referral to full recovery*" (Spagnol et al., 2013: 230).

2.2.3 Waste

Before introducing the tools used in Lean Thinking, it is important to define the concept of *muda*. *Muda* is the Japanese word for waste. As said before, Lean Thinking aims to slim activities related to production or service by reducing their waste. Waste is, in other words, any non-value adding activities performed by the company that can and should be eliminated (Womack and Jones, 2003; Riley et al., 2012).

Shigeo Shingo (considered one of the main experts in Toyota-Production-System) identified the following seven types of waste related to production that need to be eliminated (Hines and Taylor, 2000):

- Excessive transportation
- Unnecessary inventory
- Unnecessary motion
- Waiting
- Overproduction
- Inappropriate processing
- Defects

While in manufacturing industries there is an upfront definition of waste, since it is often more visible (for example, unnecessary inventory or overproduction), when it comes to services, due mainly to the lack of tangibility, it is harder to define waste (Bowen and Youngdahl, 1998; Hicks, 2007; Bonaccorsi et al, 2011). The fact that consumers are involved in the service processes also contributes to this problem (Ahlstrom, 2004). As stated above, waste can be described as every non-value adding activity, and according to Womack and Jones (2003), when considering the service industry, value is only defined by the consumer. Thus, consumers are the ones that decide what is waste and what is not (Hines et al, 2004). The downstream is, what one consumer sees as value, another can see as waste (Ahlstrom, 2004).

Swank (2003), Womack and Jones (2003), Hines et al. (2004), Hicks (2007), Song et al. (2009), Bonaccorsi et al (2011) and Radnor (2011) all contributed to the studies of waste related to services.

Song et al. (2009) stated that, according to Womack and Jones (2003) and Bicheno (2004), when lean philosophy is applied to manufacturing, the target is to eliminate material, production time and operations wastages. When applied to services, the target shifts to eliminating waste related to time, service quality and information errors. Table 2.1, which is adapted from Song et al. (2009), Bonaccorsi et al. (2011), Radnor (2011), Weiss et al. (2017) and Sarkar (2017), reveals how can the seven deadly wastes can be transported from manufacturing to service industries and to the healthcare setting.

Table 2.1 - Lean wastes in manufacturing, service industry and healthcare

Adapted from Song et al. (2009); Bonaccorsi et al. (2011); Radnor (2011), Weiss et al. (2017) and Sarkar (2017).

Manufacturing	**Service Industry** (adapted from Song et al., 2009; Bonaccorsi et al., 2011; Radnor, 2011 and Sarkar, 2017)	**Healthcare** (adapted from Radnor, 2011 and Weiss et al., 2017)
Transportation	• Ineffective filing • Excessive approvals/ handoffs	• Patient transport • Medicine delivery • Central storage of equipment instead of being where they are used
Inventory	• Excess inventory/ stock out • Wasting time finding what is needed • Delay on delivery time • Duplication of data	• Unnecessary supplies • Patient blockage/ waiting to be discharged • Excessive stock
Motion	• Poor ergonomics in the workplace and in the service encounter • Lack of understanding of work flow • Queueing of customers • Lack of one-stop	• Searching for supplies (e.g. paper work, syringes, needles) • Not having basic equipment in every examination room • Staff walking
Waiting	• Waiting for approvals • Downtime • Long processing times • Unclear communication leading to delays in the service • Customers in queues	• Waiting for patients • Waiting for exam results/ prescriptions • Waiting for doctors to discharge patients
Overproduction	• Unnecessary reports • Processing paperwork before time • Substitute products or services	• Requesting unnecessary tests/ exams
Overprocessing/ Inappropriate Processing	• Redundant steps in a process • Failure to establish rapport • Ignoring customers	• Duplication of information asked from the patients • Repeated clerking of patients

Defects	• Data entry errors • Errors in the service transaction • Lost or damage goods	• Incorrect medicine given to patient • Readmissions

2.2.4 Tools and Approaches

In the literature, there is a broad range of tools and approaches used in Lean Thinking, which all aim to reduce waste and improve efficiency, as mentioned before.

As examples of tools most widely used we have 5s (Song et al., 2009; Drotz and Poksinka, 2014), Kaizen Events (Radnor, 2011) – also known as Kaizen Blitz or Rapid Improvement Events (RIE), Spaghetti Diagram (Johnson et al., 2010), Standardization (Kim, 2007; Song et al., 2009; Drotz and Poksinka, 2014; Khodambashi, 2014), Value Stream Mapping (Savory and Olson, 2001; Kim, 2007; Song et al., 2009; Johnson et al., 2010; Bonaccorsi et al., 2011; Riley et al., 2012; Drotz and Poksinka, 2014; Khodambashi, 2014) and Visual Control (Song et al., 2009; Drotz and Poksinka, 2014).

The tools and approaches that are explained below are the ones that, according to the literature researched, have had applications in the healthcare setting. In this section, only the concept and explanation on how to implement them will be addressed, while in the section below (2.3), examples of its application will be exposed.

Value Stream Mapping

Value Stream Mapping (VSM) is a tool used to map the value stream of a company (Riley et al., 2012). As explained in section 2.2.2., the value stream is the entire set of actions necessary to deliver a good or product (Wickramasinghe et al., 2014). Khodambashi (2014: 316) explains that in Value Stream Mapping "(…) *key people, resources, activities and information flows, which are required to deliver a service or product, are mapped graphically to identify opportunities to reduce waste and integrate process steps, thus improving process efficiency*". In other words, this tool maps every step involved in providing a product or service, since its start to its end (Riley et al., 2012).

When Value Stream Mapping, the first task is to find the purpose of the improvement, since for each improvement purpose, different features of each process will be studied. Afterwards, the team in charge of this activity should collect data regarding how the process works by, for example, conducting interviews with the people involved in it (Song et al., 2019). With this data, "As-is" (also referred as "Current State Map" by other authors) process maps are created. These are the maps that will help the team understand where room for improvement is (Savory and Olson, 2001). When analyzing "As-is" maps, it is possible to identify activities that do and do not add value. It is possible to visualize which steps are not being well conducted, resulting in additional waste and redundant tasks (Song et al., 2009; Khodambashi, 2014). After analyzing, it is helpful to create "To-be" (also referred as "Should Be" or

"Future State Map" by some authors) process maps, mapping the ideal flow of the value stream. With this tool, it is easier to understand which modifications need to be done in order to improve performance (Savory and Olson, 2001; Riley et al., 2012).

Rapid Improvement Events

Rapid Improvement Events are a tool applied in Lean Thinking when the improvement necessary is not large, and when it is needed fast. It is a three-phase event, starting with preparation, moving to a 5-days period where changes are identified, ending in a 3 to 4-week period, when the changes identified are implemented. These events are conducted by a multidisciplinary team, including members of different departments within the company and members of the Lean team. This tool has been acknowledged by the fast return for effort, as well as the visibility and fast demonstration of performance (Chen, 2010; Radnor, 2012).

Spaghetti Diagram

Spaghetti Diagram is a Lean Thinking tool used to demonstrate the movements (distance) of employees and costumers inside the working area (Johnson et al., 2010; Riley et al., 2012). Most sets involved in a process require traveling and transportation within a certain space (Riley et al., 2012), and by representing them in a Spaghetti Diagram, it is possible to understand what movements are being repetitive (Johnson et al., 2010). The objective of this tool is eliminating movement that does not add any value, in order to minimize the time required to provide a good or service (Riley et al., 2012).

Visual Control

Visual Control is a method of displaying visually stimulating information throughout the work environment, in places that are visible for employees. This information comes in forms of boards, displays and labels that indicate the objectives for the day/week and performance feedback. The purpose is making it easier to understand if there is any irregularity on what is supposed to be accomplished on that day/week. These displays help employees to comprehend unbalanced activities and bottlenecks and take corrective actions upon them. By using Visual Control, the commitment to improving activities increases (Song et al., 2009; Drotz and Poksinska, 2014).

2.3 Lean Thinking in healthcare

Lean Thinking, as of today, is no longer limited to companies in the manufacturing business. Most companies that desire to improve their efficiency and effectiveness are embracing Lean tools and techniques. Healthcare is one of the areas where its applications have been intensifying over the past decades (Drotz and Poksinska, 2014; Tay, 2016).

Radnor (2012) states that the objective of implementing Lean tools in the healthcare setting is to eliminate procedures that are not needed and duplicate processes.

According to Wickramasinghe et al. (2014), the application of Lean Thinking to Healthcare brings several benefits. The first benefit identified is the (1) improvement of quality and safety (by decreasing mistakes and accidents), followed by (2) improved delivery (decreasing the time necessary to do a task), (3) improved throughput (perform better results with the same providers and equipment) and finally the (4) accelerated momentum (which regards clear and standardized processes).

Several authors have conducted case studies regarding the application of lean techniques for process improvement in the health care sector.

Value Stream Mapping was used by Kim et al. (2007), Johnson et al. (2010), Khodambashi (2014) and Hayes et al. (2014) in order to reduce waste in the value stream and increase its flow. Johnson et al. (2010) were able to reduce patient waiting time from 90 to 20 minutes, by condensing and eliminating steps from the patient encounter. Kim et al. (2007) also condensed the steps needed in the patients' process, shrinking it from 27 original processes to 16. Khodambashi (2014) use this tool in order to identify, and subsequentially reduce, the non-value adding time that was being generated by lacking an integrated Health Information System. In each of these examples, the flow of the processes increased, which led to reducing waiting times, thus increasing performance efficiency.

Rapid Improvement Events were conducted by Hayes et al. (2014) and Tay (2016) in order to rapidly improve an occurring problem. Tay (2016) conducted these workshops with the intent of eliminating process redundancy. Hayes et al. (2014) solved a lack of space problem, by increasing work flow. In these RIE, the authors applied other lean tools, such as Value Stream Mapping and Spaghetti Diagrams to improve the way the processes were conducted, leading to a better utilization of the work area.

Spaghetti Diagrams were used by Johnson et al. (2010) and Hayes et al. (2014), with the objective of reducing the length walked by the staff members. By observing the daily routine of the employees and drawing the routes taken by them, the authors were able to eliminate repeated "walks" and motions, thence decreasing waste related to this aspect.

Visual Control was used by Drotz and Poksinska (2015) to aid in the Lean implementation, by delivering a stronger feedback on work performance, making it easier to understand the objectives of the process improvement.

Whilst there are a broad variety of studies concerning the implementation of Lean techniques for process improvement to the Healthcare setting, no studies were found regarding process improvement in LTC. Thence, this research aims to reduce the existing gap in the literature.

2.4 Conclusions

With the theoretical support presented in this chapter, this project aims to present improvement opportunities in the processes of a Long-term Care unit, in order to reduce the waste generation and increasing efficiency.

Keeping this in mind, the literature review related to process improvement and lean thinking is presented. Firstly, the concept of process improvement is given. Subsequently, Optimization, Simulation, Lean and Six Sigma are given as examples of methodologies and approaches used in the task of process improving.

Lean Thinking is emphasized since, in compliance with the objectives, it will aid in reaching the purpose of this project. To better understand how Lean can be applied to the service sector, its principles and the most common tools are displayed, highlighting Rapid Improvement Events, Spaghetti Diagram, Visual Control and Value Stream Mapping.

According to the literature review herein presented, Lean applications in the Healthcare setting have been increasing, with the shared objective of reducing waste and ameliorating the value stream flow. Table 2.2 displays previous studies conducted in the field of Lean applications in Healthcare, concerning the tools and approaches used and the purpose of implementing this methodology.

Table 2.2 – Lean applications in the Healthcare Setting

Based on Kim et al. (2007); Johnson et al. (2010); Drotz and Poksinska (2014); Hayes et al. (2014); Khodambashi(2014) and Tay (2016).

Authors	Tools/Approach	Healthcare Area
Kim et al. (2007)	Value Stream Mapping Standardization	Radiation Therapy
Johnson et al. (2010)	Value Stream Mapping	Magnetic Resonance Imaging
Johnson et al. (2010)	Spaghetti Diagram	Radiography
Drotz and Poksinska (2014)	Visual Control	Several Areas
Khodambashi (2014)	Value Stream Mapping	Heart operations
Hayes et al. (2014)	Rapid Improvement Event Value Stream Mapping Spaghetti Diagram	Emergency and pathology department
Tay (2016)	Rapid Improvement Events	Several Areas

After researching the literature, it is possible to conclude that there are several studies regarding the application of Lean Thinking for process improvement in services and in healthcare, although none was found in the LTC setting. Therefore, this study, aside from contributing to improve the processes of UCCI Almada - a LTC unit - it also intends to reduce the existing literature gap regarding process improvement in the LTC setting.

3 Methodology

In this chapter, the methodology adopted for this project is presented.

The case study methodology will be introduced in subchapter 3.1 including its characterization and design. In subchapter 3.2, the research steps used to achieve the objectives will be described, as well as the data collection methods and tools used to support each step.

3.1 Case Study Methodology

In order to select the most suitable structure of research for this project, it is necessary to take into consideration the research question type, the range of control that the researcher has over the events and the focus on contemporary events rather than exclusively historical ones (Yin, 2014).

According to this author, when "*a "how" or "why" question is being asked about a contemporary set of events, over which the researcher has little or no control*" (Yin, 2014; 73) the most suitable research methodology is a case study.

This project research question (as mentioned in section 1.2) is "*How to improve the UCCI Almada direct health providers processes, in order to make them more efficient?"*, answering to a "how" question.

Also, this project aims to study contemporary events - the processes of a LTC facility, UCCI Almada – rather than historical ones. Hence, the data collection methods applied should be direct observation and interviews with people involved in the processes (Eisenhardt, 1989; Yin, 2014).

Finally, the activities in question in this project are not under the control of the researcher, since no essential behavior can be manipulated (Yin, 2014).

Regarding the case study characterization, it is based on two different strategies: descriptive and exploratory. On one hand, it is a descriptive case study, since it describes the processes of UCCI Almada, in order to facilitate the identification of the waste and value in its activities and processes. On the other hand, it is an exploratory case study, as Lean tools and methods are applied to aid the process of finding improvement opportunities.

This case study is a single-case study (instead of a multiple one), since it focusses exclusively in processes of one LTC facility, UCCI Almada.

3.2 Research Steps

In this subchapter, the steps that are going to be undertaken in this project are presented. In Figure 3.1, the sequence of the steps is presented, including also the data collection methods and the Lean tools that will be used.

Data Collection				
Primary Data: Qualitative: Semi-structured Interviews Focus-Group Quantitative: Observation **Secondary Data:** Documents	**Primary Data:** Qualitative: Semi-structured Interviews Focus-Group Quantitative: Observation **Secondary Data:** Documents	**Primary Data:** Qualitative: Semi-structured Interviews Focus-Group **Secondary Data:** Documents	**Primary Data:** Qualitative: Semi-structured Interviews Focus-Group Measurements	
Tools				
Value Stream Maps As-is Process Maps		To-be Process Maps Visual Control	Spaghetti Diagram	

Figure 3.1 - Research steps and tools used in each research step

Map and characterize the processes

In this step, the UCCI Almada's morning shift DHPs processes and subprocesses will be mapped using Value Stream Mapping, which will support on identifying value adding activities, necessary non-value adding activities and activities that do not add any kind of value – thus considered as waste. In order to map the "As-is" processes maps, primary and secondary data will be collected. The primary data will be captured by direct observation of the processes and by conducting semi structured interviews (see annex A) to the Clinic Director, the DHPs' supervisor as well as the direct health providers that work directly with the patients. Secondary data will be collected through the official documentation of the facility. When and if the information gathered does not match, focus groups will be conducted. Focus groups will aid on understanding any type of inconsistency in the data obtained.

Identify improvement opportunities

After assessing the processes mapped in the first stage, activities that are essential, as well as the ones generating waste are identified. Based on this identification, it is easier to understand where there is room for improvement alongside with which activities should be revised or eliminated. Following that, semi-structured interviews with the Clinic Director and the DHPs supervisor should be conducted in order to validate the opportunities found.

Propose improvement solutions

After the activities that are generating waste are identified, as well as the processes that are not flowing correctly, some improvement solutions will be presented, in order to eliminate/reduce these difficulties. In order to present these solutions, "To-be" maps will be developed, aiding to understand the benefits that can be brought. These solutions will be based in Lean tools gathered from the literature review, such as Visual Control and Spaghetti Diagrams. In this step, new semi-structured interviews will be needed to validate the solutions together with healthcare providers and the Clinic Director.

Implement and assess the solutions proposed

After the solutions' proposals are validated, the next step involves its implementation. If a solution cannot be implemented, a proposal of implementation will be delivered. When apprising the potential of the solutions proposed/implemented, several KPIs (Key Performance Indicators) - such as time and motion - will be taken into consideration. Measurements of these KPIs will be computed before and after the implementation of the solutions, thus leading to conclusions regarding the success or lack of success of each solution. Direct observation, semi-structured interviews and focus groups (if and when necessary) will be conducted, with the objective of measuring the KPIs.

Recommendations

At the end of this project, some recommendations regarding achieving process efficiency will be providing, based on the analysis done in the previous step.

4 Case study

This chapter aims to answer the research question brought forward in Chapter 1.

To do so, an assessment of the efficiency of the processes performed by a LTC unit – UCCI Almada - is provided.

In subchapter 4.1, a brief characterization of the LTC setting in Portugal is delivered (section 4.1.1), followed by the description of UCCI Almada (4.1.2).

In subchapter 4.2, the research steps stipulated in Chapter 3 will be applied to UCCI Almada. First, in section 4.2.1, the characterization of the processes, as well as the "As-is" process maps will be delivered. Following (section 4.2.2), the improvement opportunities are identified, and the wastes associated to the processes characterized in 4.2.1 are described. In section 4.2.3, the improvement proposals are explained, being assessed in the next section (4.2.4).

In subchapter 4.3, the conclusions of this chapter will be aid out.

4.1 Case study characterization

In this subchapter, the case study characterization is going to be delivered. The LTC setting in Portugal is described (4.1.1), followed by the description of UCCI Almada (4.2.1)– where this project takes place.

4.1.1 Long-term care setting in Portugal

Portugal has been categorized by its ageing population over the years. This aligned to the decreasing number of informal care givers – due to the growth in female employment -, rose the necessity of developing alternative care solutions.

The NNLTC was created in 2006, with the purpose of filling the until then existing gap, related to long-term and palliative care. This network delivers different typologies of institutionalization: convalescence (short-term recovery, until 30 days); medium-term care and rehabilitation (30-90 days stay); long-term care and maintenance (stays longer than 90 days) and palliative care. It also provides day care services for people that do not want/need to be institutionalized overnight (Simões et al., 2017) and the option of Care Givers Rest *(Descanso do Cuidador)* (maximum of 90 days per year), where the informal care giver can hospitalize the dependent person for a short period of time, in order to rest (Social Security, 2020).

In 2018, this network provided, national wise, 4,794 beds for the LTCM institutionalization typology, registering an occupation rate of 98%. 742 people were waiting for a vacancy, being 43,3% of this people from the LTV area. Taking into account these numbers, it is clear the need to reevaluate the way these organizations are carrying out their procedures, since it is an overloaded sector, where the processes need to be as efficient as possible.

4.1.2 UCCI Almada

UCCI Almada is a long-term care unit, integrated in the NNLTC. It is located in Almada, as part of a partnership between *Cooperativa Almadense* and *Grupo Alif Senior*.

Its' purpose is to provide health, rehabilitation and maintenance services to dependent people, that are unable to receive these services at home. The unit provides long-term care and maintenance services (admissions up to 90 days), as well as "Care Givers Rest" (*Descanso do Cuidador*) (up to 90 days a year, to allow the informal care givers' rest), under the control of the Portuguese State (public health service). It also provides care giving services in the private sector, without a defined length of stay.

The LTC unit offers several services to the people admitted, such as everyday activities, meals, hygiene, laundry, help with the medication, psychological support, physiotherapy and occupational therapy. To deliver these services, a health provider team is available, including 22 direct health providers. These workers are organized in two teams, the common room team – the DHPs who cater to the needs of patients that are in the common spaces – and the floor team – the DHPs that provide services directly in each patient's room. The latter (floor DHPs) are the target of study of this project since, according to the semi-structured interviews with the Clinic Director of UCCI Almada, they perform the processes that have reported larger delays in the past years.

UCCI Almada has 40 rooms available for their patients spread out through two floors, being 33 within the NNLTC, that have the capacity to accommodate 70 patients, and 7 rooms at a private level, that accommodate 17 patients. Currently, they have 87 patients institutionalized, being most patients over 65 years old (78.57%), meaning they are working at full capacity, having no vacant rooms.

The processes of the morning shift DHPs have shown to produce delays throughout the shift, impacting the process flow. Based on the semi-structured interviews and direct observation, the delays in the morning shift processes have led to situations in which other workers from UCCI Almada had to help the floor DHPs completing their tasks, and patients having to wait a great amount of time to have lunch. Keeping in mind that working as efficiently as possible is essential, combined with the need of minimizing these delays, this study aims to reduce or even eliminate the wastes associated to the process flow.

4.2 Research steps applied to UCCI Almada

In this subchapter, the research steps presented in the methodology will be applied to UCCI Almada. First, the processes and subprocesses in which the floor DHPs are directly involved (and these floor DHP will be hereafter mentioned as DHPs) will be mapped and characterized (4.2.1), and the improvement opportunities found are presented (4.2.2). In 4.2.3, the proposals that aim to reduce/eliminate the wastes associated to UCCI Almada's processes are aid out, followed by the description on how they can be implement and the assessment of their success/lack of success (4.2.4). In the end of this subchapter, some recommendations regarding the achievement of correct flow of the processes will be provided.

4.2.1 Map and characterize the processes

In this subsection, the processes in which DHP are involved are going to be presented. The following maps and their characterization are based in the already existing documentation that was provided by UCCI Almada, as well as direct observation of each step of the processes and semi-structured interviews with the workers involved in such processes.

The overall process of the DHP (figure 4.1) consists in three distinct activities – opening meeting, daily care and shift closing. In the opening meeting, the DHPs starting their shifts are briefed by their colleagues from the previous shift, regarding any important information needed to assure the next shift functions well. Following, the DHPs proceed to complete the daily care activities. Finally, the overall process ends with the shift closing, where the DHPs make sure that everything is set for the next shift to start.

Figure 4.1 - Overall process of the FDHP

The following figure (figure 4.2) represents the Value Stream Map of the overall process of the DHP. Patients referred through public healthcare will communicate their need to be institutionalized in a LTC unit to the NNLTC, and wait for a vacancy, while through private healthcare, this information will be provided directly by the client to UCCI Almada. When the patient is admitted in UCCI Almada, the unit will deliver the patients' information to the DHPs, which is crucial for them to perform their processes.

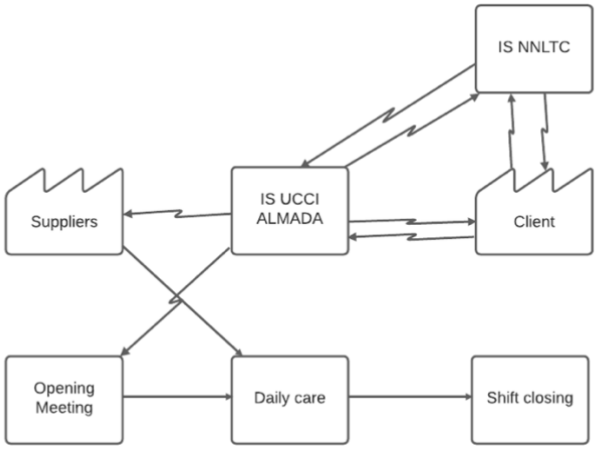


Figure 4.2 – Value Stream Map of the overall process

Legend: IS UCCI Almada – Information System UCCI Almada; IS NNTLC – Information System National Network for Long-term Care; Straight lines – physical flow of products and services; Curved lines – information flow

From direct observation and semi-structured interviews with the Clinic Director and the DHPs, it was concluded that the processes and subprocesses involved in the daily care activity, particularly in the morning shift, needed to be studied with greater detail. The morning shift comprises the most complex processes performed by the DHP team, and often leads to delays. Taking these reasons into consideration, there will be a focus on this process, which will further be mapped and characterized below.

4.2.1.1 Process – Global Daily Care (Morning Shift)

The Global Daily Care process is preceded by a brief meeting (opening meeting) where the DHP from the shift that is ending communicate important information regarding the flow of that shift, as well as relevant information about the patients.

In this brief 10-minute meeting, the proceeding shift will get to know any important information regarding the patients' status, in addition to any health constraints that might affect the daily care processes. Afterwards, each one of the DHPs will get a sheet of paper containing the information about the patients/floors/wings that are assigned to them that day. The "M" list is for the morning shift, the "T" list for the afternoon and the "N" list for the night shift.

The lists (see annex B) comprise information on every patient staying in UCCI Almada. It gives information such as the name of the patient, their age, the room where he/she is, if they should take a bath in the bed or in the shower and if they should be lifted that day. These lists also include other data that will aid in the daily care process, such as the responsibilities of each shift, the break hours or at what time they should send the dirty clothes cart to the laundry.

M list

The M list is divided in 7 M's. M1 is assigned to one DHP, as well as M2, M5, M6 and M7. M3+4 and M8+9 is assigned to two DHP. The latter are considered the "heavy lists" which are assigned to two DHPs because, being UCCI Almada an LTC facility, some of the institutionalized patients have low mobility, and two people are necessary for tasks such as giving a bath, reposition the patient, or moving him/her. Patients that, for e.g., are heavy or that just had a surgery and have temporary reduced mobility, also fall in this list.

The list is organized by floors (floor 0 and floor 1) and in floor 1 by wings (south wing and north wing), M1, M2 and M3+4 are from floor 0; M5, M6, M7 and M8+9 are from floor 1. The "M" assigned to each DHP will change after no more than 4 days, since DHPs assigned to the "heavy list" cannot do it for more than 4 days in a row.

Table 4.1 displays the rooms assigned to each "M", based on the official "M" list (see annex B).

Table 4.1– Rooms assigned to each "M" list.

Based on the "M" list provided by UCCI Almada (annex B)

	M List						
	M1	**M2**	**M3+4**	**M5**	**M6**	**M7**	**M8+9**
Rooms Assigned	012	004	013	GAB	115	104	121
	011	003	011	122	114	105	120
	008	002	010	121	113	106	118
	007	001	009	120	112	107	117
	006	U3	007	119	111	108	116
	005	U2	005	117	101	109	110
		U1	001	116	102	110	107
			U2		103	123	106
							105
							104
							103
							101

Following the opening meeting, the Daily Care process starts. Figure 4.3 represents the "As-is" process map of the morning shift DHP daily care process.

The DHP head to the floor/wing assigned to them that day and start with the complete hygiene of each patient. This task alters if the patient is bedridden, as will be explained in section 4.2.1.2 ("Complete hygiene" subprocess). Every patient ready before 10h (and that isn't bedridden) is taken to the dining hall, where breakfast is served by the common room DHP team. The ones that aren't ready until 10h will eat in their rooms. In this case, breakfast is given by the DHP as the food cart arrives from the kitchen – there is an "M" assigned by floor and wing to prepare and provide the breakfasts in the rooms.

After every hygiene is complete, the DHP proceed cleaning the rooms (explained in greater detail in section 4.2.1.3) – their task is to make the beds and organize patients' personal belongings, the floors and bathrooms are cleaned by the cleaning staff. All dirty sheets and clothes should be deposited in the dirty clothes cart, which by 12h will be sent to the laundry department by the floor DHP supervisor.

Next, DHPs start giving lunches (by 12h) – 3 are responsible for giving lunches to the patients that did not get out of bed/room that day; while 2 will aid in the lunches in the dining hall.

Following the lunches, they do the "First round" (explored in section 4.2.1.4). In this task, the DHP will go around the rooms and check every patient. The main goal of this task is to change the patients

diapers and attend other needs that they might have. At this moment, they also aid on laying down the patients that want so.

Having this task complete, the DHP start doing their daily chore. This chore changes from day to day (e.g. Monday they check and clean the oxygen therapy systems, Tuesday they clean the hygiene and laundry carts, …)

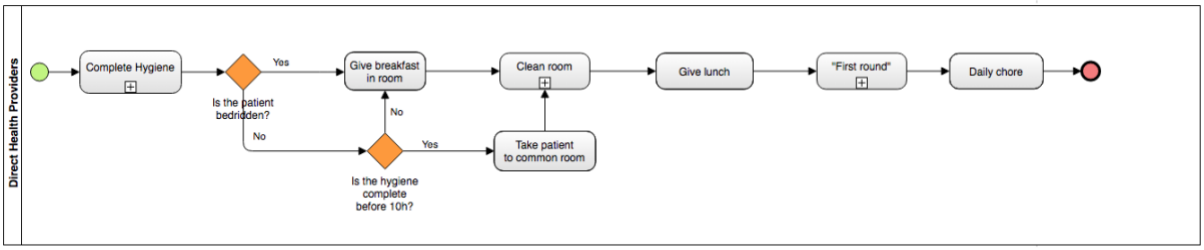


Figure 4.3– As-is process map of the "Global daily care" process

At the end of the shift, the DHP proceed to do the activities regarding the shift closing (leaving everything prepared for the next shift).

In the following sections (4.2.1.2 to 4.2.1.5) the subprocesses involved in the global daily care process will be analyzed in greater detail, in order to understand which have associated waste, therefore having room for improvement.

4.2.1.2 Subprocess – Complete Hygiene

This subprocess starts after each DHP has its "M list". Either if it is assigned an "M" from the "heavy list" or not, the process is done the same way. Figure 5 displays the "As-is" process map of this activity.

The DHP start with collecting safety equipment – gloves and apron – sponges and trash bags from the cart that is located in the middle of each wing. They then confirm if the patient they are going to bathe takes its bath in the shower or in bed – this information is in the "M" list. The necessary equipment differs between the two types of baths – for WC baths, a shower chair is required, as for baths in bed, they need a bowl. They then proceed to collect towels and for the bed baths, bedlinen (since in this case the DHP has to make the beds right after giving the bath). If there are not clean sheets available in the cart, the DHP should go to the storage closet, collect them to refill the cart and proceed with their task. If they are not in the storage closet, they should place a request.

In case it is a WC bath, the DHP gets the shower chair from the sterilization room and takes it to the room. They then transfer the patient to the chair and take him/her to the bathroom. Some patients are more independent, only requiring supervision during the bath, others need DHPs' help in that process. Following that, the DHP assists in the task of getting dressed and confirm if that patient should be set in an armchair, in a wheelchair or if they require any equipment that aids their walking, such as a

crutch or a walker. After each WC bath, the DHP will take the shower chair back to the sterilization room and clean it, so that it can promptly be used in the next patient.

In case it is a bed bath, the DHP gets the bowl from the sterilization room and takes it to the room. They then proceed to give the bath to the patient, dry and dress him/her. After that, the DHP make the patients bed. They then confirm if that patient is getting up that day, and if so in what circumstances (to an armchair, wheelchair, etc). When finishing this step, the DHP takes the bowl to the "dirty room", where the bowls line up waiting for the sterilization machine. Since this machine only takes one bowl at the time, it is the job of every DHP to continuously check if the machine is full or if they can insert a dirty bowl.

Completing the hygiene of the patient and dressing him/her, the DHP should take the patients (that aren't bedridden) to the common room.

Before starting another hygiene, the DHP take the trash (diapers, sponges, gloves and apron) to the trash bin in the cart and the dirty clothes and towels to the dirty clothes cart. In order to better understand the "Complete hygiene" subprocess and characterize it, table 4.2 shows which activities involved in the process are value adding, necessary non value adding (activities that do not have perceived value but are required to maintain the correct flow of the process) and non-value adding (activities that do not add any value and show be eliminated). If the bath is in bed, there are two non-value activities that might occur in the process – checking if there's clean sheets and in case not, request for more.

This characterization was validated with the Clinic Director and the DHPs' supervisor, during the semi-structured interviews.

Table 4.2– VAA, NNVAA and NVAA of the subprocess "Complete Hygiene"

Value Adding Activities	Necessary Non-Value Adding Activities	Non-Value Adding Activities
Give bath	Collect safety equipment, sponges and trash bags	Check if there's clean sheets
Help dressing	Get towels	Request clean sheets
Get shower chair/bowl	Take dirty clothes to laundry cart	
Disinfect shower chair/bowl	Take trash	

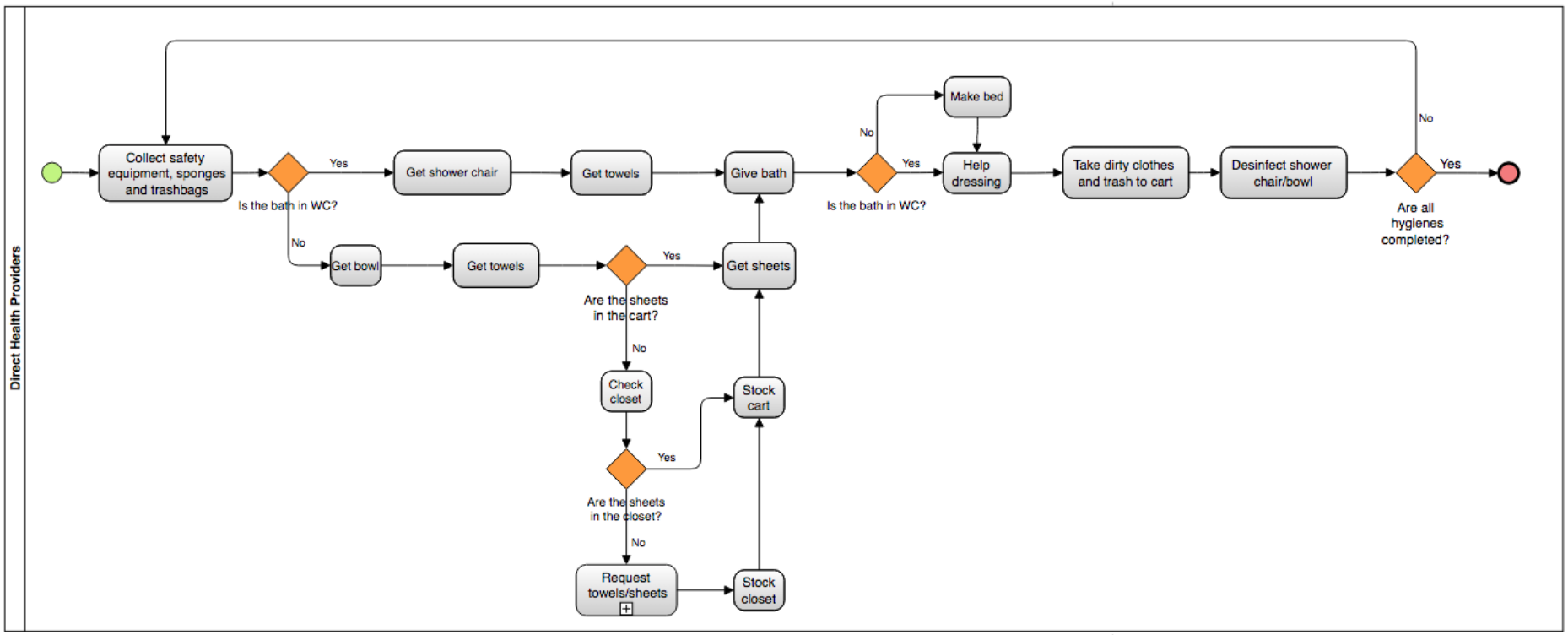


Figure 4.4 - As-is process map of the subprocess "Complete hygiene"

4.2.1.3 Subprocess - Clean rooms

This subprocess starts after every patient is prepared for the day. Figure 6 exhibits the "As-is" process map of Cleaning rooms.

In case the bath given was a bed bath, the beds are already made and the DHP only have to organize the patient's personal belongings and check if there is any trash.

If the bath was a WC bath, the DHP start by changing the sheets and only after they organize the patient's belongings. After this, the DHP checks if there is any trash and if so, takes the trash to the cart and the used sheets to the dirty clothes cart. This cart is sent back to the laundry department by 12h (morning shift). Table 4.3 displays the activities associated with this process that add value to it, as well as the ones that do not (either necessary or unnecessary).

Table 4.3 - VAA, NNVAA and NVAA of the subprocess "Clean rooms"

Value Adding Activities	Necessary Non-Value Adding Activities	Non-Value Adding Activities
Make beds	Get sheets from cart	Check if there's clean sheets
Organize patients' personal belongings	Take dirty clothes to laundry cart	Request clean sheets

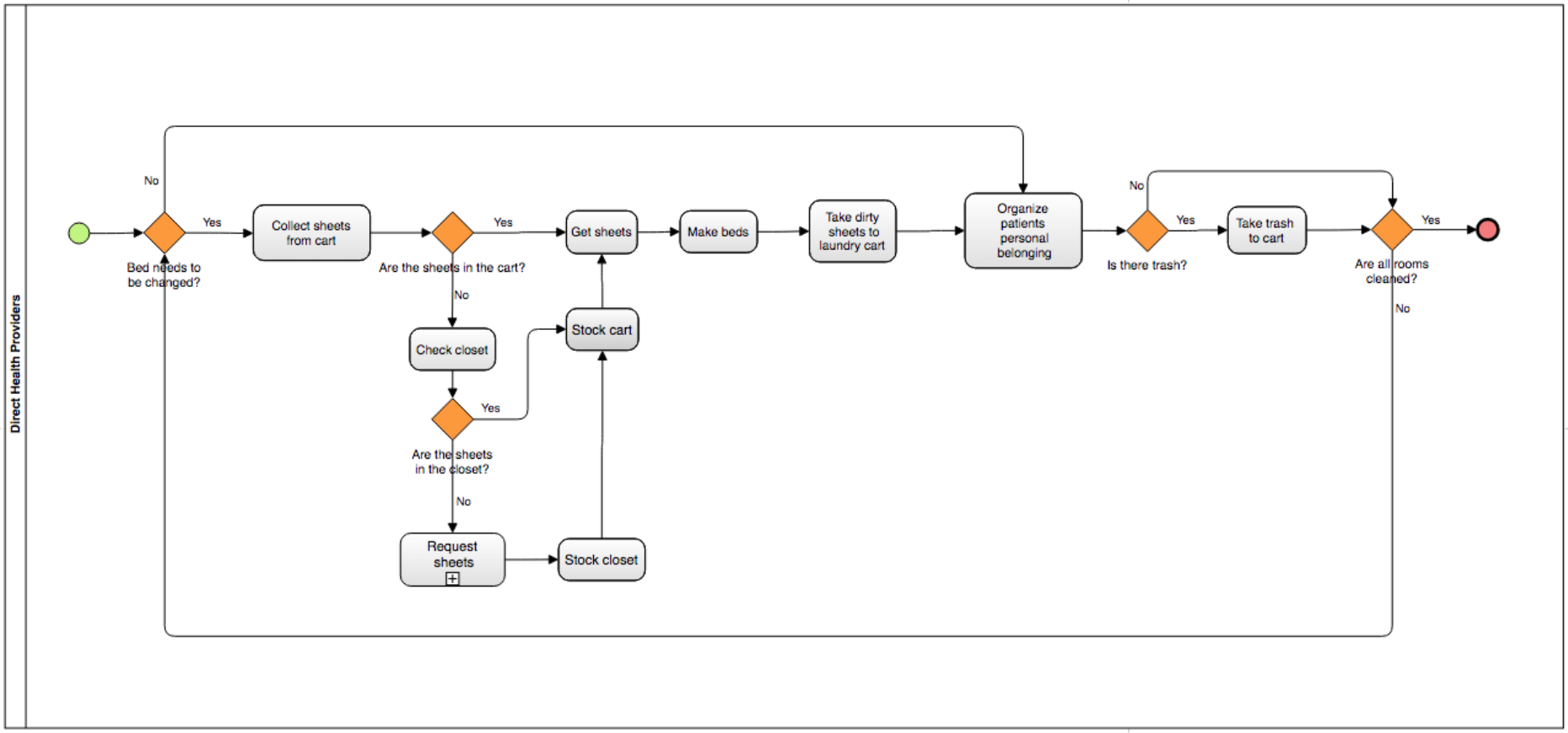


Figure 4.5 - As-is process map of the subprocess "Clean rooms"

4.2.1.4 First Round

The "rounds" are done six times during a 24-hour period. These all have the same purpose, which is checking on the patients, but have slight differences between them. The main objective is understanding if the patients need anything, changing their diapers and reposition them.

In the "first round" (14h), there are two teams – the common room team (composed by 2 common room DHP and 5 floor DHP) and the floor team (composed by 4 floor DHP).

The floor team is in charge of checking the patients that are laying down/bedridden. They should check if the patients need anything, or if they require a diaper change, as well as if the sheets needs to be changed. In case the patient does not need to change the diaper, they should reposition him/her.

The common room team will be checking the patients that are in the dining hall or in the common area. It is also their job to aid the patients that want to lay down after lunch.

Figure 4.4 shows the "As-is" process map of this subprocess, as table 4.5 reveals the VAA, NNVAA and NVAA of this subprocess.

Table 4.4 – VAA, NNVAA and NVAA of the subprocess "First round"

Value Adding Activities	Necessary Non-Value Adding Activities	Non-Value Adding Activities
Check patient	Get diaper and trash bag	Check if there's clean sheets
Reposition patient	Take dirty clothes to laundry cart	Request clean sheets
Change patients diaper	Take trash	
Make bed		
Help patient lay down		

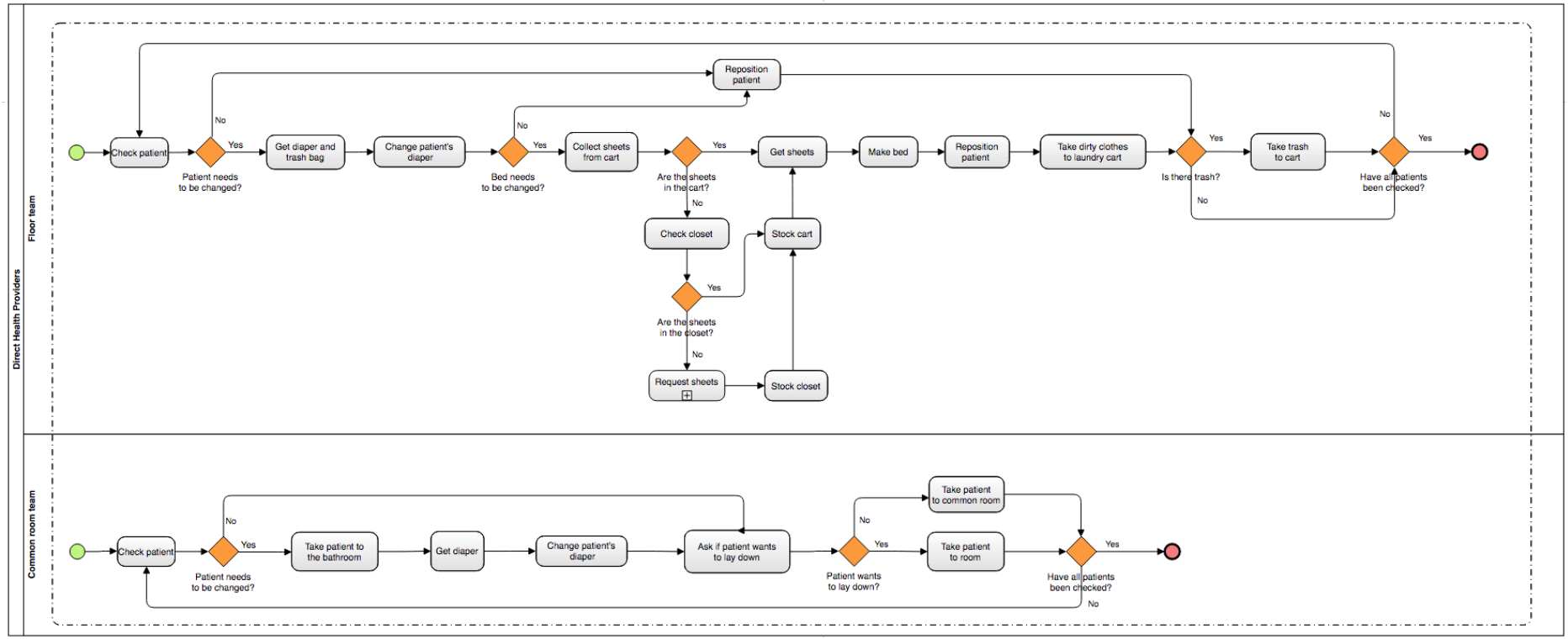


Figure 4.6 - As-is process map of the subprocess "First round"

4.2.1.5 Request Sheets

This activity occurs every time there is a shortage of clean sheets. This might occur during three different subprocesses of the morning shift Daily Care process - Complete Hygiene (baths in bed), Clean Rooms and First Round.

When the DHPs are making the beds and realize that there is no clean bedlinen neither in the cart nor in the closet, they inform the floor supervisor. The floor supervisor contacts the laundry department asking for a new cart of clean sheets. The laundry department sets the cart in the elevator and the DHPs collect it. The figure below (figure 4.7) displays the "As-is" process map of this subprocess.

The activities involved in this subprocess are all considered non-value adding, since they generate time related waste for the global daily care process.

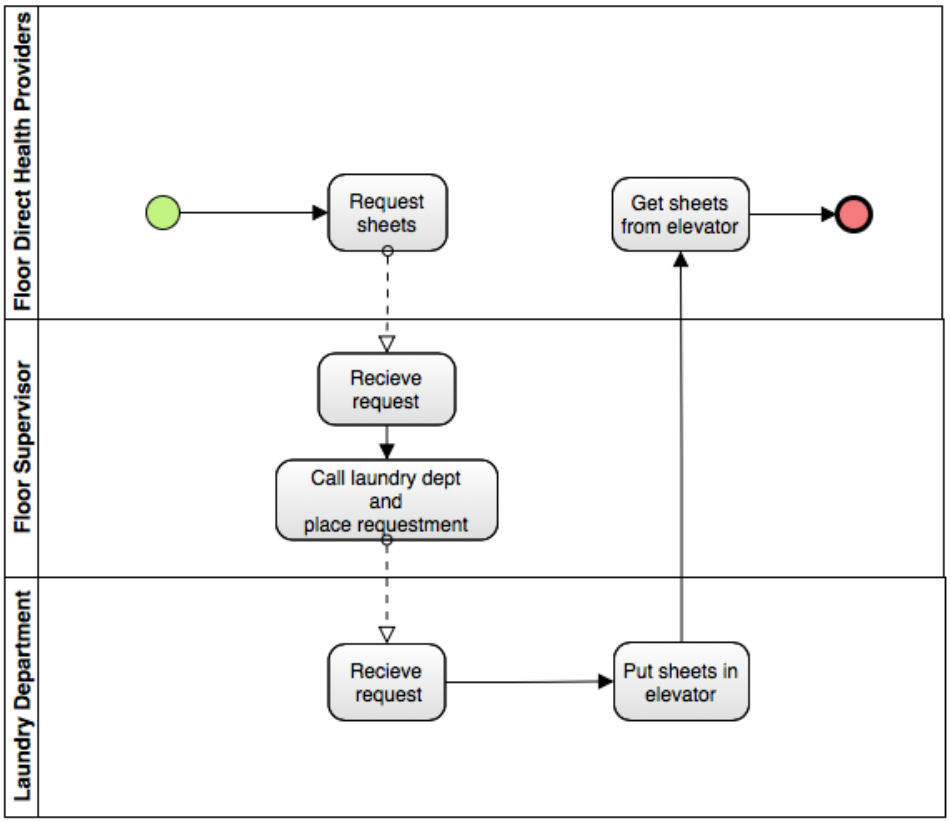


Figure 4.7– As-is process map of "Request Sheets"

4.2.2 Identify improvement opportunities

After describing the processes and subprocesses of the DHPs in detail, and crossing this information with the semi-structured interviews and direct observation executed throughout the project, it is possible to understand which activities are generating waste, as well as the possibilities of improvement in each step.

In the subchapter above, the value adding, the necessary non-value adding and the non-value adding activities were identified, and considering that information, the conclusion that there are activities that have room for improvements can be reached.

As stated above, the process that shows a higher potential for improvement is the global daily care process of the morning shift, being the one with larger workload, resulting therefore in higher delays that need to be reduced.

Table 4.5 displays the opportunities of improvement found in this process, that will be further explained below.

Table 4.5 – Improvement opportunities

Subprocess	Improvement opportunity	Waste associated
Requesting sheets/towels (might occur during Complete Hygiene – bed baths; Clean rooms and First round subprocesses)	I	Waiting Incorrect inventory Unnecessary motion Unclear communication
Complete hygiene Clean rooms First round	II	Unnecessary motion Delays
Complete hygiene	III	Unnecessary motion Delays
Complete hygiene Clean rooms	IV	Unnecessary motion Delays

4.2.2.1 Improvement opportunity I

The first improvement opportunity concerns the subprocess of "Requesting sheets/ Request towels". This subprocess was characterized as a non-value adding activity, requiring to be completely eliminated. This subprocess might occur when the DHP are giving bed baths, when they clean the rooms or during the first round. Based on the semi-structured interview with the supervisor of the DHP and in the direct observation of the daily care process, this issue occurs specially during the "Clean rooms" process.

At the beginning of the morning shift, the laundry department sends a cart with a fixed number of sheets for that day, without knowing if they are enough. These sheets are used during the subprocesses of bed bath (since the bed is made right after the bath), cleaning the rooms and during the rounds (if there is a need to change the sheets). If for some reason the DHPs need to change the patients sheets more than once, there is going to be a shortage of clean sheets.

If this happens, the DHPs need to stop what they are doing to check if there are more sheets in the closet, which will lead to unnecessary motion (and consequently to wasted time), and if the closet is empty, the DHP will have to request the sheets and wait for the laundry department to send more. This then strikes as a problem of unclear communication, since the number of sheets necessary and the number sent can sometimes be different.

The wastes associated with this subprocess are related to:

- Waiting – This type of waste can be identified when the DHPs spot a shortage of clean sheets and need to request more from the laundry department. By doing so, they need to find the supervisor and ask him/her to contact the laundry, which will then send the sheets up to the floor where they're needed. Even though this process might not take that much time, it will be wasted time (since they can't carry out their task without the sheets, which will lead to a delay).
- Incorrect inventory – Although there is no specific number of sheets necessary, nor number of sheets sent currently, there are several complaints that this number differs. By not knowing how many sheets are necessary daily, the chances of needing a higher number than what is being received increases.
- Unnecessary motion - Since the sheets are stored in the closet and only t a few are in the cart leads to unnecessary motion of the DHPs to search for them. This waste also occurs when the staff needs to get the clean sheets cart from the elevator.
- Unclear communication – The fact that there is a miscommunication between the laundry department and the DHPs is one of the reasons why this subprocess occurs in the first place. If the information on how many sheets will be needed for each shift was passed to the laundry department, the number of sheets to send in the beginning of the workday would be clear, eliminating this whole subprocess.

4.2.2.2 Improvement opportunity II

The second improvement opportunity regards every process that deals with dirty towels or sheets – "Complete hygiene", "Clean rooms" and "First round". This will also aid in the other "Rounds", that are performed by the afternoon shift and night shift. Whenever the DHPs need to change the sheets or give a bath, they then need to walk to the laundry cart in order to place the used sheets/towels. Currently, UCCI Almada has 5 laundry carts set throughout the unit – 2 in floor 0 and 3 in floor 1. These carts are enough, although some rooms are more than 40 meters away from the carts. This means that every time the DHPs clean those rooms or give a bath, they need to walk all the way back to the laundry cart just to place the dirty clothes. By doing so, it will lead to unnecessary walking, as well as wasted time.

The wastes associated to these subprocesses are:

- Unnecessary motion – The fact that the DHPs have to walk to the laundry cart after every bed is made or every bath is given will incur in additional walking.

- Delays – By walking more than necessary, the DHPs will take more time doing their tasks, which might result in delays.

4.2.2.3 Improvement opportunity III

The third improvement opportunity is related with the "Complete hygiene" process. As described in the chapter above (table 4.2), this process has several necessary non-value adding steps. The steps involved in gathering the equipment necessary for the hygiene (sponges, towels, …), although needed in order to achieve the healthy flow of the process, are not considered value adding ones. Therefore, these steps should be simplified at its most.

Before each bath, the DHP gather the equipment from the cart, give the bath, and repeat this path before each hygiene. This means that they perform this process individually – patient by patient –, separating each bath from the next one. By doing so, they will incur in unnecessary movement and wasted time.

The wastes associated with this subprocess are related to:

- Unnecessary motion – This will occur when the staff walks back and forth from the cart to the room to collect every equipment needed to give a bath.
- Delays – The fact that they collect the equipment necessary for the baths individually leads to more time spent doing this task.

4.2.2.4 Improvement opportunity IV

The fourth improvement opportunity concerns the "Complete hygiene" and "Clean rooms" subprocesses.

DHPs only start the process of cleaning the rooms after each hygiene is completed. This means that they have already been in each room giving a bath (starting in one end and finishing on the other). With the current way they perform this task, every DPH must walk back to the room where he/she started the shift and return to each room again. This will lead to walking twice as much as they should, which will reveal in additional time spent.

The wastes associated with this subprocess are:

- Unnecessary motion – Related to the fact that the DHPs will have to go back to each room where they have already been in order to clean them, doubling the distance they should be walking.
- Delays – There is a delay related to the time lost going back to each room, that might affect the rest of the activities involved in the morning shift daily care process, as well as the flow of the following shift.

4.2.3 Improvement proposals

In this subchapter, the proposals of improvement will be addressed in greater detail.

These proposals are related to the improvement opportunities found in the subchapter above (4.2.2.). Their objective is to aid in diminishing or even eliminating associated waste and help restoring the flow of the processes.

4.2.3.1 Proposal I

This proposal addresses the improvement opportunity of removing the issues associated with the subprocess "Request sheets". In order to do so, it is necessary to improve the communication between the laundry department and the DHPs team.

An easy way of eliminating this error is to understand how many times the sheets are changed in a day (during the three shifts), by registering this number and crossing the information with the number of sheets the laundry department sends each day. If the demand for clean sheets is higher, the DHPs should communicate it to their supervisor, whom will ask the laundry to send more sheets daily.

To prevent the shortage of bedlinen, the number of times the bedsheets are changed should be calculated. To record this number, a table (see figure 4.8 below) containing the room and bed number on the columns and the shifts in the rows is affixed in each room. The table presented in figure 4.8 concerns a double room.

QUARTO:_____

Data	Turno	Cama 1	Cama 2
Segunda-feira	Manhã		
	Tarde		
	Noite		
Terça-feira	Manhã		
	Tarde		
	Noite		
Quarta-feira	Manhã		
	Tarde		
	Noite		
Quinta-feira	Manhã		
	Tarde		
	Noite		
Sexta-feira	Manhã		
	Tarde		
	Noite		
Sabado	Manhã		
	Tarde		
	Noite		
Domingo	Manhã		
	Tarde		
	Noite		

Data	Turno	Cama 1	Cama 2
Segunda-feira	Manhã		
	Tarde		
	Noite		
Terça-feira	Manhã		
	Tarde		
	Noite		
Quarta-feira	Manhã		
	Tarde		
	Noite		
Quinta-feira	Manhã		
	Tarde		
	Noite		
Sexta-feira	Manhã		
	Tarde		
	Noite		
Sabado	Manhã		
	Tarde		
	Noite		
Domingo	Manhã		
	Tarde		
	Noite		

Data	Turno	Cama 1	Cama 2
Segunda-feira	Manhã		
	Tarde		
	Noite		
Terça-feira	Manhã		
	Tarde		
	Noite		
Quarta-feira	Manhã		
	Tarde		
	Noite		
Quinta-feira	Manhã		
	Tarde		
	Noite		
Sexta-feira	Manhã		
	Tarde		
	Noite		
Sabado	Manhã		
	Tarde		
	Noite		
Domingo	Manhã		
	Tarde		
	Noite		

Figure 4.8 – Record of each time the sheets are changed

Every time a DPH made a bed, they should fill in the correct space. At the end of the day, it could be calculated the number of sheets that are necessary. This measurement should be done for three to four weeks to have a more accurate appraisal.

Upon knowing the number of sheets necessary for each day, the DHPs' supervisor should email the laundry department to understand if the number necessary and the number of sheets they are sending is the same. If not, the number should be adjusted.

By reducing the possibility of stock out, the DHPs will have their processes simplified. This improvement proposition is expected to eliminate the activity of "Requesting sheets". With it, the time they would have to wait for the laundry department to send new sheets, the unnecessary walking they would do from the closet to finding the supervisor, as well as the walk to the elevator and back to the room would also be eliminated.

The following figures (figure 4.9, 4.10 and 4.11) display the "To-be" maps of the subprocesses that this proposal impact.

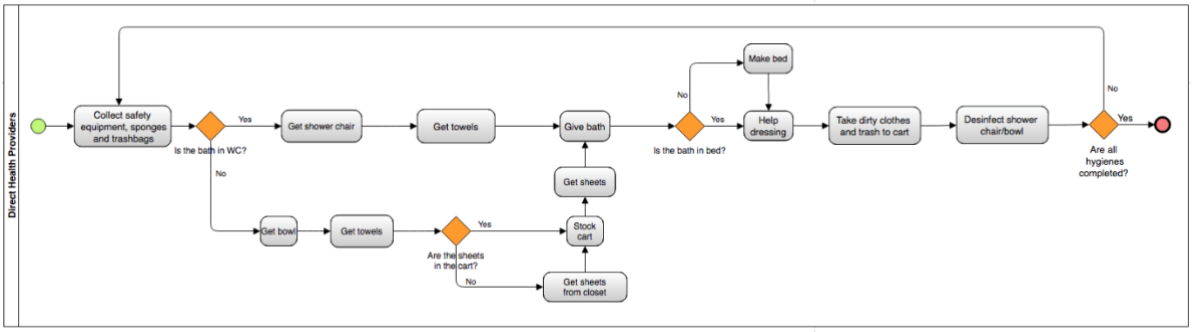


Figure 4.9 – To-be process map of the subprocess "Complete Hygiene" upon implementing Proposal I

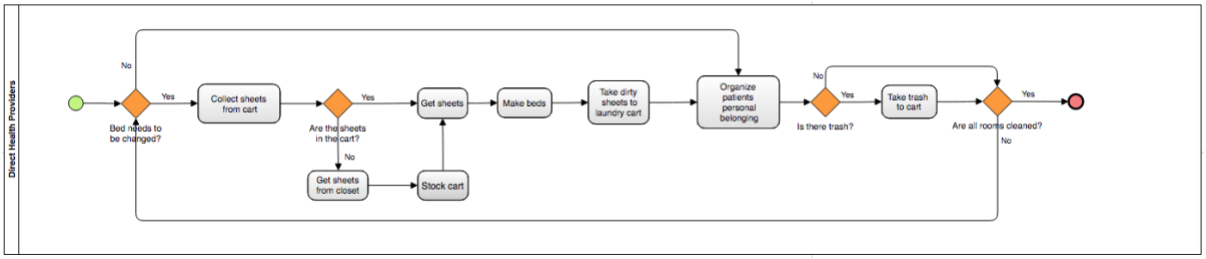


Figure 4.10 – To-be process map of the subprocess "Clean Rooms" upon implementing Proposal I

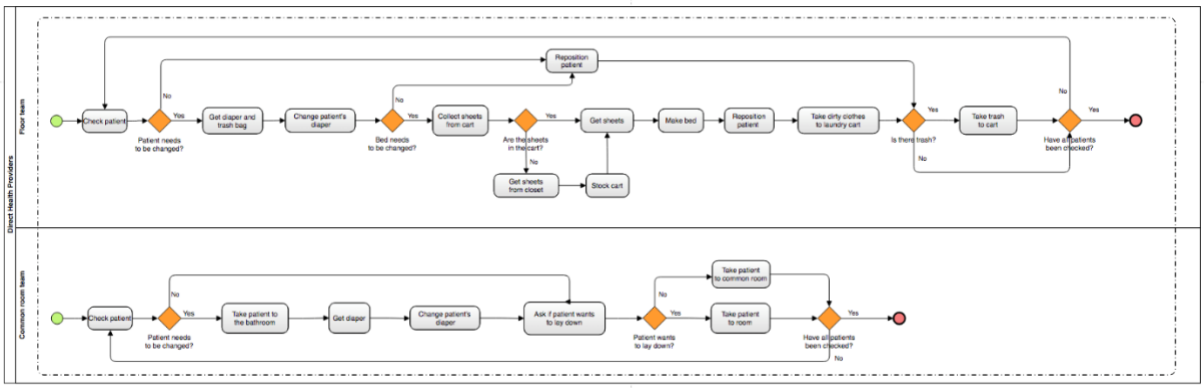


Figure 4.11 – To-be process map of the subprocess "First Round" upon implementing Proposal I

By applying this proposal, it is expected to:

- Increase the time the DHPs have available to do their activities, by eliminating the time they spend looking for clean sheets, as well as waiting for the laundry department to send more.
- Eliminate the chance of stockouts.
- Improve the communication between the DHPs and the laundry department.

4.2.3.2 Proposal II

This proposal aims to facilitate the subprocesses of "Complete hygiene", "Clean rooms" and "First round" by eliminating the current need of walking to the laundry cart every time the DHPs change a bed or give a bath. In order simplify these subprocesses, it is proposed to improve the hygiene carts, placing an extra container that would be used to set the dirty clothes. By creating this space, the DHPs would only need to go to the laundry cart whenever they pass by it (or when finishing their processes).

The hygiene carts of UCCI Almada are similar to the one below (figure 4.12). They have two garbage containers (yellow bags), currently divided in common waste and infectious waste. In each one of the yellow containers a trash bag is set – black for common waste and white for infectious.

If the two trash bags were placed on one side, it would create a new space where the dirty sheets/towels could be placed momentarily, until the DHPs pass by the laundry cart.

Figure 4.12 –Hygiene cart

Figures 4.13, 4.14 and 4.15 display the "To-be" maps of the subprocesses that this proposal impact.

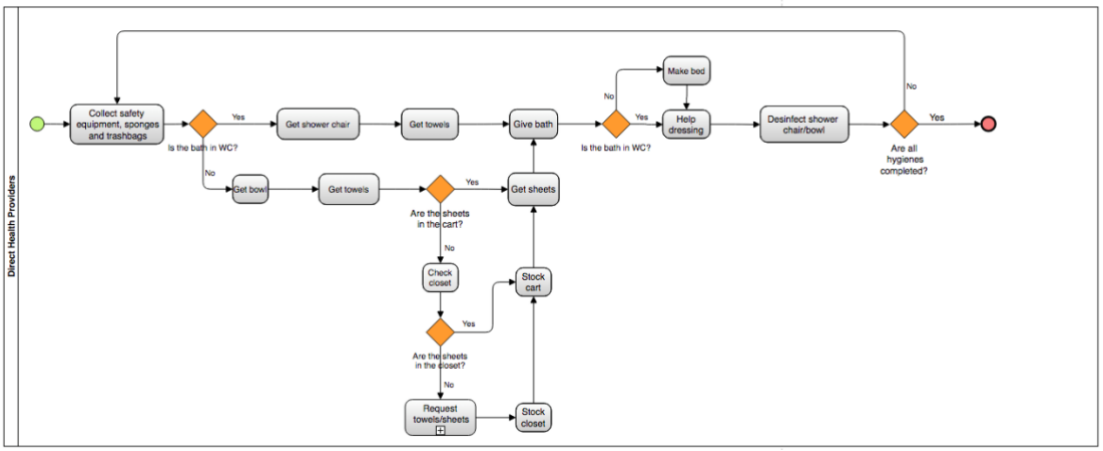


Figure 4.13– To-be process map of the subprocess "Complete Hygiene" upon implementing Proposal II

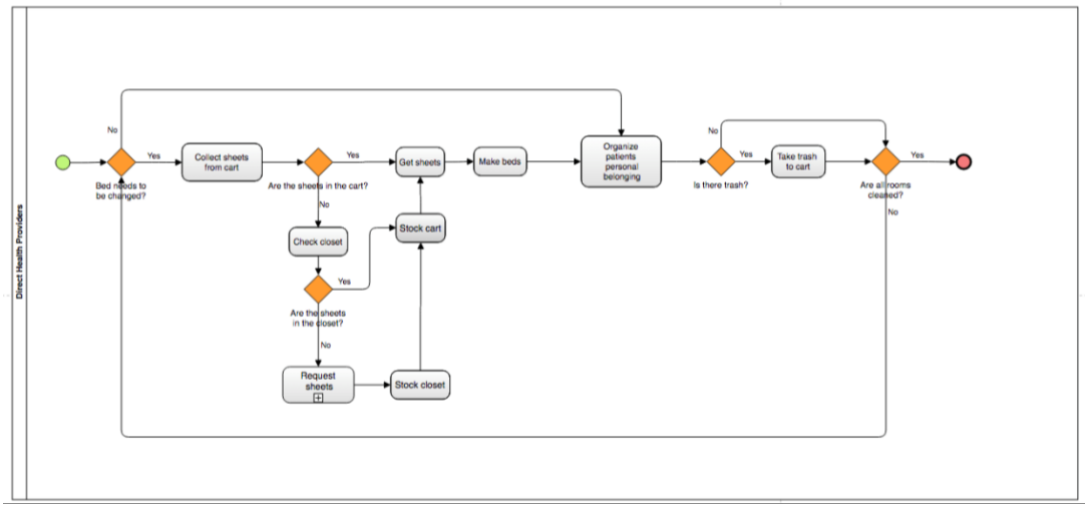


Figure 4.14 - To-be process map of the subprocess "Clean rooms" upon implementing Proposal II

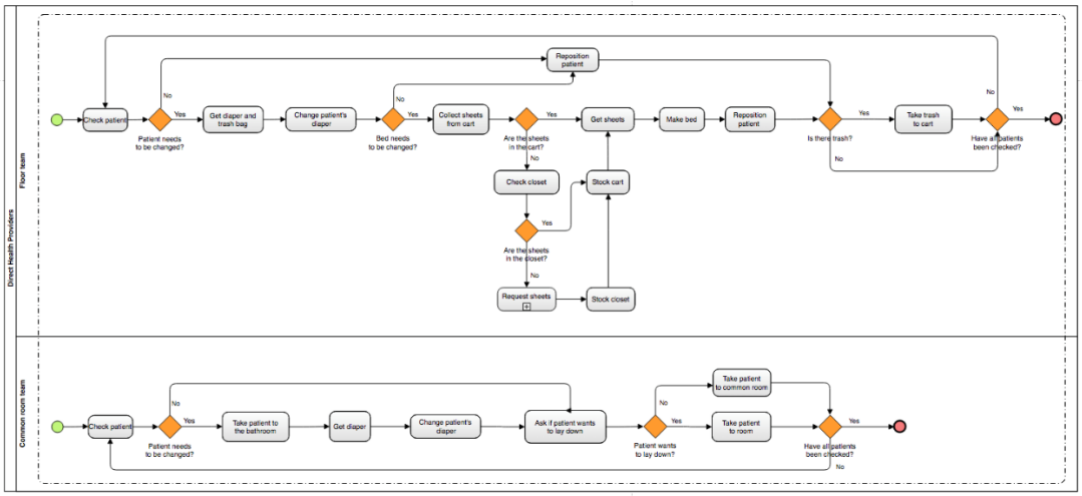


Figure 4.15- To-be process map of the subprocess "First round" upon implementing Proposal II

By implementing this proposal, it is expected to:

- Shorten the distance walked by the DHPs
- Reduce the time needed to perform these processes

4.2.3.3 Proposal III

With the purpose of improving the process of "Complete hygiene", the activities that were mentioned as necessary nonvalue adding activities should be simplified. To do so, three proposals were created that serve the same purpose – minimize or even eliminate the activities that are generating unnecessary motion and wasted time.

Presently, the DHPs walk from the carts to the room after completing the hygiene of each patient. Proposal III_1 suggests that they collect the necessary equipment once a room (instead of patient by patient), hence condensing the distance walked. Proposal III_2 proposes that each "M" team has its own hygiene cart, and walk with the cart from room to room. Proposal III_3 recommends changing the carts for the improved ones from Proposal II, meaning they would have room to place the dirty clothes.

Proposal III_1 - Gathering the equipment by room

By collecting the equipment used in the hygiene by room the DHPs will be able to eliminate one trip each way.

This proposal is expected to:

- Reduce the distance walked by the DHPs from the cart to the room
- Decrease the time needed to complete this process

Proposal III_2 – Walking with the carts

If each "M" has a cart assigned to them, they can push the cart from room to room. By doing so, they will not have to walk back to the cart every time they need something. This proposal requires an additional hygiene cart, since currently, UCCI Almada has 6 carts and 7 "M" teams.

This proposal is expected to:

- Eliminate the distance walked from the room to the cart
- Reduce the time necessary to complete this process

Proposal III3 – Walking with the "improved" carts

By combining both proposals II and III_3, the DHPs will have their paths simplified to the point where they only need to move from room to room, eliminating the redundant motion.

By applying this proposal, it is expected to:

- Eliminate the distance walked from the room to the cart, as well as the distance from each room to the laundry cart
- Decrease the time needed to perform this process

4.2.3.4 Proposal IV

With the objective of reducing the wastes associated with the process of "Daily Care", this proposal suggests that this process should be done right after each bath is given.

Currently, the DHPs perform each hygiene before cleaning the rooms, which means they walk back to every room where they have already been. This results in unnecessary motion and time wasted. To counter this, Proposal IV suggests that these paths are eliminated. The DHPs should go to each room, complete the patients' hygiene and make the bed immediately after.

This proposal is also divided in Proposal IV_1 and Proposal IV_2, the difference being that in Proposal IV_1 the DHPs still walk to and from each cart, while on Proposal IV_2, the DHPs walk with the "improved" hygiene cart while performing the process (combining Proposal IV with Proposal III_3).

Figure 4.16 displays the "To-be" process map of the daily care process, after this proposal is implemented.

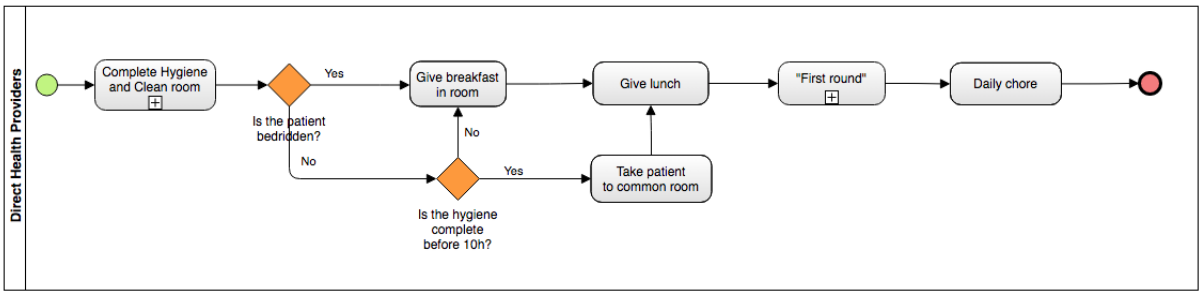


Figure 4.16 – To-be process map of the process "Daily care" upon implementing Proposal IV

By applying these proposals, it is expected to:

- Reduce greatly the distance walked by the DHPs.
- Increase the time the DHPs have available to do their activities, by eliminating the time they would spend going back to each room.

Table 4.6 summarizes the information regarding the waste each proposal intends to reduce or even eliminate.

Table 4.6 – Expected outcome of implementing the improvement proposals

Proposal	Process/Subprocess Associated	Expected outcome
I	Request sheets (might occur during Complete Hygiene – bed baths; Clean rooms and First round subprocesses)	Reduce the waiting time Eliminating the chances of a stock out Improve the communication with the laundry dept
II	Complete hygiene Clean rooms First round	Decrease the distance walked from and to the laundry cart Reduce the time needed to complete these processes
III	Complete hygiene	Reduce/eliminate the distance walked from and to the hygiene carts Decrease the time needed to perform this process
IIII	Complete hygiene Clean rooms	Shorten the distance walked by the DHPs during these processes Increase the time available for other activities

4.2.4 Assessment of the proposals

In this subchapter, the implementation plan of the proposals described above (4.2.3.) is detailed and assessed.

Being UCCI Almada an health institution, the proposals could not be implemented due to the COVID-19 pandemic. They are, however, deemed to have great potential and might one day be implemented by the unit. To understand their potential, the proposals are assessed using the KPIs shown in table 4.7.

Table 4.7 – KPIS used to assess the Improvement Proposals

Proposal	Process/Subprocess Associated	KPIs
I	Request sheets	Process break (KPI I_1) Time (KPI I_2)
II	Complete hygiene Clean rooms First round	Time (KPI II_1) Distance (KPI II_2)
III	Complete hygiene	Time (KPI III_1) Distance ((KPI III_2)
IV	Complete hygiene Clean rooms	Time (KPI IV_1) Distance (KPI IV_2)

4.2.4.1 Proposal I

Based on the semi-structured interviews with the DHPs and their supervisor, this shortage occurs at least two times per week. This means that twice a week the process is interrupted due to a miscalculation of the number of clean sheets necessary.

The time (KPI I_2) between realizing that there are no clean sheets and receiving them is around 10 minutes - when the sheets are already cleaned and just need to be sent. In the occasions the sheets are still being washed, the DHPs will have to wait longer. This means that every time there is a shortage, the process is stopped for at least 10 minutes.

Considering the average time spent by a DHP making one bed is 5 minutes, and the total number of beds (displayed in table 4.8) it is possible to calculate the impact of one daily break.

Table 4.8– Consequences of one 10-minute break in the process

	Number of beds assigned to each "M"	Total time required to make the beds	Efficiency lost with a 10-minute break
M1	11	55	18,18%
M2	14	70	14,29%
M3+4	11	55	18,18%
M5	9	45	22,22%
M6	16	80	12,5%
M7	11	55	18,18%
M8+9	14	70	14,29%
Average loss of efficacy			16,83%

Considering the data presented in table 4.8, it is possible to infer that a 10-minute break in the process would lead to an average loss of efficiency of 16,83% (KPI I_1). This percentage is calculated for one 10-minute break in the process, although this might happen more than once in the same day and/or take longer than 10 minutes.

This proposal is expected to eliminate this potential interruption altogether, preventing this loss of efficacy from happening.

4.2.4.2 Proposal II

In order to assess this proposal from a quantitative standpoint, the floor plans of UCCI Almada (check annex C) were used to calculate the distances walked by the DHPs in this process.

To understand what benefits might arise from this proposal, the current scenario was computed and will be compared to the improved scenario.

For the "Complete hygiene" subprocess, every room where the DHPs are going to give baths is considered, since the DHPs need to go to the laundry cart after each bath to set towels and in case it is a bed bath, sheets. In this assessment, only the rooms where the patients' hygiene is done during the night shift were ignored.

In the "Clean rooms" subprocess, every room is considered, since they must clean all rooms. Nevertheless, in some rooms the DHPs do not have to change the sheets (because they were already changed during the bed baths). In the rooms where the sheets do not need to be changed, the distance walked to the laundry cart is not calculated.

In the "First Round" subprocess, only the rooms accommodating bedridden patients were considered, since the other patients are not in their rooms. For the purpose of this assessment, it was

considered that every bedridden patient needs their sheets to be changed, since this is the most common scenario (consideration based on the semi-structured interviews with the DHPs and direct observation).

The KPIs used to assess this proposal are distance and time. First, the paths currently used by the DHPs in order to collect the necessary items to perform the processes, alongside to the paths walked to set the dirty clothes in the laundry cart, were calculated. Second, the paths taken if this proposal is implemented were calculated. A spaghetti diagram of the current scenario and of the improved one was drawn for a better understanding of these movements. To understand the time-related benefits, an average walking speed of 1.2m/s was assumed, making it possible to estimate the time the DHPs would save by implementing this proposal.

The results collected are displayed hereafter for one "M" list – M2 (for "Complete hygiene" and "Clean rooms" subprocess). In annex D, the calculation for another single M list, but from a different floor – M6 – and for the heavy lists – M3+4 and M8+9 - can be found. For the "First round" subprocess, the results are displayed by floors, since for this subprocess the DHPs are no longer divided by "M" lists (as mentioned in section 4.2.1.5).

Complete Hygiene subprocess

Table 4.9 shows the paths walked by the DHPs when performing the "Complete Hygiene" process, before and after the implementation of Proposal II. The paths to collect a bowl/shower chair and to disinfect them were not included since they are crucial to the process and are not going to be affected by this proposal.

Table 4.9 – Paths walked by the DHPs of M2 during the "Complete Hygiene" process.

Legend:C2 and C3 – hygiene carts; RS2 – laundry cart; numbers 001-004 and U1-U2 – rooms.

Current Scenario		**Proposal II**	
Path	**Meters**	**Path**	**Meters**
C2-004	1	C2-004	1
004-RS2	4,5	004-C2	1
RS2-C2	5,5	C2-003	5,5
C2-003	5,5	003-C2	5,5
003-RS2	11	C2-003	5,5
RS2-C2	5,5	003-C2	5,5
C2-003	5,5	C2-002	12
003-RS2	11	002-C2	12
RS2-C2	5,5	C2-002	12
C2-002	12	002-C2	12
002-RS2	17,5	C2-001	11

RS2-C2	5,5	001-C3	47
C2-002	11	C3-U1	7
002-RS2	16,5	U1-C3	7
RS2-C2	5,5	C3-U1	7
C2-001	11	U1-C3	7
001-RS2	16,5	C3-U1	7
RS2-C2	5,5	U1-C3	7
C2-U1	43,5	C3-U2	1
U1-RS2	51,5	U2-C3	1
RS2-C3	46,5	C3-C2	38,5
C3-U1	7	C2-RS2	5,5
U1-RS2	51,5		
RS2-C3	46,5		
C3-U1	7		
U1-RS2	51,5		
RS2-C3	46,5		
C3-U2	1		
U2-C3	1		
C3-RS2	46,5		
TOTAL(meters)	558		218
TIME (seconds)	465		182

From the data gathered in the above table, upon applying this proposal the DHPs of M2 would walk 340 meters less (KPI II_2), only by setting the dirty sheets/towels in the hygiene carts.

In order to calculate KPI II_1 (time), an average walking speed of 1.2 m/s (Truong et al., 2018) was assumed. This proposal would save M2 283 seconds per day. This accounts to a total of 28hours and 41 minutes saved a year.

The spaghetti diagrams displaying the paths in table 4.9 are presented in figure 4.17 (current scenario) and 4.18 (improved by proposal II). These diagrams intend to simplify the analysis of this proposal, by delivering a visual representation.

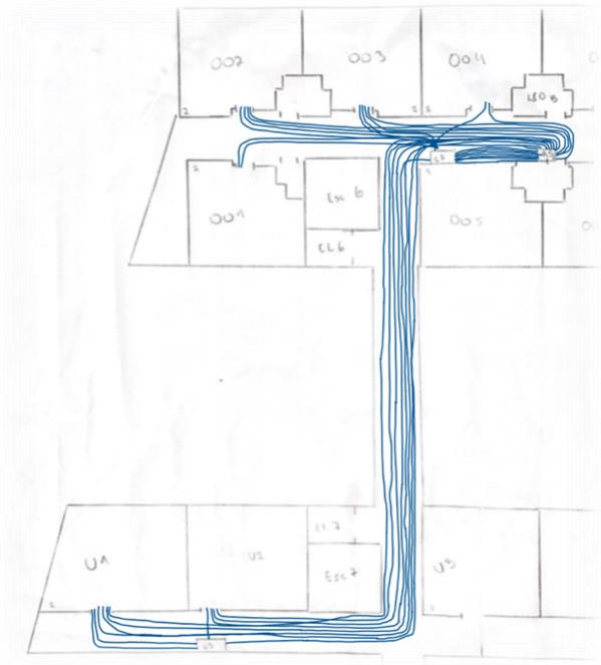


Figure 4.17 - Spaghetti diagram of the paths currently walked by M2 during the "Complete hygiene" subprocess

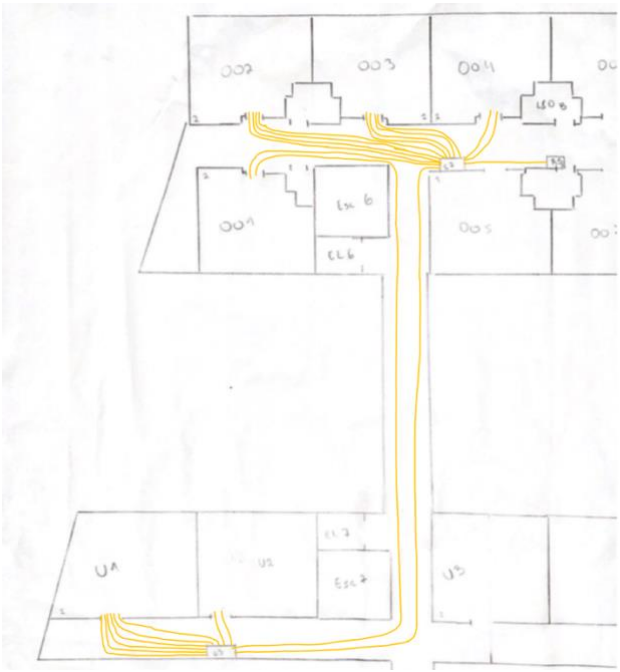


Figure 4.18 - Spaghetti diagram of the paths walked by M2 upon implementing Proposal II to the "Complete hygiene" subprocess

Clean Rooms subprocess

Table 4.10 gathers every path walked by the DHPs when performing the process of "Clean Rooms", before and after Proposal II is implemented.

Room U3 appears in this table and not in the "Complete hygiene" because the hygiene of this patient is done during the night shift, but the morning shift is in charge of cleaning the room.

Table 4.10 - Paths walked by the DHPs of M2 during the "Clean rooms" subprocess.

Legend: C2 and C3 – hygiene carts; RS2 – laundry cart; numbers 001-004 and U1-U3 – rooms

Current Scenario		**Proposal II**	
Path	**Meters**	**Path**	**Meters**
C2-004	1	C2-004	1
004-RS2	4,5	004-C2	1
RS2-C2	5,5	C2-003	5,5
C2-003	5,5	003-C2	5,5
003-RS2	11	C2-002	12
RS2-C2	5,5	002-C2	12
C2-002	12	C2-001	11
002-RS2	17,5	001-C3	47
RS2-C2	5,5	C3-U3	15,5
C2-001	11	U3-C3	15,5
001-RS2	16,5	C3-U2	1
RS2-C2	5,5	U2-C3	1
C2-U3	31	C3-U1	7
U3-RS2	39	U1-C3	7
RS2-C3	46,5	C3-C2	38,5
C3-U1	7	C2-RS2	5,5
U1-RS2	51,5		
RS2-C3	46,5		
C3-U2	1		
U2-C3	1		
C3-RS2	46,5		
TOTAL(meters)	371		186
TIME (seconds)	309		155

Based on the table above, it is estimated that by applying this proposal to the "Clean rooms" process, the DHPs of M2 would walk 135,5 meters less (KPI II_2).

To calculate the time (KPI II_1), the same assumption of average walking speed of 1.2m/s was made (Truong et al., 2018). This proposal would save M2 113 seconds per day, which sums up to 11 hours and 27 minutes per year.

The spaghetti diagrams displaying the paths in table 4.10 are presented below in figures 4.19 (current scenario) and 4.20 (improved scenario).

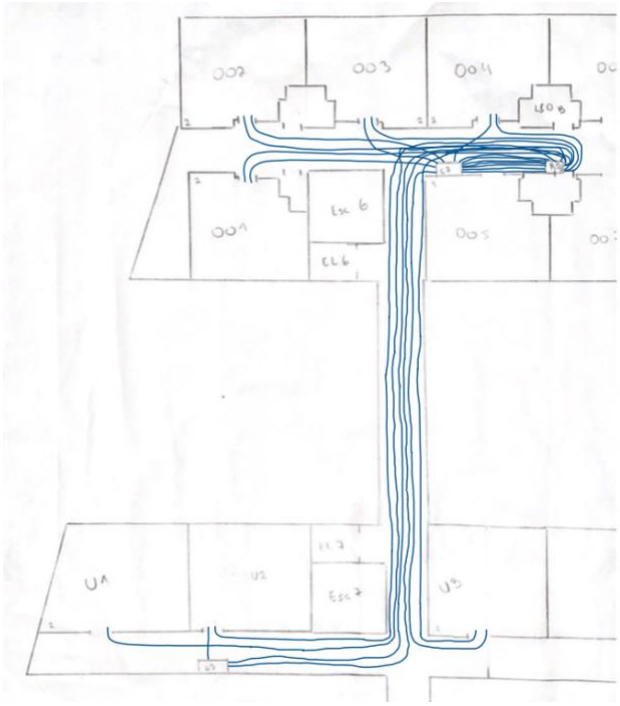


Figure 4.19– Spaghetti diagram of the paths currently walked by M2 during the "Clean Rooms" subprocess

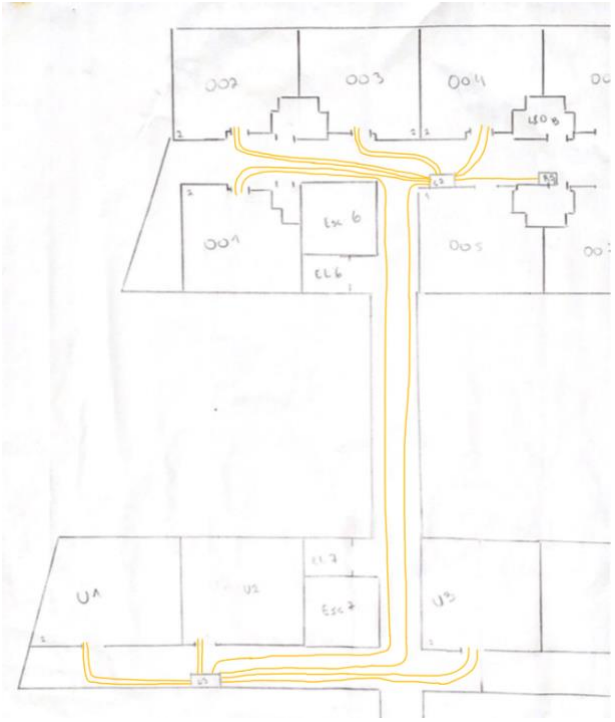


Figure 4.20 -– Spaghetti diagram of the paths walked by "M2" upon implementing Proposal II to the "Clean rooms" subprocess

First round subprocess

Table 4.11 gathers the paths walked by the floor team DHPs during the "First Round" process. It is divided by floors, since in this subprocess the DHPs' are not divided in lists anymore.

Table 4.11 - Paths walked by the floor team DHPs during the "First round" process.
Legend: C1-C5 – hygiene carts; RS1-RS5 – laundry carts; numbers 003-123 – rooms.

Floor 0				**Floor 1**			
Current Scenario		**Proposal II**		**Current Scenario**		**Proposal II**	
Path	**Meters**	**Path**	**Meters**	**Path**	**Meters**	**Path**	**Meters**
C1-011	3	C1-011	3	C4-121	9,5	C4-121	9,5
011-RS1	10,5	011-C1	3	121-RS3	10,5	121-C4	9,5
RS1-C1	7,5	C1-011	3	RS3-C4	3	C4-120	2
C1-011	3	011-C1	3	C4-120	2	120-C4	2
011-RS1	10,5	C1-010	3,5	120-RS3	4,5	C4-RS3	3
RS1-C1	7,5	010-C1	3,5	RS3-C4	3	RS3-C4	3
C1-010	3,5	C1-RS1	7,5	C4-114	23,5	C4-114	23,5
010-RS1	4	RS1-C1	7,5	114-RS4	2,5	114-C6	31

RS1-C1	7,5	C1-009	9,5	RS4-C5	5,5	C6-103	11
C1-009	9,5	009-RS1	2,5	C5-103	36,5	103-C6	11
009-RS1	2,5	RS1-C1	7,5	103-RS5	17,5	C6-107	2,5
RS1-C1	7,5			RS5-C6	6,5	107-C6	2,5
				C6-107	2,5	C6-123	20,5
				107-RS5	4,5	123-C6	20,5
				RS5-C6	6,5	C6-123	20,5
				C6-123	20,5	123-C6	20,5
				123-RS5	14	C6-RS5	6,5
				RS5-C6	6,5		
				C6-123	20,5		
				123-RS5	14		
				RS5-C6	6,5		
TOTAL (meters)	76,5		53,5		220		199
TIME (seconds)	64		45		183		166

Considering the results above, it is estimated that by applying this proposal to the "First round" subprocess, the DHPs of floor 0 would walk 23 meters less, while the ones on floor 1 would decrease the distance walked by 21 meters (KPI II_2).

When assessing the time related (KPI II_1) benefits (applying the average walking speed of 1.2m/s), this proposal is expected to save 19 seconds per day in floor 0, and 17 seconds in floor 1. These results sum up to a total of 1 hour and 55 minutes saved a year by floor 0, and 1 hour and 43 minutes by floor 1.

The spaghetti diagrams displaying the paths taken by the DHPs of floor 0 are presented in figure 4.21 (current scenario) and 4.22 (improved scenario). The paths walked by the DHPs of floor 1 are presented in figure 4.23 (current scenario) and 4.24 (improved scenario).

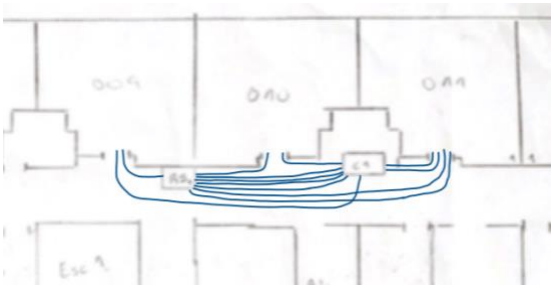


Figure 4.21 – Spaghetti diagram of the paths currently walked by the DHPs of floor 0 during the subprocess "First round"

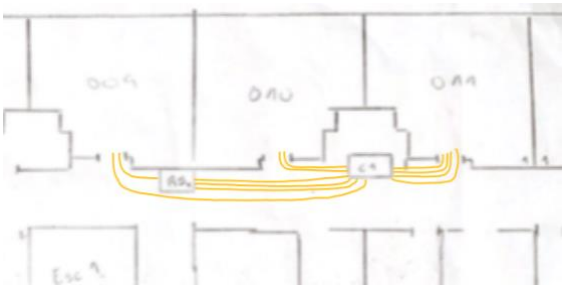


Figure 4.22 - Spaghetti diagram of the paths walked by the DHPs of floor 0 upon implementing Proposal II to the subprocess "First round"

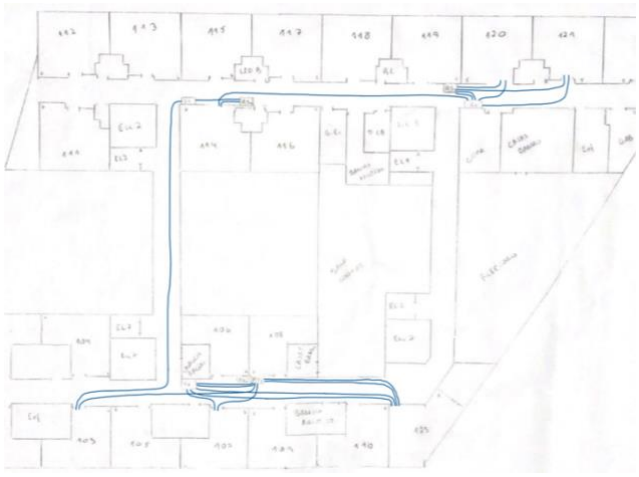


Figure 4.23 - Spaghetti diagram of the paths currently walked by the DHPs of floor 1 during the subprocess "First round"

Figure 4.24- Spaghetti diagram of the paths walked by the DHPs of floor 1 upon implementing Proposal II to the subprocess "First round"

The tables below gather the expected results of implementing this proposal to every "M" list. Table 4.12 respects the process of "Complete Hygiene" and table 4.13 is related to the "Clean rooms" process.

Table 4.12 - Total amount of meters and time saved by applying Proposal II to the process of "Complete Hygiene".

	Complete Hygiene						
	Meters			Seconds			Δ%
	Current Scenario	Proposal II	Saved	Current Scenario	Proposal II	Saved	
M1	245	206,5	38,5	204	172	32	15,71%
M2	558	218	340	465	182	283	60,93%
M3+4	366,5	231	135,5	305	193	112	36,97%
M5	185,5	167	18,5	155	139	16	9,97%
M6	361	242	119	301	202	99	32,96%
M7	237,5	201,5	36	198	168	30	15,16%
M8+9	322	257,5	64,5	268	215	54	20,03%
TOTAL			752			627	

Based on this table, the conclusion that this proposal is expected to bring positive results to the process of "Complete hygiene" can be reached. By implementing this proposal, the DPHs are expected to walk, overall, 752 meters less on a daily basis. Regarding the time spent walking, they are expected to save up to 627 seconds per day. The average percentage of time gained is 21,30%.

Table 4.13– Total amount of meters and time saved by applying Proposal II to the process of "Clean Rooms"

	Clean rooms						
	Meters			Seconds			Δ%
	Current Scenario	Proposal II	Saved	Current Scenario	Proposal II	Saved	
M1	118	118	0	98	98	0	0%
M2	371	186	185	309	155	154	49,87%
M3+4	205,5	183	22,5	171	153	19	10,95%
M5	157	143	14	131	119	12	8,92%
M6	252,5	195	57,5	210	163	48	22,77%
M7	190	160,5	29,5	158	134	25	15,53%
M8+9	309,5	253,5	56	258	211	47	18,09%
TOTAL			364,5			304	

Considering the results displayed in table 4.13, it is possible to understand that Proposal II is also expected to bring benefits to the "Clean rooms" process, when it comes to less meters walked and consequently, less time needed to perform this task. By implementing this proposal, the DHPs are expected to save, 364,5 meters overall (KPI II_2), which translates in 304 seconds saved daily (KPI II_1). This accounts to an expected average time-related benefit of 18,02%.

Taking into account that currently, during these three processes ("Complete hygiene", "Clean rooms" and "First round"), the DHP spend walking 57 minutes and 59 seconds, and they are expected to spend 41 minutes and 53 seconds walking (KPI II_1). With the implementation of this proposal, the time-related benefit associated to the implementation is 27,73%.

4.2.4.3 Proposal III

As described in the subchapter 4.2.3, Proposal III is divided in Proposal III_1, Proposal III_2 and Proposal III_3, but all serve the same purpose – to reduce the redundant walks taken by the DHPs during the "Complete Hygiene" process.

To assess these proposals, the floor plans of UCCI Almada were again used to calculate the distances walked by the DHPs, for each scenario (Current, Proposal III_1, Proposal III_2 and Proposal III_3). The rooms considered for this proposal are the same as in Proposal II – Complete hygiene. Once again, the paths to collect a bowl/shower chair and to disinfect them were not included, for the reasons presented in Proposal II.

The results obtained for M2 are displayed below in table 4.14 (refer to annex E for the calculation of another single M list, but from a different floor – M6 – and for the heavy lists – M3+4 and M8+9).

Table 4.14– Paths walked by M2 when applying Proposal III.

Legend: C2 and C3 – hygiene carts; RS2 – laundry cart; numbers 001-004 and U1-U2 – rooms

Current Scenario		**Proposal III_1**		**Proposal III_2**		**Proposal III_3**	
Path	**Meters**	**Path**	**Meters**	**Path**	**Meters**	**Path**	**Meters**
C2-004	1	C2-004	1	C3-U1	7	C3-U1	7
004-RS2	4,5	004-RS2	4,5	U1-RS2	51,5	U1-U2	6
RS2-C2	5,5	RS2-C2	5,5	RS2-U2	45,5	U2-001	46
C2-003	5,5	C2-003	5,5	U2-RS2	45,5	001-002	1
003-RS2	11	003-RS2	11	RS2-001	16,5	002-003	6,5
RS2-C2	5,5	RS2-C2	5,5	001-RS2	16,5	003-004	6,5
C2-003	5,5	C2-002	11	RS2-002	17,5	004-C2	1
003-RS2	11	002-RS2	16,5	002-RS2	17,5	C2-RS2	5,5
RS2-C2	5,5	RS2-C2	5,5	RS2-003	11		
C2-002	12	C2-001	11	003-RS2	11		
002-RS2	17,5	001-RS2	16,5	RS2-004	4,5		
RS2-C2	5,5	RS2-C2	5,5	004-C2	1		
C2-002	11	C2-U1	43,5	C2-RS2	5,5		
002-RS2	16,5	U1-RS2	51,5				
RS2-C2	5,5	RS2-C3	46,5				
C2-001	11	C3-U2	1				
001-RS2	16,5	U2-C3	1				
RS2-C2	5,5	C3-RS2	46,5				
C2-U1	43,5						
U1-RS2	51,5						
RS2-C3	46,5						
C3-U1	7						
U1-RS2	51,5						
RS2-C3	46,5						
C3-U1	7						
U1-RS2	51,5						
RS2-C3	46,5						
C3-U2	1						
U2-C3	1						

C3-RS2	46,5						
TOTAL	558		291		250,5		79,5
TIME (seconds)	465		243		258		82

Considering the results displayed in the table above, it is estimated that by applying these proposals to the "Complete hygiene" process, the DHPs of M2 save up to 267 meters if Proposal III_1 is implemented, 307,5 meters if they select Proposal III_2 and 478,5 meters when Proposal III_3 is applied.

Regarding the time KPI, the average walking speed of 1.2m/s for the Current Scenario and Proposal III_1 was assumed. For Proposal III_2 and Proposal III_3 an average walking speed of 0,97m/s (Canadian Centre for Occupation Health and Safety, 2018) was considered, given that in both these proposals FDHPs will be pushing a cart, which slows their pace. From the data in the table, we can reach the conclusion that if any of these proposals was implemented, the DHPs would save time spent walking. It is however possible to understand that Proposal III_2 is not ideal, since it does not save time when comparing to Proposal III_1, nor compared to Proposal III_3.

In this case, Proposal III_3 is the proposal that is suggested to be implemented, since it is the one reporting better results. By applying this proposal, the DHPs of M2 would save, daily, 383 seconds walking (6 minutes and 23 seconds), which sums up to 38 hours and 50 minutes yearly.

The spaghetti diagrams of the paths proposed above are presented below (figure 4.25 – Proposal III_1; figure 4.26 - Proposal III_2; figure 4.27 – Proposal III_3) The Current Scenario was displayed above in figure 4.17 (in the assessment of Proposal I – Complete hygiene subprocess) (check annex F for the spaghetti diagrams of the paths walked by other "M" lists - M6, M3+4 and M8+9, when implementing Proposal III_3).

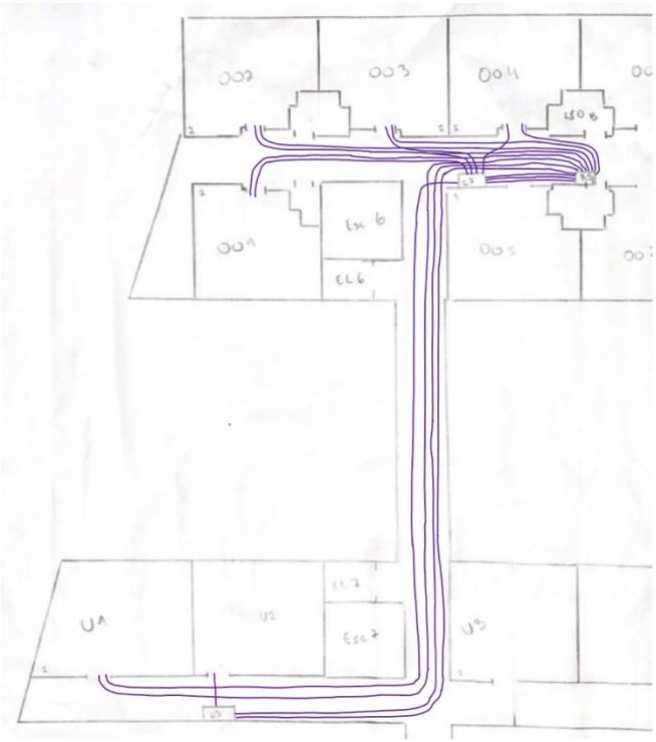


Figure 4.25 - Spaghetti diagram of the paths walked by M2 upon implementing Proposal III$_1$

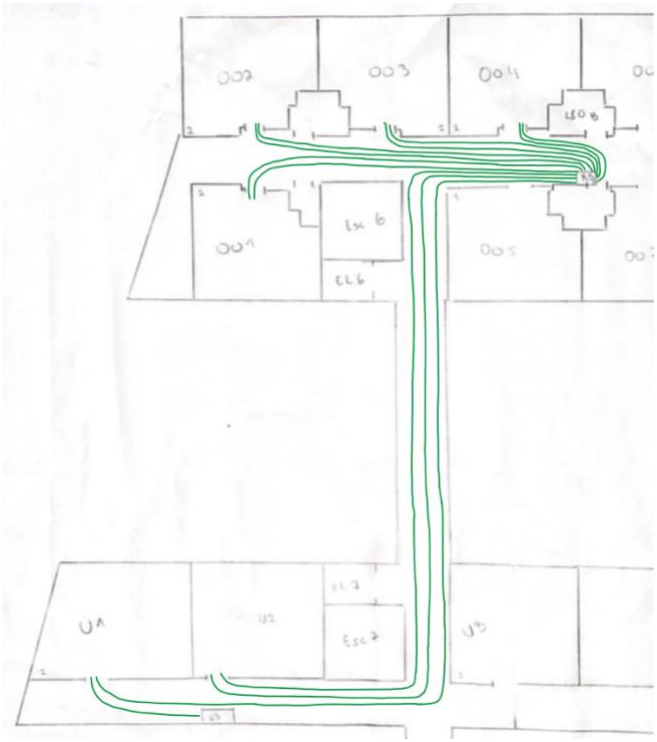


Figure 4.26- Spaghetti diagram of the paths walked by M2 upon implementing Proposal III$_2$

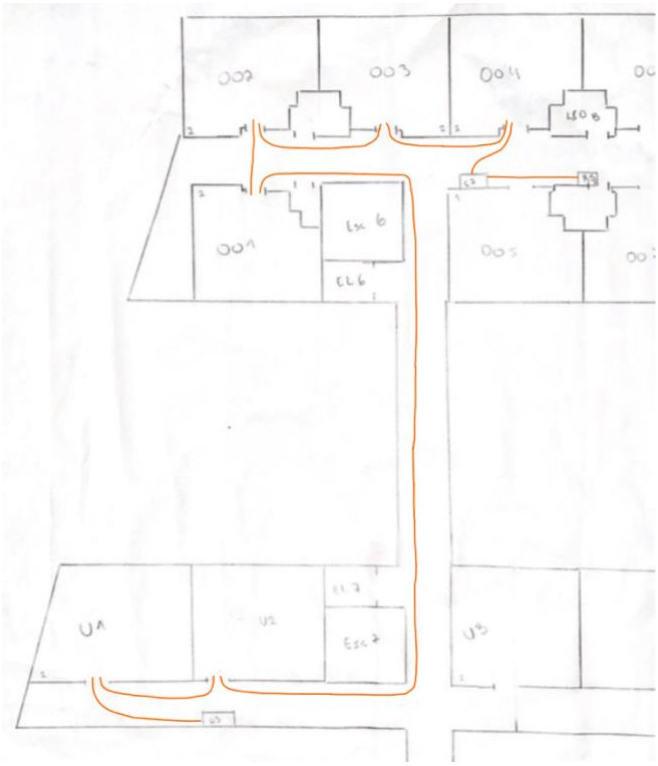


Figure 4.27 - Spaghetti diagram of the paths walked by M2 upon implementing Proposal III$_3$

The following table (table 4.15) gathers the total amount of meters and time saved daily by each "M" team when applying Proposal III_3.

Table 4.15 – Total amount of meters and time spent walked by the DHPs before and after applying Proposal III_3

	Meters			Seconds			Δ%
	Current Scenario	**Proposal III_3**	**Saved**	**Current Scenario**	**Proposal III_3**	**Saved**	
M1	245	57,5	187,5	204	59	145	70,97%
M2	558	79,5	478,5	465	82	383	82,37%
M3+4	366,5	152	214,5	305	157	148	48,69%
M5	185,5	58	127,5	155	60	95	61,32%
M6	361	92	269	301	95	206	68,47%
M7	237,5	43	194,5	198	44	154	77,6%
M8+9	308,5	130	178,5	257	134	123	66,53%
TOTAL			1650			1254	

Taking these values into consideration, it may be concluded that if this proposal is implemented, the overall distance walked is expected to reduce by 1650 meters, on a daily basis. This translates in 20 minutes and 54 seconds. This proposal partakes to an expected average time-related benefit of 67,99%.

The implementation of this proposal requires the purchase of a new hygiene cart. As UCCI Almada is an unit inserted in the NNLTC, the financial resources for further investments might be scarce, creating a need for a rigorous plan of financial allocation. With this being said, it is essential to enlighten that the implementation of this proposal will lead to added economic value, reflected in the operational efficiency obtained.

It is then relevant to explore the return on investment associated with the new cart. Considering the morning shift as reference, 9 DHPs operate for 8 hours, at an hourly wage of 3,97€. The investment of 300€ in a new hygiene cart would lead to daily time savings of 20 minutes and 55 seconds. Without the new hygiene cart, the DHPs spend, 31 minutes and 25 seconds per day in these movements, which adds up to in 2,08€ (at the rate of 3,97€/h). With the investment on the new cart, the DHPs would spend only 10 minutes and 30 seconds walking, daily, which accounts to 0,69€. Accordingly, it is achieved an economic efficiency of 1,38€ per day (2,08-0,69), meaning that after 218 days (300/1,38), the investment in a 300€ cart would be reimbursed.

4.2.4.4 Proposal IV

This proposal intends to simplify the DHPs daily care process, by including the process of cleaning the rooms in the "Complete Hygiene" process.

To assess the success or lack of success of this proposal, each scenario was calculated using the floor plants of UCCI Almada.

The Current Scenario was calculated by adding the distances walked by the DHPs in both processes ("Complete hygiene" and "Clean rooms"), since currently they perform these tasks individually.

The expected results for Proposal IV_1 were calculated as if the DHPs would go to each bed once during the overall daily process. This means they do not have to go back to the rooms to clean them – this subprocess is done right after the hygiene. For the assessment of this proposal, it is assumed that the hygiene carts are static and not improved, meaning the DHPs still have to do the paths from and to both carts.

Proposal IV_2 was calculated considering that the DHPs go to each room only once, and that they walk with the improved hygiene carts, meaning a new hygiene cart needs to be purchased.

The expected results of implementing these proposals to M2 are displayed on table 4.16. The results for the lists M3+4 (heavy list of floor 0), M6 (single list of floor 1) and M8+9 (heavy list of floor 1) can be checked in annex G.

Table 4.16 – Paths walked by "M2" when applying Proposal IV.

Legend: C2 and C3 – hygiene carts; RS2 – laundry cart; numbers 001-004 and U1-U3 – rooms

Proposal IV_1		**Proposal IV_2**	
Path	**Meters**	**Path**	**Meters**
C2-004	1	C3-U1	7
004-RS2	4,5	U1-U2	6
RS2-C2	5,5	U2-U3	14,5
C2-004	1	U3-001	39,5
004-RS2	4,5	001-002	1
RS2-C2	5,5	002-003	6,5
C2-003	5,5	003-004	6,5
003-RS2	11	004-C2	1
RS2-C2	5,5	C2-RS2	5,5
C2-003	5,5		
003-RS2	11		
RS2-C2	5,5		
C2-002	12		
002-RS2	17,5		
RS2-C2	5,5		
C2-002	11		

002-RS2	16,5		
RS2-C2	5,5		
C2-001	11		
001-RS2	16,5		
RS2-C2	5,5		
C2-U1	43,5		
U1-RS2	51,5		
RS2-C3	46,5		
C3-U1	7		
U1-RS2	51,5		
RS2-C3	46,5		
C3-U1	7		
U1-RS2	51,5		
RS2-C3	46,5		
C3-U2	1		
U2-C3	1		
C3-RS2	46,5		
C3-U3	15,5		
U3-RS2	39		
RS2-C3	46,5		
C3-U3	15,5		
U3-RS2	39		
RS2-C3	46,5		
C3-U3	15,5		
U3-RS2	39		
RS2-C3	46,5		
TOTAL (meters)	558		218
TIME (seconds)	465		182

The calculations for these scenarios are displayed below on table 4.17 (Proposal IV_1) and 4.18 (Proposal IV_2). The same average walking speed was used to calculate the KPI time – 1.2m/s for the Current Scenario and Proposal IV_1 (walking hands free) and 0,97m/s for Proposal IV_2 (when walking with the cart).

Table 4.17 - Total amount of meters and time spent walked by the DHPs before and after applying Proposal VI_1

	Meters			Seconds			Δ%
	Current Scenario	**Proposal IV_1**	**Saved**	**Current Scenario**	**Proposal IV_1**	**Saved**	
M1	363	245	118	303	204	99	32,51%%
M2	929	893	36	774	744	30	3,88%
M3+4	572	366,5	205,5	477	305	172	35,93%
M5	342,5	203,5	139	285	170	115	40,58%
M6	613,5	519	94,5	511	433	78	15,4%
M7	427,5	270,5	157	356	225	131	36,73%
M8+9	631,5	366,5	265	526	305	221	41,96%
TOTAL			1015			846	

Considering the results gathered in the table above, it is possible to conclude that if Proposal IV_1 was implemented, the DHPs would walk 1015 meters less, accounting to 846 seconds saved walking. The expected average efficiency benefit of this proposal is 29,57%

Table 4.18 - Total amount of meters and time spent walked by the DHPs before and after applying Proposal VI_2

	Meters			Seconds			Δ%
	Current Scenario	**Proposal IV_1**	**Saved**	**Current Scenario**	**Proposal IV_1**	**Saved**	
M1	363	57,5	305,5	303	59	244	80,4%
M2	929	87,5	841,5	774	90	684	88,35%
M3+4	572	152	420	477	157	320	67,13%
M5	342,5	58	284,5	285	60	225	79,05%
M6	613,5	92	521,5	511	95	416	81,45%
M7	427,5	55,5	372	356	57	299	83,94%
M8+9	631,5	130,5	501	526	135	391	74,43%
TOTAL			3246			2579	

Based on table 4.18, the conclusion that this proposal would bring benefits when it comes to time and distance savings can be reached. The implementation of this proposal is expected to bring down by

3246 meters the distance walked daily by the DHPs (KPI IV_2). Regarding the time (KPI IV_1), this proposal is expected to save 2579 seconds each day all across the "M" lists, which accounts to an average gain of 79,25%.

Although both proposals bring benefits when it comparing to the current scenario, it is suggested that Proposal IV_2 is the one implemented, since the benefits it brings are fairly higher.

The implementation of this proposal (just as Proposal III_3), would require the purchase of the new hygiene cart (priced at 300€). Considering the calculations made for Proposal III_3, the DHPs currently walk (daily), from the carts to the rooms, 53 minutes and 52 seconds, which has an associated cost of 3,56€. If the new cart is bought, they would walk 10 minutes and 50 seconds daily, costing 0,72€. The addition of a new cart would reveal in an economic benefit of 2,84€ (3,56-0,72) a day, leading to this reimbursement of this investment after just 106 days (300/2,84).

The following table (table 4.19) summarizes the expected results of each improvement proposal.

Table 4.19 – Summary of the proposals expected results

Proposal	**Expected results**		**Wastes reduced/eliminated**
	Qualitative	**Quantitative**	
I	• Diminishing the chances of a stockout	• Eliminate 16,83% average loss of efficiency due to 10-minute process break (KPI I_1) • Eliminating the time wasted waiting for clean bedlinen (KPI I_2)	Delays Incorrect inventory
II	• Improves the hygiene cart • Generate time for the DHPs to do other tasks • Decrease the chances of delays	• Decreasing the distance walked from 4175,5 meters to 3015 meters (KPI II_2) • Reducing the time walked from 57 minutes and 59 seconds to 41 minutes and 53 seconds (KPI II_1) • Benefit of 27,73%	Delays Unnecessary motion
III	• Obtain a new hygiene cart • Decrease the chances of delays	• Decreasing the distance walked from 2262 meters to 611 meters (KPI III_2)	Delays Unnecessary motion

	• Generate time for the DHPs to do other tasks	• Reducing the time walked from 31 minutes and 25 seconds to 10 minutes and 30 seconds (KPI III_1) • Benefit of 67,99%	
IIII	• Obtain a new hygiene cart • Reduce the redundant paths taken by the DHPs • Decrease the chances of delays • Generate time for the DHPs to do other tasks	• Decreasing the distance walked from 3879 meters to 633 meters (KPI IV_2) • Reducing the time walked from 53 minutes and 52 seconds to 10 minutes and 50 seconds (KPI IV_1) • Benefit of 79,25%	Delays Unnecessary motion

4.2.5 Recommendations

In this subchapter, the final research step is presented. Grounded on the results gathered in the previous subchapter (4.2.4) some recommendations to UCCI Almada are delivered.

Firstly, it is suggested that the DHPs collect the data referring to how many sheets they need in each shift, with the purpose of eliminating the chances of the process stopping due to a shortage of clean bedlinen.

It is highly recommended that the DHPs clean each room right after the bath is given, since by doing this they will save a great amount of time that can be used to perform other activities.

Lastly, it is also recommended that UCCI Almada purchases a new hygiene cart, and improve the existing ones, so that the redundant distances walked by the DHPs during almost all their processes are eliminated. This purchase has an associated cost of 300€ that, when applied only to the process of "Complete hygiene", would be reimbursed in 218 days. If applied to the combination of the "Complete hygiene" and "Clean rooms" subprocesses, the investment would be reimbursed in just 106 days.

4.3 Conclusion of the chapter

In this chapter, taking the objectives and the proposed research question into consideration, the processes of UCCI Almada were mapped and characterized, allowing improvement opportunities to be found. Subsequently, improvement proposals were delivered, with the purpose of improving the efficiency of the subprocesses involved in the global daily care process of the morning shift DHPs.

Proposal I advocates for an accurate reckon of the number of clean bedlinens required during a one-day time period, since the laundry department dispatches sheets daily. Proposal II suggests that UCCI Almada improves their hygiene carts, in order to eliminate the need to walk to the laundry cart every

time there are dirty sheets or towels. Proposal III recommends that UCCI Almada purchases a new hygiene cart, with the purpose of each team having its own cart, eliminating the dislocations to the carts altogether. Proposal IV advises that by merging the subprocesses of “Complete hygiene” and “Clean rooms”, the DHPs would save time, meaning they would not incur in frequent delays.

Furthermore, the proposals were assessed, delivering the expected results displayed in table 4.19.

5 Conclusions

This project was developed in a LTC unit, UCCI Almada. The purpose of this study is to improve the processes of this facility, in particular the processes in which the morning shift Direct Health Providers are involved. To achieve this objective, the current processes of UCCI Almada were mapped and characterized, identifying the inherent waste. In order to reduce or even eliminate the waste, improvement proposals were delivered, concluding with their assessment.

UCCI Almada is a Long-term care facility, responsible for delivering health, rehabilitation and maintenance services to dependent people, that do not have the possibility of receiving these services at home. With the purpose of finding solutions for this projects' target, an intensive literature review regarding process improvement was conducted. Being UCCI Almada an health institution, and due to fact that no studies regarding process improvement in the LTC setting were found, studies conducted in the healthcare setting were used as a reference. Henceforward, methodologies such as optimization, simulation, optimization-simulation, lean, six sigma and lean-six sigma were found to be effective when concerning process improvement in healthcare. Having in mind the main purpose of this study, which is the reduction or even elimination of the process-associated wastes, Lean Thinking proven to be the most suitable methodology to achieve it.

To answer the research question "*How to improve the UCCI Almada direct health providers processes, in order to make them more efficient?*", the characterization of these processes was undertaken initially, delivering the "As-is" process maps of the process Global daily care (morning shift) and the subprocesses involved – Complete Hygiene; Clean rooms; First round and Request sheets. This characterization was grounded on semi-structured interviews with the Clinic Director, the DHPs supervisor and the DHPs themselves, on direct observation and in documents from UCCI Almada. Subsequently, the wastes associated to these processes were found and consequently the improvement opportunities were identified. To tackle the wastes discovered and taking into consideration the tools and approaches applied in Lean, four improvement proposals were delivered. While the proposals were not implemented, an assessment of the expected results was carried out, revealing that if UCCI Almada chooses to implement the proposals, it will incur in great benefits regarding the process flow. Proposal I is expected to decrease the likelihood of happening a shortage of equipment necessary to complete the processes. Proposal II is expected to bring an average expected time-related benefit of 27,73%, Proposal III expects 67,99% and Proposal IV 79,25%.

The main limitation of this project was the coronavirus pandemic. Being UCCI Almada an health facility, institutionalizing patients within risk groups (elderly and/or diagnosed with chronic diseases), the unit had to shut down all projects that were being undertaken there, following the Directorate-General for Health's (*Direção Geral de Saúde*) guidelines. This leads to the second limitation, which concerns the short timeframe. By not being able to go to UCCI Almada during the confinement months, the research work was delayed, making the implementation of the proposals inconceivable. This, allied

to the fact that every health professional was dealing with a new virus, resulted in the non-participation of the DHPs in the attempt of implementing Proposal I.

Having in mind the already mentioned absence of studies regarding process improvement in the LTC setting, a few options for future research may be the implementation of other methodologies (such as optimization or six sigma) to these type of healthcare services, understanding the positive impact these can bring to the efficiency of a LTC unit. A complementary study regarding the perspective of the patients of UCCI Almada would be an excellent complement to this study, as well as analyzing the improvement opportunities of the processes inherent to the whole health professionals' team.

References

ACSS – DRS, 2018. Relatório De Monitorização Da Rede Nacional De Cuidados Continuados Integrados (RNCCI).

Adesola, S. and Baines, T., 2005. Developing and evaluating a methodology for business process improvement. ***Business Process Management Journal***, 11(1): 37-46.

Åhlström, P., 2004. Lean service operations: translating lean production principles to service operations. ***International Journal of Services Technology and Management***, 5 (5/6): 545–564.

Ahmed, M and Alkhamis T., 2009. Simulation optimization for an emergency department healthcare unit in Kuwait. ***European Journal of Operational Research***, 198: 936-942.

Al-Qatawneh, L., Abdallah, A. and Zalloum, S., 2019. Six sigma application in healthcare logisctics: A framework and a case study. ***Journal of Healthcare Engineering***, 1: 1-12.

Antoni, C., 1996. Lean production in Europe: a matter of technical adjustment or cultural change?, ***Applied Psychology***, 45 (2): 139-142.

Bhat, S., Antony, J., Gijo, E. and Cudney E., 2020. Lean six sigma for the healthcare sector: a multiple case study analysis from the Indian context. ***International Journal of Quality & Reliablitiy Management,*** 37 (1): 90-111.

Bhattacharjee, P. and Ray, P., 2014. Modelling and optimisation of healthcare systems: an overview. ***International Journal Logistics Systems and Management***, 19(3): 356–371.

Bertsimas, D., Silberholz, J. and Trikalinos, T., 2016. Optimal healthcare decision making under multiple mathematical models: application in prostate cancer screening**. *Health Care Management Science***, 21(1): 105–118.

Bonaccorsi, A., Carmignani, G. and Zammori, F., 2011. Service Value Stream Management (SVSM): Developing Lean Thinking in the Service Industry. ***Journal of Service Science and Management***. 4: 428–439.

Bowen, D. and Youngdahl, W., 1998. "Lean" service: In defense of a production-line approach. ***International Journal of Service Industry Management***, 9(3): 207-225.

Broutos, T. and Cardella, J., 2016. ***The basics of process improvement.*** New York, Taylor & Francisc Group.

Broutos, T. and Purdie T., 2014. ***The process improvement handbook. A blueprint for managing change and increasing organizational performance***. McGraw-Hill Education.

Canadian Centre for Occupational Health and Safety. Official website of. Canadian Centre for Occupational Health and Safety. https://www.ccohs.ca/oshanswers/ergonomics/push2.html. Accessed on May 20th, 2020.

Carson Y. and Maria A., 1997. Simulation Optimization: Methods and Applications, ***Winter Simulation Conference Proceedings***, Atlanta, 118-126.

Chen, J., Li, Y. and Shady, B., 2010. From value stream mapping toward a lean/sigma continuous improvement process: an industrial case study. ***International Journal of Production Research***, 48(4): 1069-1086.

Cheng, S., Bamford, D., Papalexi, M. and Dehe B., 2015. Improving access to health services – challenges in Lean application, ***International Journal of Public Sector Management***, 28 (2): 121 – 135.

Chemweno, P., Brackenier, L., Thijs, V., Pintelon, L., Horenbeek, A. and Michiels, D., 2016. Optimising the complete care pathway for cerebrovascular accident patients. ***Computer & Industrial Engineering,*** 93: 236-251.

Chiarini, A. and Cherrafi A., 2017. Improving patient satisfaction using lean manufacturing tools. Case studies from Italy. ***20th Excellence in Services International Conference***.

Davenport, T., 1993. Need radical innovation and continuous improvement? Integrate process reengineering and TQM. ***Planning Review***, 21(3): 6-12.

Decreto-lei no 101/2006: Cria a Rede Nacional de Cuidados Continuados Integrados [Creates the National Network of Long-Term Care]. Diário da República: I Série-A, no 109 de 6 de Junho.

Drotz, E. and Poksinska, B., 2014. Lean in Healthcare from Employees' Perspectives. ***Journal of Health Organization and Management***, 28(2): 177-195.

Earl, M., 1994. The New and Old of Business Process Redesign. ***Journal of Strategic Information Systems***, 3(1): 5-22.

Eisenhardt, K. M., 1989. Building theories from case study research. ***The Academy of Management Review***, 14 (4): 532-550.

Fairley, M., Scheinker, D., and Brandeau, M., 2018. Improving the efficiency of the operating room environment with an optimization and machine learning model. ***Health Care Management Science.***

Hammer, M and Champy, J.,1993. ***Reengineering the Corporation: A Manifesto for Business Revolution.*** New York: Harper Collins.

Harmon, P., 2014. ***Business process change*** (3rd ed.), Morgan Kaufmann.

Harrington, H., 1991. ***Business Process Improvement: The Breakthrough Strategy for Total Quality, Productivity and Competitiveness***, New York: McGraw-Hill.

Harrington, H., 1998. Performance improvement: The rise and fall of reengineering. ***The TQM Magazine***, 10(2): 69-71.

Hayes, K., Reed, N., Fitzgerald, A. and Watt, V., 2014. Applying lean flows in pathology laboratory remodeling. ***Journal of Health Organization and Management***, 28(2): 229-246

Hicks, B., 2007. Lean information management, understanding and eliminating waste. ***International Journal of Information Management***, 27: 233-249.

Hines, P. and Rich, N., 1997. The seven value stream mapping tools. ***International Journal of Operations and Production Management***, 17 (1): 46-64.

Hines, P., and Taylor, D., 2000. ***Going lean***. Cardiff: Lean Enterprise Research Centre, Cardiff Business School.

Hines, P., Holweg, M. and Rich, N., 2004. Learning to evolve: A review of contemporary lean thinking. ***International Journal of Operations & Production Management***, 24(10): 994–1011.

Holweg, M., 2007. The genealogy of lean production. ***Journal of Operations Management***, 25(2): 420–437.

Instituto Nacional de Estatística, 2017. ***Projeções de População Residente 2015-2080***.

Instituto Nacional de Estatística. 2011. ***Censos 2011 – Resultados Definitivos – Portugal,*** Lisbon, Instituto Nacional de Estatística, I.P.

Instituto Nacional de Estatística, 2016. ***Inquérito Nacional de Saúde 2014***, Lisbon, Instituto Nacional de Estatística, I.P.

Johnson, C., Miranda, R., Aakre, K., Roberts, C., Patel, M., and Krecke, K., 2010. Process Improvement: What is it, Why is it important, and How is it done?, ***American Journal of Roentgenology***, 194: 461-468

Khodambashi, S., 2014. Lean Analysis of an Intra-operating Management Process – Identifying Opportunities for Improvement in Health Information Systems, ***Procedia Computer Science***, 37: 309-316.

Kim, C., Hayman, J., Billi, J., Lash, K. and Lawrence, T., 2007. The Application of the Lean Thinking to the Care of Patients with Bone and Brain Metastasis with Radiation Therapy, ***Journal of Oncology Practice***, 4: 189-193.

Leite, H. and Vieira, G., 2015. Lean philosophy and its applications in the service industry: A review of the current knowledge. ***Production***, 25(3): 529-541.

Liker, J. and Morgan, J., 2006. The Toyota Way in Services: The Case of Lean Product Development. ***Academy of Management Perspectives***, 20(2): 5–20.

Lukrafka, T., Silva, D. and Echeyeste, M., 2020. A geographic picture of Lean adoption in the public sector: cases, approaches, and a refreshed agenda., ***European Management Journal***.

OECD, 2019, ***Health at a glance 2019: OECD indicators***, Paris, OECD Publishing.

OECD, 2011. Help Wanted? Providing and Paying for Long-Term Care. http://www.oecd.org/els/health-systems/47884520.pdf. Accessed on March 18th, 2020.

Piercy, N., and Rich, N., 2008. Lean Transformation in the pure service environment: the case of the call service centre. ***International Journal of Operations & Production Management***, 29(1), 54-76.

Pinjari, H., Teli, S. and Gaikwad, L., 2017. Lean Six Sigma Applications. Conference paper

Radnor, Z. and Boaden, R., 2008. Editorial: Lean in public services – Panacea or paradox?, ***Public Money & Management***, 28(1): 3-7.

Radnor, Z., Holweg, M. and Waring, J., 2012. Lean in healthcare: The unfilled promise?, ***Social Science & Medicine***, 74: 364-371

Radnor, Z., 2011. Implementing lean in health care: Making the link between the approach, readiness and sustainability. ***International Journal of Industrial Engineering and Management***, 2(1): 1-12

Radnor, Z.R. and Boaden, R., 2004. Developing an understanding of corporate anorexia. ***International Journal of Operations & Production Management***, 24 (4): 424-440.

Ramori, K., Cudney, E., Elrod, C. and Antony, J., 2019. ***Lean business models in healthcare: a systematic review***. Total Quality Management & Business Excellence.

Riley, W., Smalley, B., Pulkrabek, S., Clay, M. and McCullough, J., 2012. Using lean techniques to define the platelet (PLT) transfusion process and cost- effectiveness to evaluate PLT dose transfusion strategies, ***Transfusion Practice***. 52(9): 1957-1967.

Sabale, S. and Thorat, S., 2019. Applications of Lean Six Sigma. ***International Research Journal of Engineering and Technology.*** 6 (9).

Sarkar, D., 2017. ***Building a lean service enterprise: Reflections of a lean management practitioner.*** Boca Raton, FL: CRC Press.

Savory, P. and Olson, J., 2001. Guidelines for Using Process Mapping to Aid Improvement Efforts, ***Hospital Material Management Quarterly***, 22(3): 10-16.

Segurança social. Site oficial da Segurança Social. http://www.seg-social.pt/rede-nacional-de-cuidados-continuados-integrados-rncci. Accessed on November 30th, 2019.

Scremcev, N., Lazarevic, M., Krainovic, B., Mandic, J., and Medojevic, M., 2018. Improving teaching and learning process by applying Lean thinking. ***Procedia Manufacturing***, 17: 595–602.

Simões, J., Augusto, G., Fronteira, I., and Hernández-Quevedo, C., 2017. Portugal: Health System Review, ***Health Systems in Transition***, 19(2).

Song, W., Tan, K. H. and Baranek, A., 2009. Effective toolbox for lean service implementation. ***International Journal of services and Standards***, 5(1): 1-16.

Spagnol, G., Min, L. and Newbold, D., 2013. Lean principles in healthcare: an overview of challenges and improvements. ***6th IFAC Conference on Management and Control of Production and Logistic.***

Stone, K. B., 2012. Four decades of lean: a systematic literature review. ***International Journal of Lean Six Sigma***, 3(2):112-133.

Swank, C. K., 2003. The lean service machine. ***Harvard Business Review***, 123-129.

Tamás, P. 2017. Decision Support Simulation Method for Processes Improvement of Intermittent Production Systems. ***Applied Sciences,*** 7(950): 1-16.

Taner, M., Sezen, B. and Antony, J., 2007. An overview of six sigma applications in healthcare industry. ***International Journal of Health Care Quality Assurance***, 20 (4): 329–340.

Tay, H. L., 2016. Lean improvement practices: Lessons from healthcare service delivery chains. ***IFAC – PapersOnLine,*** 49 (12): 1158-1163

Thawesaengskulthai, N. and Tannock, J., 2008. A decision aid for selecting improvement methodologies, ***International Journal of Production Research***, 46(23): 6721-6737.

Tortorella, G., Rosa, M., Caiado, R., Nascimento, D. and Sawhney, R. (2019). Assessment of Lean implementation in Hotels' supply chains. ***Production***, 29

Truong, L., Kutadinata, R., Espada, I., Robinson, T., Burdan, J., Costa, F. and Lin E., 2018. Walking speeds for timing of pedestrian walk wand clearance intervals. ***Australasian Transport Research Forum***.

Vergidis, K., Tiwari, A. and Majeed, B., 2008. Business process analysis and optimization: Beyong reengineering. ***IEEE Transactions on systems, man, and cybernetics - part C (applications and reviews)***, 38(1): 69-82.

Uriarte, A., Zúñiga, E., Moris, M. and Ng, A., 2017. How can decision makers be supported in the improvement of an emergency department? A simulation, optimization and data mining approach, ***Operations Research for Health Care***.

Weiss, E., Jackson, S., English, A. and Stevenson, D., 2017. Lean tools for service business model innovation in healthcare. In M. A. Pfannstiel and C. Rasche (Eds.). ***Service Business Model Innovation in Healthcare and Hospital Management***: 233-247. Springer International Publishing.

Wickramasinghe, N., Al-Hakim, L., Gonzalez, C. and Tan, J., 2014. ***Lean thinking for healthcare***, New York, Springer.

Williams, H. P., 2013. ***Model Building in mathematical programming*** (5th ed.). West Sussex, John Wiley & Sons Ltd.

Womack, J. and Jones, D., 2003. ***Lean thinking: Banish waste and create wealth in your corporation*** (2nd ed.), New York: Free Pass.

Worldbank website. World Development Indicators: Structure of output. http://wdi.worldbank.org/table/4.2. Acessed on May 7th, 2020.

Yin, R., 2013. ***Case study research: Design and Methods.*** (5th ed.). Thousand Oaks: SAGE Publications.

Zhou, Y. and Chen, Y., 2003. Project-oriented business process performance optimization, ***Proceedings IEEE International Conference on Systems, Man and Cybernetics***, 5: 4079–4084.

Annexes

Annex A – Semi-structured interviews

Throughout this project, semi-structured interviews with the Clinic Director, the DHPs' supervisor and the DHP themselves were made. These interviews aimed to better understand the processes, as well as the inherent waste, the improvement opportunities and to validate the improvement proposals.

Mapping and characterizing the processes

During these interviews, the purpose was to understand the physical and information flow of every process in which the morning shift DHPs were involved. The interviews were conducted firstly with the Clinic Director, secondly with the supervisor and lastly with the DHPs working in the morning shift. It was asked what the sequence of the processes was, as well as the activities that they consider value-adding or non-value adding.

Identify improvement opportunities

In these interviews, questions regarding the process's complications were asked to the DHPs, with the purpose of understanding which activities were generating waste, thus having room to be improved. It was also asked, to the DHPs and to the DHPs supervisor if there was any process they would do differently.

Improvement Proposals

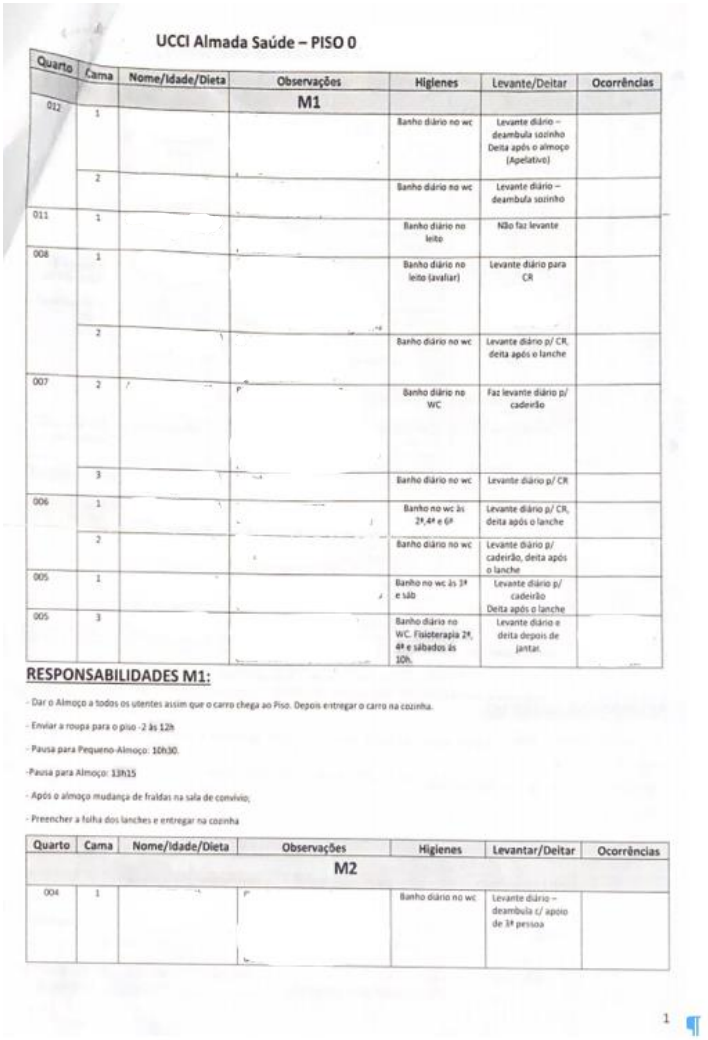
In this step, the interviews were conducted with the DHPs, to understand if they had any suggestions to ameliorate the processes. The Clinic Director and the DHPs supervisor were also interviews to comprehend if the improvement proposals delivered made sense in the context of UCCI Almada

Assessment of the Improvement Proposals

These interviews were done mainly with the Clinic Director having the purpose to understand what the common scenarios in UCCI Almada were, that consequently should be assessed.

Annex B – M lists

The following pictures correspond to the scanned M lists. Some information was erased, according to the confidentiality agreement with UCCI Almada.



UCCI Almada Saúde – PISO 0

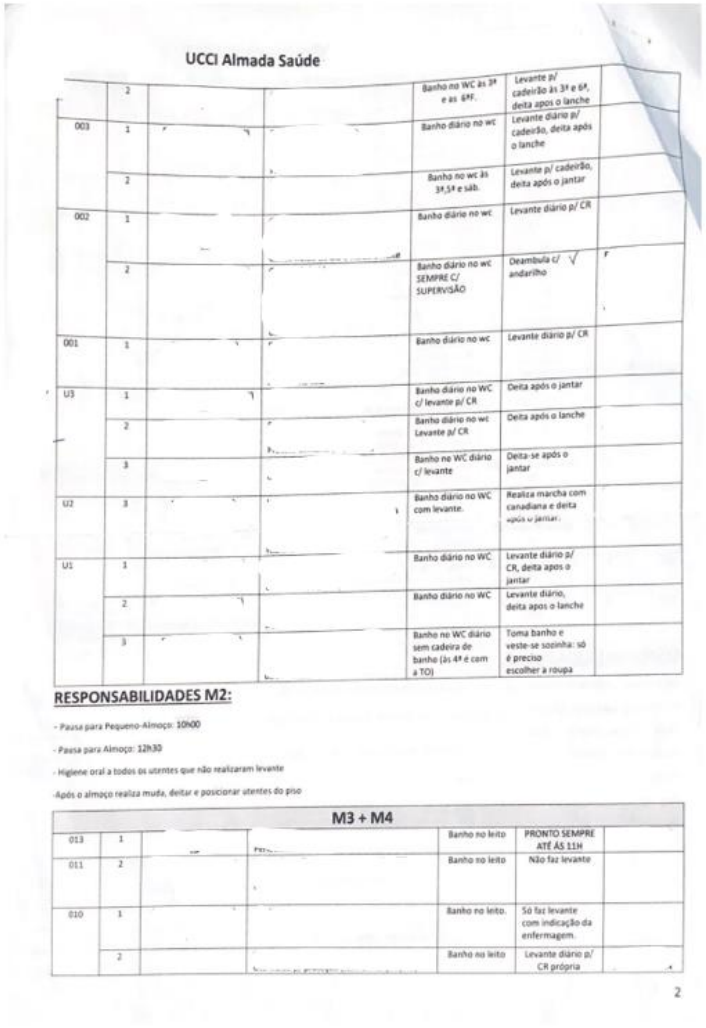
Quarto	Cama	Nome/Idade/Dieta	Observações	Higienes	Levante/Deitar	Ocorrências
			M1			
012	1			Banho diário no wc	Levante diário – deambula sozinho Deita após o almoço (Apelativo)	
	2			Banho diário no wc	Levante diário – deambula sozinho	
011	1			Banho diário no leito	Não faz levante	
008	1			Banho diário no leito (avaliar)	Levante diário para CR	
	2			Banho diário no wc	Levante diário p/ CR, deita após o lanche	
007	2			Banho diário no WC	Faz levante diário p/ cadeirão	
	3			Banho diário no wc	Levante diário p/ CR	
006	1			Banho no wc às 2ª,4ª e 6ª	Levante diário p/ CR, deita após o lanche	
	2			Banho diário no wc	Levante diário p/ cadeirão, deita após o lanche	
005	1			Banho no wc às 3ª e sáb	Levante diário p/ cadeirão Deita após o lanche	
005	3			Banho diário no WC. Fisioterapia 2ª, 4ª e sábados às 10h.	Levante diário e deita depois de jantar.	

RESPONSABILIDADES M1:

- Dar o Almoço a todos os utentes assim que o carro chega ao Piso. Depois entregar o carro na cozinha.
- Enviar a roupa para o piso -2 às 12h
- Pausa para Pequeno-Almoço: 10h30.
- Pausa para Almoço: 13h15
- Após o almoço mudança de fraldas na sala de convívio;
- Preencher a folha dos lanches e entregar na cozinha

Quarto	Cama	Nome/Idade/Dieta	Observações	Higienes	Levantar/Deitar	Ocorrências
			M2			
004	1			Banho diário no wc	Levante diário – deambula c/ apoio de 3ª pessoa	

1



UCCI Almada Saúde

	2		Banho no WC às 3ª e às 6ªF.	Levante p/ cadeirão às 3ª e 6ª, deita apos o lanche	
003	1		Banho diário no wc	Levante diário p/ cadeirão, deita após o lanche	
	2		Banho no wc às 3ª,5ª e sáb.	Levante p/ cadeirão, deita após o jantar	
002	1		Banho diário no wc	Levante diário p/ CR	
	2		Banho diário no wc SEMPRE C/ SUPERVISÃO	Deambula c/ √ andarilho	
001	1		Banho diário no wc	Levante diário p/ CR	
U3	1		Banho diário no WC c/ levante p/ CR	Deita após o jantar	
	2		Banho diário no wc Levante p/ CR	Deita após o lanche	
	3		Banho no WC diário c/ levante	Deita-se após o jantar	
U2	3		Banho diário no WC com levante.	Realiza marcha com canadiana e deita após o jantar.	
U1	1		Banho diário no WC.	Levante diário p/ CR, deita apos o jantar	
	2		Banho diário no WC	Levante diário, deita apos o lanche	
	3		Banho no WC diário sem cadeira de banho (às 4ª é com a TO)	Toma banho e veste-se sozinha: só é preciso escolher a roupa	

RESPONSABILIDADES M2:

- Pausa para Pequeno-Almoço: 10h00
- Pausa para Almoço: 12h30
- Higiene oral a todos os utentes que não realizaram levante
- Após o almoço realiza muda, deitar e posicionar utentes do piso

M3 + M4					
013	1		Banho no leito	PRONTO SEMPRE ATÉ ÁS 11H	
011	2		Banho no leito	Não faz levante	
010	1		Banho no leito.	Só faz levante com indicação da enfermagem.	
	2		Banho no leito	Levante diário p/ CR própria	

2

UCCI Almada Saúde – PISO 0

					(CHAMAR SEMPRE O ENF)	
009	1			**Banho WC 2ª, E 5ª Feira**	**Não faz levante até ordem da enfermagem.**	
	2			**Banho no leito sempre. Lavar a cabeça 3ª, 5ª e sábado Shampoo p/ seborreia**	Levante diário p/ CR da utente (Tem uma lona exclusiva c/ apoio de cabeça)	
007	1			Banho no wc às 3ª e 6ª	Levante às 3ª e 6ª p/ cadeirão, deita após o almoço	
005	1			Banho no WC 4ª e sábado	Levante Diário p/ cadeirão, deita após o lanche	
001	2			Banho diário no WC	Levante diário p/ cadeirão, deita após o lanche	
U2	1			Banho no WC 3ª, 5ª e domingo	Levante p/ CR Deita após o lanche	
	2			Banho diário no WC c/ levante p/ CR	Usa cueca fralda dia e noite usa urinol e evacua na sanita	

Desejos de um dia Feliz ☺

RESPONSABILIDADES M3+M4:

- M3 Pausa para almoço 12h30, quando regressa faz hora de almoço na sala 0

-M4 dá almoços no refeitório e faz a higiene oral, pausa para almoço quando termina

- M3 Deitar, mudar e posicionar utentes no piso

-M4 realiza a muda da fralda na sala de convivio

UCCI Almada Saúde – PISO 1

Quarto	Cama	Nome/Idade/Dieta	Observações	Higienes	Levante/Deitar	Ocorrências
			M5			
048	1			Banho no wc diário c/ levante p/ CR c/ CONTENÇÃO	COLOCAR CAMA SEMPRE EM BAIXO - RISCO DE QUEDA	
122	1			Banho diário no WC		
	2			Banho diário no wc (colocar almofada)	Levante diário p/ CR Andarilho p/ curtas distâncias	
121	1			Banho diário no wc **USA CUECA PRÓPRIA (VAI AO WC) – Não dizer p/ fazer na fralda!!!**	Faz levante p/ cadeira de rodas própria por curtos períodos	
120	2			Banho no diário no WC	Levante diário p/ cadeirão, deita após o lanche	
119	1			Banho diário no WC	**Levante diário p/ cadeirão**	
	2			Banho diário no leito. Usa fralda permanentemente.	**Levante diário para cadeirão e deita depois do lanche, não sai do quarto**	
117	2			Banho no wc diário	Levante diário p/ cadeirão, Deita após almoço	
116	1			Banho diário no wc às 7.30H	Levante diário p/ cadeira de rodas (Deita após o jantar)	

RESPONSABILIDADES M5:

- Dar o Almoço a todos os utentes assim que o carro chega ao Piso. Depois entregar o carro na cozinha.

- Enviar a roupa para o piso -2 às 12h

- Pausa para Pequeno-Almoço: 10h30.

-Pausa para Almoço: 13h15

- Após o almoço mudança de fraldas na sala de convívio;

Quarto	Cama	Nome/Idade/Dieta	Observações	Higienes	Levantar/Deitar	Ocorrências
			M6			
115	1			Banho no wc 2ª, 4ª, 6ª e domingo	Levante diário	
	2			Banho no wc	**Levante diário com andarilho, deambula com supervisão As 10:00hs**	
114	2			Banho diário no wc	Levante diário p/ cadeirão, deita após o lanche	
	1			Banho no leito	Não faz levante	

UCCI Almada Saúde – PISO 1

113	2			Banho diário no WC	Colocar sempre talla p/ realizar levante	
112	1			Banho diário no WC, toma sozinho c/ supervisão	Pronto às 9h	
	2			Banho diário no WC Senhor ajuda a vestir a parte de cima	Levante diário p/ CR	
	3			Banho diário no WC	Levante diário p/ CR	
111	1					
	2			Banho wc às 3ª, 5ª e domingo c/ levante	Deita depois do lanche	
101 (Ala Sul)	1			Banho diário no WC c/ levante	Usa cueca fralda	
	2			Banho diário no WC c/ levante p/ CR.	**Uso de fralda**	
	3			Banho diário no WC às **07:30h**	**Levante p/ CR Deita apos do jantar**	
102 (ala sul)	2			Banho diário no WC c/ levante às **7.30H**	Usa cueca fralda	
	3			Banho WC c/ supervisão.		
103	1			Banho diário no WC.	**Deambula sozinha incentivar nas atividades diárias**	

RESPONSABILIDADES M6:

- Pausa para Pequeno-Almoço: 10h00
- Pausa para Almoço: 12h30
- Higiene oral a todos os utentes que não realizaram levante
- Após o almoço realiza muda, deitar e posicionar utentes do piso

Quarto	Cama	Nome/Idade/Dieta	Observações	Higienes	Levante/Deitar	Ocorrências
M7						
104 (ala sul)	3			Banho diário no WC **às 7h**	Levante diário p/ CR	
105 (ala sul)	1			Banho diário no WC	Levante diário p/ CR, deita após o lanche	
105 (Ala Sul)	3			Banho diário no WC.	Deita após o jantar.	
106 (ala sul)	2			Banho diário no WC	Levante diário – deambula c/ canadianas	

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107 (Ala Sul)	1			Banho diário no WC	Pronto às 8.30h	
108 (ala sul)	1			Banho diário no WC	Levante diário p/ cadeirão deita apos o lanche	
108 (ala sul)	2			Banho diário no WC	Levante diário p/ CR Deita apos o jantar	
109 (ala sul)	2			Banho diário no wc c/ ajuda		
	1			Banho diário no wc	Levante diário p/ cadeirão (fica no quarto)	
110 (ala sul)	2			Banho diário no WC c/ levante p/ CR	Levante p/ CR Pronto às 9.30h	
123	1			Banho no leito	**Avaliar levante**	
	2			Banho diário no leito	**Não faz levante até segunda ordem**	

RESPONSABILIDADES M7:

- Pausa para Pequeno-Almoço: 10h45
- Dar o Pequeno-Almoço aos utentes da ala sul assim que o carro chega ao Piso (Após as higienes prioritárias). Entregar o carro na cozinha.
- Pausa para Almoço: 13h30
- Vai p/ o refeitório dar almoços e realiza a higiene oral aos utentes após o almoço
- Após o almoço realiza muda de fraldas na sala de convívio

M8 + M9						
GAB	1			Banho diário no WC	Levante diário p/ cadeirão, após almoço e deita após o lanche	
121	2			Banho no WC aos domingos	Levante diário p/ Cadeirão (apenas p/ ir à fisioterapia)	
120	1			Banho da noite. Banho no wc no primeiro sábado do mês	LEVANTE ÀS 2ª e 5ª feiras p/ cadeirão, mas fica no quarto.	
118	2			Banho diário no WC. Usa fralda permanente – **DEIXAR URINOL**	Faz levante diário p/ cadeirão, deita após o almoço	
	1			Banho no leito	Levante diário para cadeirão. Deita após o lanche.	
117	1			Banho diário c/ transferência de 2 auxiliares	Levante diário p/ cadeirão.	
116	2			Banho no leito	Levante diário p/ cadeirão, deita após o lanche	

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110 (ala sul)	1			Banho diário no WC c/ levante p/cadeirão	Deita depois do jantar.	
107 (Ala Sul)	2			Banho no WC 2ªF e 5ªFeiras	Levante em dias de banho no wc.	
	3			Banho diário no WC	Levante p/ cadeirão, deita após o lanche	
106 (Ala sul)	1			Banho no wc à 5ª (às 2ªF banho com TO)	Levante diário p/ CR, deita após o jantar	
105 (ala sul)	1			Banho diário no wc	Levante diário p/ CR própria, deita após o lanche	
104 (ala sul)	3			Banho no WC 3ªF	Levanta à 3ª F p/ cadeirão: **terapia da fala 11.00h**	
103 (ala sul)	2			Banho diário no leito	Não faz levante	
101 (ala sul)	1			Banho no WC	Levante diário p/ cadeirão	

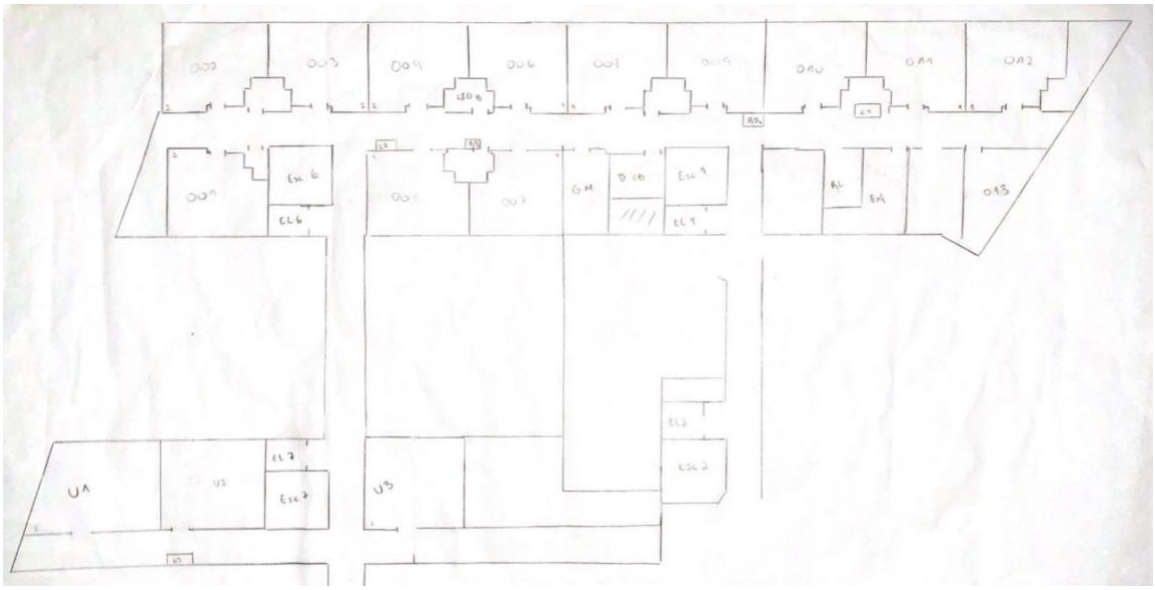
RESPONSABILIDADES M8+M9:

- M8 Pausa para almoço 12h30
- M9 pausa para almoço às 13h15
- M8 Fica responsável pela Ala Sul, mas ajuda o M9 nos almoços
- M8 Deitar, mudar e posicionar utentes no piso
- M9 realiza a muda da fralda na sala de convívio

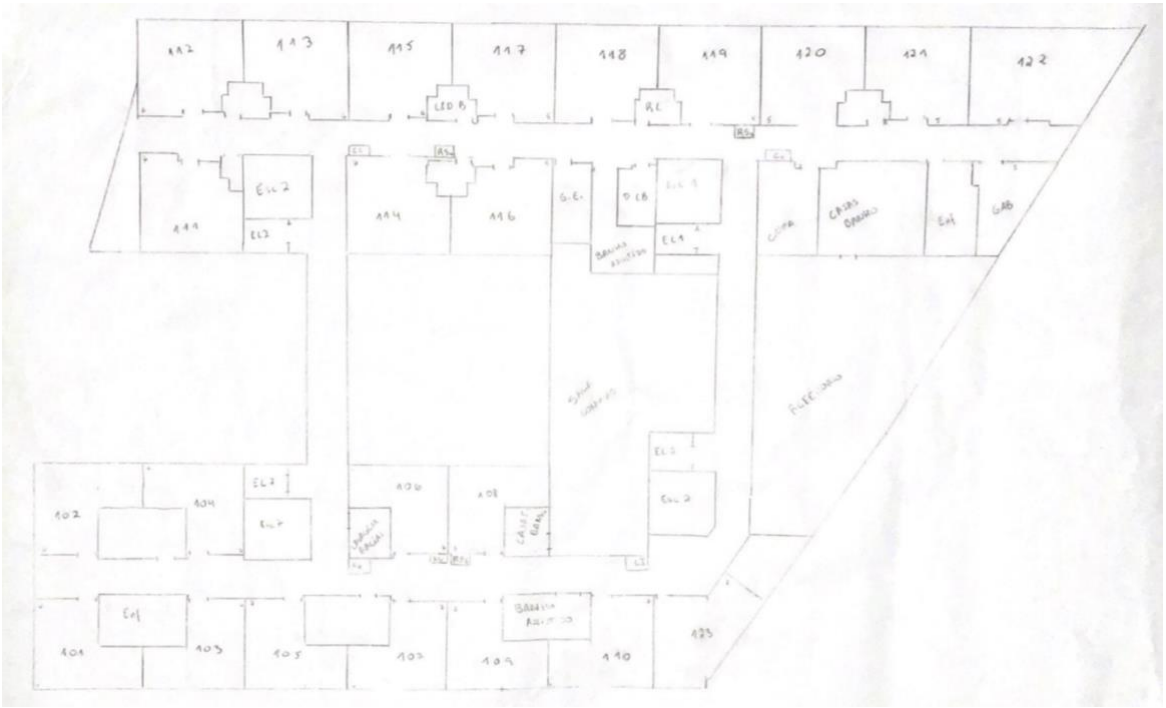
4

Annex C – Floor plans of UCCI Almada

Floor 0



Floor 1



Annex D – Expected results of implementing Proposal II to M3+4, M6 and M8+9

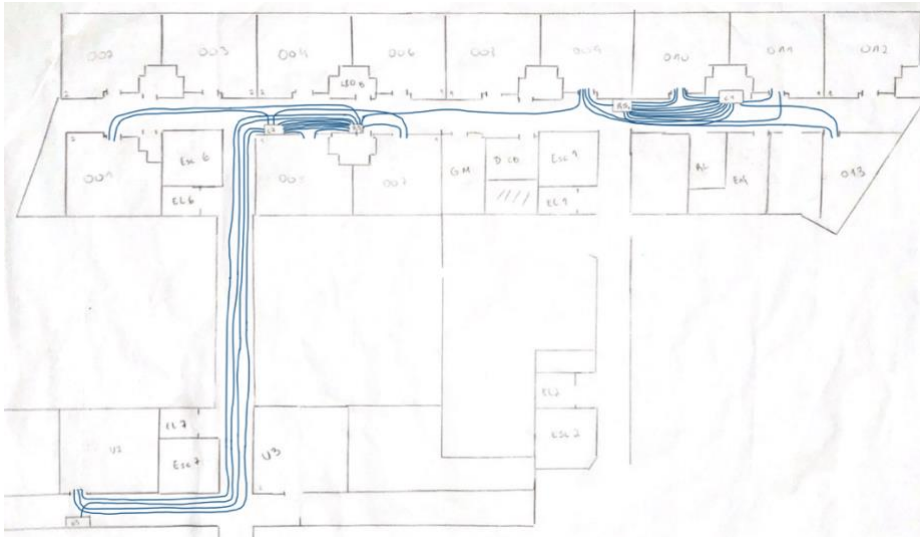
Complete Hygiene subprocess

Legend for the hereafter tables: C1-C6 – hygiene carts; RS1-RS5 – laundry carts; numbers 001-123 and U1-U2 – rooms.

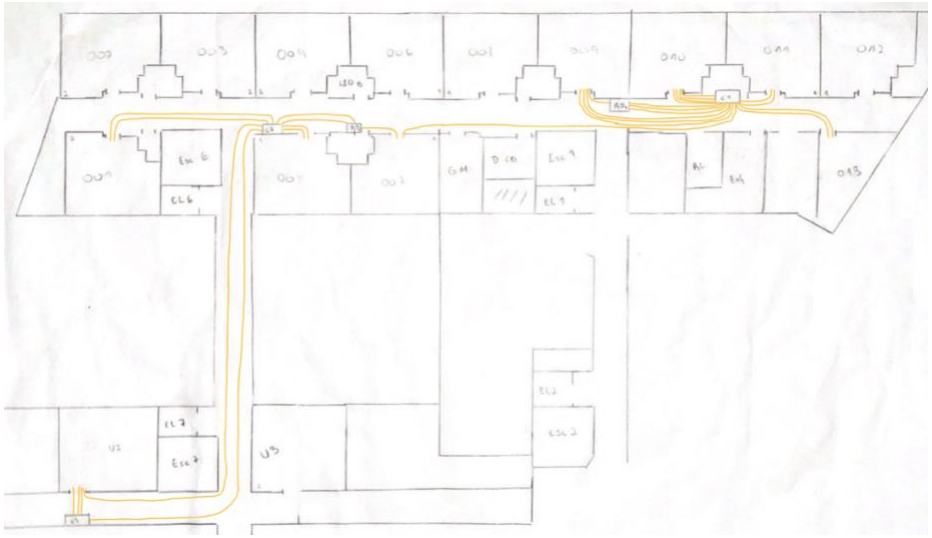
M3+4			
Current Scenario		**Proposal II**	
Path	**Meters**	**Path**	**Meters**
C1-013	8	C1-013	8
013-RS1	15,5	013-C1	8
RS1-C1	7,5	C1-011	3
C1-011	3	011-C1	3
011-RS1	10,5	C1-010	3,5
RS1-C1	7,5	010-C1	3,5
C1-010	3,5	C1-010	3,5
010-RS1	4	010-C1	3,5
RS1-C1	7,5	C1-009	9,5
C1-010	3,5	009-RS1	2,5
010-RS1	4	RS1-C1	7,5
RS1-C1	7,5	C1-009	9,5
C1-009	9,5	009-C1	9,5
009-RS1	2,5	C1-RS1	7,5
RS1-C1	7,5	RS1-C1	7,5
C1-009	9,5	C1-007	23,5
009-RS2	16,5	007-RS2	3
RS2-C2	5,5	RS2-C2	55
C2-007	8,5	C2-005	1,5
007-RS2	3	005-C2	1,5
RS2-C2	5,5	C2-005	11
C2-005	1,5	005-C2	11
005-RS2	3	C2-001	37,5
RS2-C2	5,5	001-C2	1
C2-001	11	C2-U2	1
001-RS2	16,5	U2-C3	1

RS2-C2	5,5	C3-U2	38,5
C2-U2	37,5	U2-C3	5,5
U2-RS2	45,5	C3-C2	
RS2-C2	5,5	C2-RS2	
C2-U2	37,5		
U2-C3	1		
C3-RS2	46,5		
TOTAL (meters)	366,5		231
TIME (seconds)	305		193

M3+4



Current Scenario

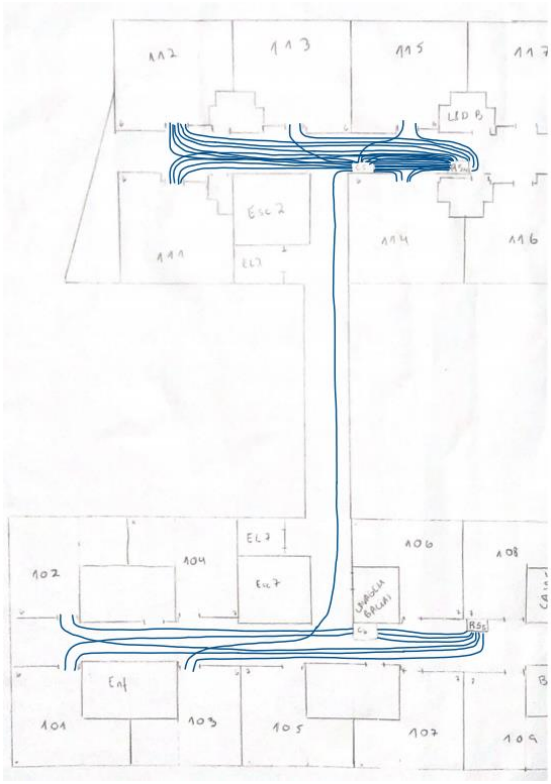


Proposal II

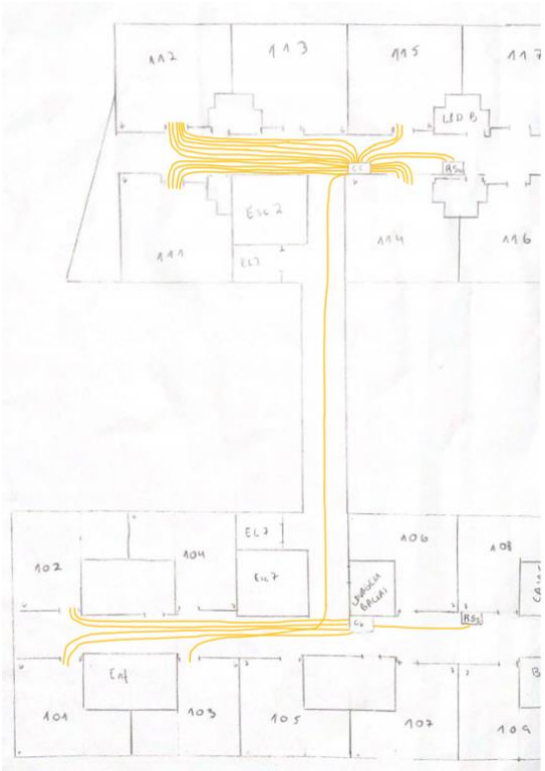
M6				M8+9			
Current Scenario		**Proposal II**		**Current Scenario**		**Proposal II**	
Path	**Meters**	**Path**	**Meters**	**Path**	**Meters**	**Path**	**Meters**
C5-114	1,5	C5-114	1,5	C4-121	9,5	C4-121	9,5
114-RS4	2,5	114-C5	1,5	121-RS3	10,5	121-RS3	10,5
RS4-C5	5,5	C5-114	1,5	RS3-C4	3	RS3-C4	3
C5-114	1,5	114-C5	1,5	C4-118	12	C4-118	12
114-RS4	2,5	C5-115	2	118-RS3	10	118-RS3	10
RS4-C5	5,5	115-C5	2	RS3-C4	3	RS3-C4	3
C5-115	2	C5-113	5,5	C4-118	12	C4-118	12
115-RS4	5,5	113-C5	5,5	118-RS4	10,5	118-RS4	10,5
RS4-C5	5,5	C5-112	11	RS4-C5	5,5	RS4-C5	5,5
C5-113	5,5	112-C5	11	C5-117	10	C5-117	10
113-RS4	3,5	C5-112	11	117-RS4	4,5	117-RS4	4,5
RS4-C5	5,5	112-C5	11	RS4-C5	5,5	RS4-C5	5,5
C5-112	11	C5-112	11	C5-116	9	C5-116	9
112-RS4	17	112-C5	11	116-RS4	3,5	116-RS4	3,5
RS4-C5	5,5	C5-111	10	RS4-C5	5,5	RS4-C5	5,5
C5-112	11	111-C5	10	C5-104	35	C5-104	35
112-RS4	17	C5-RS4	5,5	104-RS5	16,5	105-C6	10
RS4-C5	5,5	RS4-C5	5,5	RS5-C6	6,5	C6-101	18
C5-112	11	C5-103	36,5	C6-101	18	101-C6	18
112-RS4	17	103-C6	11	101-RS5	24,5	C6-105	5
RS4-C5	5,5	C6-102	17	RS5-C6	6,5	105-C6	5
C5-111	10	102-C6	17	C6-105	5	C6-107	2,5
111-RS4	16,5	C6-101	18	105-RS5	11,5	107-C6	2,5
RS4-C5	5,5	101-C6	18	RS5-C6	6,5	C6-107	2,5
C5-111	10	C6-RS5	6,5	C6-107	2,5	107-C6	2,5
111-RS4	16,5			107-RS5	4,5	C6-106	1,5
RS4-C5	5,5			RS5-C6	6,5	106-C6	1,5
C5-103	36,5			C6-107	2,5	C6-110	16,5
103-RS5	17,5			107-RS5	4,5	110-C6	16,5
RS5-C6	6,5			RS5-C6	6,5	C6-RS5	6,5
C6-102	17			C6-106	1,5		

102-RS5	23,5			106-RS5	3,5		
RS5-C6	6,5			RS5-C6	6,5		
C6-101	18			C6-110	16,5		
101-C6	18			110-C6	16,5		
C6-RS5	6,5			C6-RS5	6,5		
TOTAL (meters)	361		242		322		257,5
TIME (seconds)	301		202		268		215

M6

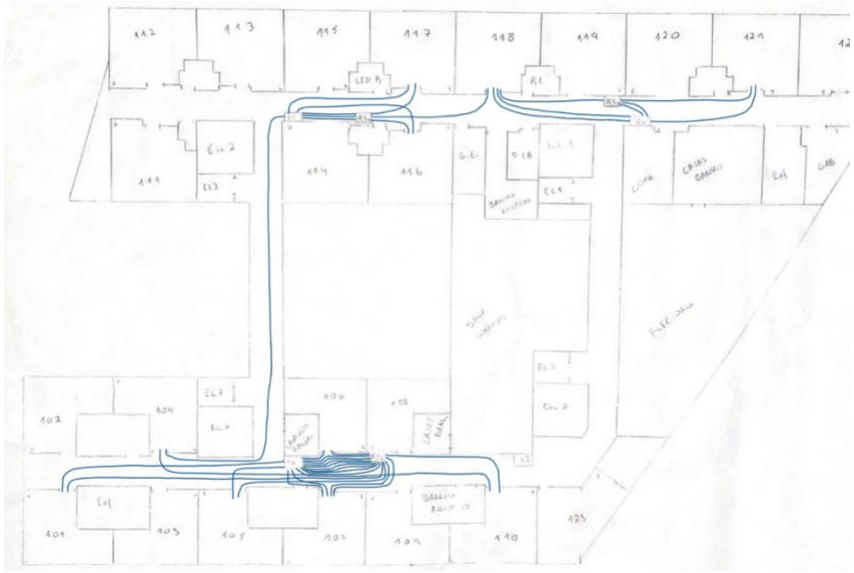


Current Scenario



Proposal II

M8+9



Current Scenario

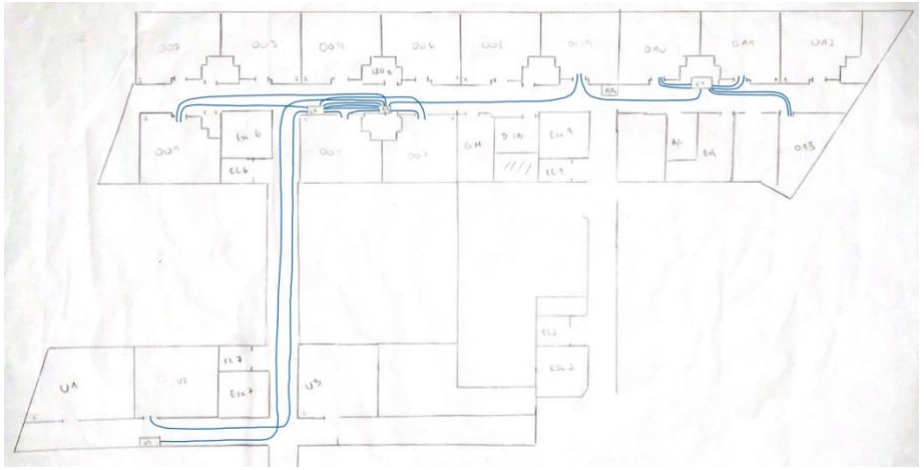
Proposal II

Clean rooms subprocess

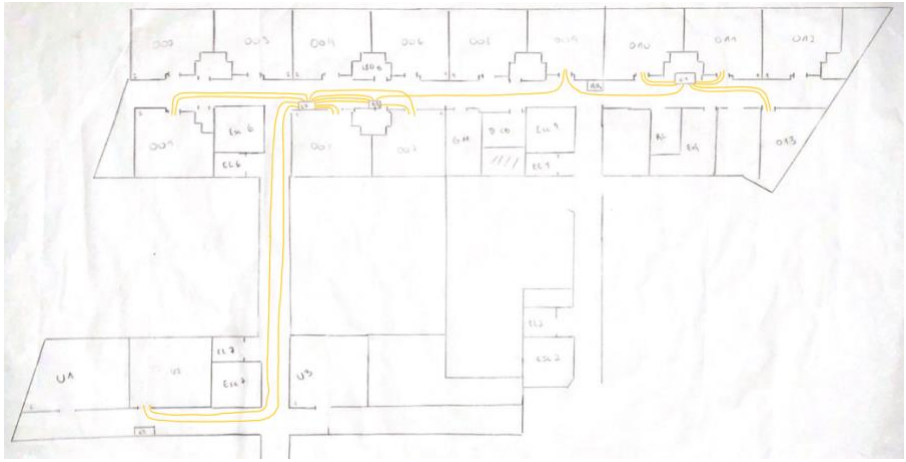
Legend for the hereafter tables: C1-C6 – hygiene carts; RS1-RS5 – laundry carts; numbers 001-123 and U1-U3 – rooms.

M3+4			
Current Scenario		**Proposal II**	
Path	**Meters**	**Path**	**Meters**
C1-013	8	C1-013	8
013-C1	8	013-C1	8
C1-011	3	C1-011	3
011-C1	3	011-C1	3
C1-010	3,5	C1-010	3,5
010-C1	3,5	010-C1	3,5
C1-009	9,5	C1-009	9,5
009-RS2	16,5	009-RS2	16,5
RS2-C2	5,5	RS2-C2	5,5
C2-007	8,5	C2-007	8,5
007-RS2	3	007-RS2	3
RS2-C2	5,5	RS2-C2	5,5
C2-005	1,5	C2-005	1,5
005-RS2	3	005-C2	1,5
RS2-C2	5,5	C2-001	11
C2-001	11	001-C2	11
001-RS2	16,5	C2-U2	37,5
RS2-C2	5,5	U2-C2	37,5
C2-U2	37,5	C2-RS2	5,5
U2-C3	1		
C3-RS2	46,5		
TOTAL (meters)	205,5		183
TIME (seconds)	171		153

M3+4



Current Scenario

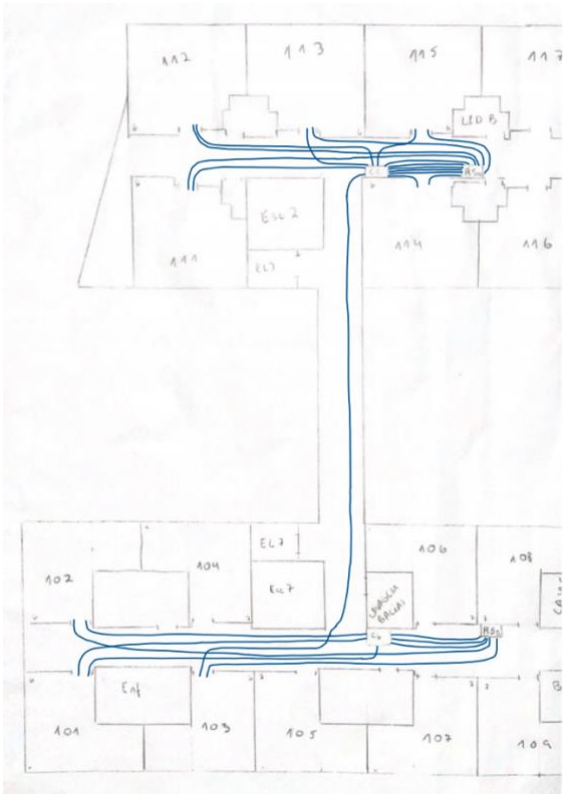


Proposal II

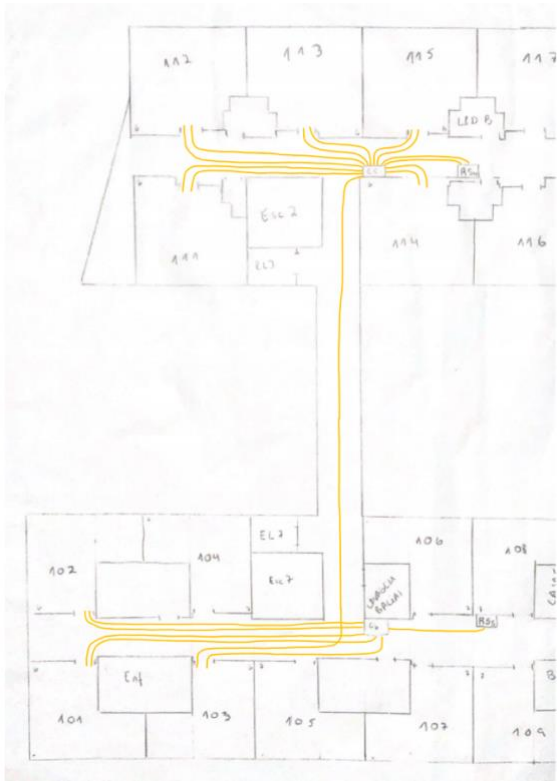
M6				M8+9			
Current Scenario		Proposal II		Current Scenario		Proposal II	
Path	Meters	Path	Meters	Path	Meters	Path	Meters
C5-114	1,5	C5-114	1,5	C4-121	9,5	C4-121	9,5
114-RS4	2,5	114-C5	1,5	121-RS3	10,5	121-RS3	10,5
RS4-C5	5,5	C5-115	2	RS3-C4	3	RS3-C4	3
C5-115	2	115-C5	2	C4-120	2	C4-120	2
115-RS4	5,5	C5-113	5,5	120-C4	2	120-C4	2
RS4-C5	5,5	113-C5	5,5	C4-118	12	C4-118	12
C5-113	5,5	C5-112	11	118-RS4	10,5	118-RS4	10,5
113-RS4	3,5	112-C5	11	RS4-C5	5,5	RS4-C5	5,5
RS4-C5	5,5	C5-111	10	C5-117	10	C5-117	10
C5-112	11	111-C5	10	117-RS4	4,5	117-RS4	4,5
112-RS4	17	C5-RS4	5,5	RS4-C5	5,5	RS4-C5	5,5
RS4-C5	5,5	RS4-C5	5,5	C5-116	9	C5-116	9
C5-111	10	C5-103	36,5	116-C5	9	116-C5	9
111-RS4	16,5	103-C6	11	C5-104	35	C5-104	35
RS4-C5	5,5	C6-102	17	104-RS5	16,5	104-C6	10
C5-103	36,5	102-C6	17	RS5-C6	6,5	C6-101	18
103-RS5	17,5	C6-101	18	C6-101	18	101-C6	18
RS5-C6	6,5	101-C6	18	101-RS5	24,5	C6-103	11
C6-102	17	C6-RS5	6,5	RS5-C6	6,5	103-C6	11
102-RS5	23,5			C6-103	11	C6-105	5
RS5-C6	6,5			103-C6	11	105-C6	5
C6-101	18			C6-105	5	C6-107	2,5
101-C6	18			105-RS5	11,5	107-C6	2,5
C6-RS5	6,5			RS5-C6	6,5	C6-106	1,5
				C6-107	2,5	106-C6	1,5
				107-RS5	4,5	C6-110	16,5
				RS5-C6	6,5	110-C6	16,5
				C6-106	1,5	C6-RS5	6,5
				106-RS5	3,5		
				RS5-C6	6,5		
				C6-110	16,5		

				110-C6	16,5		
				C6-RS5	6,5		
TOTAL (meters)	252,5		195		309,5		253,5
TIME (seconds)	210		163		258		211

M6

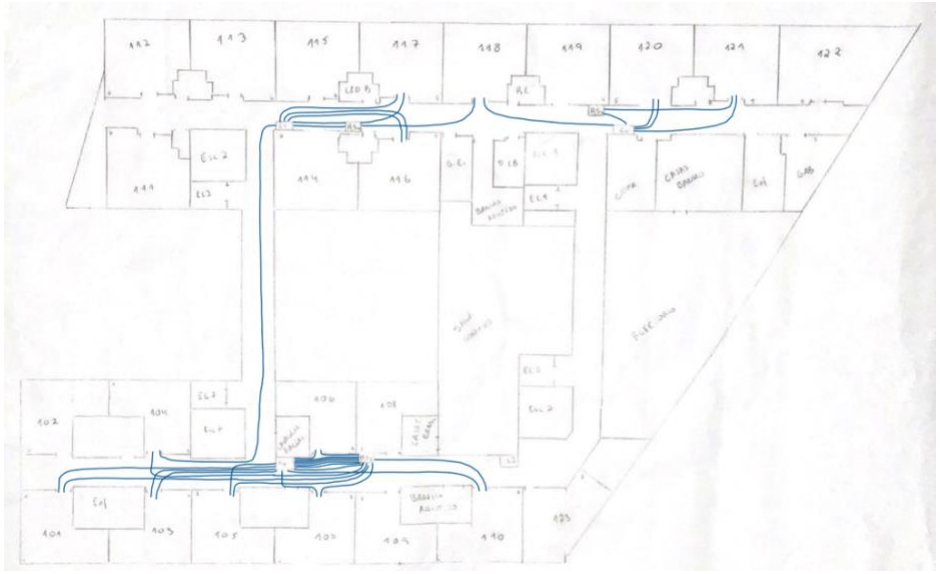


Current Scenario



Proposal II

M8+9



Current Scenario

Proposal II

Annex E – Expected results of implementing Proposal III to M3+4, M6 and M8+9

Legend for the hereafter tables: C1-C6 – hygiene carts; CI – new hygiene cart. RS1-RS5 – laundry carts; numbers 001-123 and U1-U2 – rooms.

M3+4							
Current Scenario		**Proposal III_1**		**Proposal III_2**		**Proposal III_3**	
Path	**Meters**	**Path**	**Meters**	**Path**	**Meters**	**Path**	**Meters**
C1-013	8	C1-013	8	C1-013	8	C1-013	8
013-RS1	15,5	013-RS1	15,5	013-RS1	15,5	013-011	4,5
RS1-C1	7,5	RS1-C1	7,5	RS1-011	10,5	011-010	6,5
C1-011	3	C1-011	3	011-RS1	10,5	010-RS1	4
011-RS1	10,5	011-RS1	10,5	RS1-010	4	RS1-009	2,5
RS1-C1	7,5	RS1-C1	7,5	010-RS1	4	009-007	14
C1-010	3,5	C1-010	3,5	RS1-009	2,5	007-RS2	3
010-RS1	4	010-RS1	4	009-RS1	2,5	RS2-005	3
RS1-C1	7,5	RS1-C1	7,5	RS1-007	3	005-001	13
C1-010	3,5	C1-009	9,5	007-RS2	3	001-U2	46
010-RS1	4	009-RS2	16,5	RS2-005	3	U2-C3	1
RS1-C1	7,5	RS2-C2	5,5	005-RS2	3	C3-RS2	46,5
C1-009	9,5	C2-007	8,5	RS2-001	16,5		
009-RS1	2,5	007-RS2	3	001-RS2	16,5		
RS1-C1	7,5	RS2-C2	5,5	RS2-U2	45,5		
C1-009	9,5	C2-005	1,5	U2-C3	1		
009-RS2	16,5	005-RS2	3	C3-RS2	46,5		
RS2-C2	5,5	RS2-C2	5,5				
C2-007	8,5	C2-001	11				
007-RS2	3	001-RS2	16,5				
RS2-C2	5,5	RS2-C2	5,5				
C2-005	1,5	C2-U2	37,5				
005-RS2	3	U2-C3	1				
RS2-C2	5,5	C3-RS2	46,5				
C2-001	11						
001-RS2	16,5						
RS2-C2	5,5						

C2-U2	37,5						
U2-RS2	45,5						
RS2-C2	5,5						
C2-U2	37,5						
U2-C3	1						
C3-RS2	46,5						
TOTAL (meters)	366,5		243,5		195,5		152
TIME (seconds)	305		203		202		157

M6							
Current Scenario		**Proposal III_1**		**Proposal III_2**		**Proposal III_3**	
Path	**Meters**	**Path**	**Meters**	**Path**	**Meters**	**Path**	**Meters**
C5-114	1,5	C5-114	1,5	C5-114	1,5	C5-114	1,5
114-RS4	2,5	114-RS4	2,5	114-RS4	2,5	114-115	1
RS4-C5	5,5	RS4-C5	5,5	RS4-115	5,5	115-113	6,5
C5-114	1,5	C5-115	2	115-RS4	5,5	113-112	6,5
114-RS4	2,5	115-RS4	5,5	RS4-113	3,5	112-111	1
RS4-C5	5,5	RS4-C5	5,5	113-RS4	3,5	111-103	44,5
C5-115	2	C5-113	5,5	RS4-112	17	103-101	6,5
115-RS4	5,5	113-RS4	3,5	112-RS4	17	101-102	1
RS4-C5	5,5	RS4-C5	5,5	RS4-111	16,5	102-C6	17
C5-113	5,5	C5-112	11	111-RS4	16,5	C6-RS5	6,5
113-RS4	3,5	112-RS4	17	RS4-103	17,5		
RS4-C5	5,5	RS4-C5	5,5	103-RS5	17,5		
C5-112	11	C5-111	10	RS5-102	23,5		
112-RS4	17	111-RS4	16,5	102-RS5	23,5		
RS4-C5	5,5	RS4-C5	5,5	RS5-101	24,5		
C5-112	11	C5-103	36,5	101-C6	18		
112-RS4	17	103-RS5	17,5	C6-RS5	6,5		
RS4-C5	5,5	RS5-C6	6,5				
C5-112	11	C6-102	17				
112-RS4	17	102-RS5	23,5				

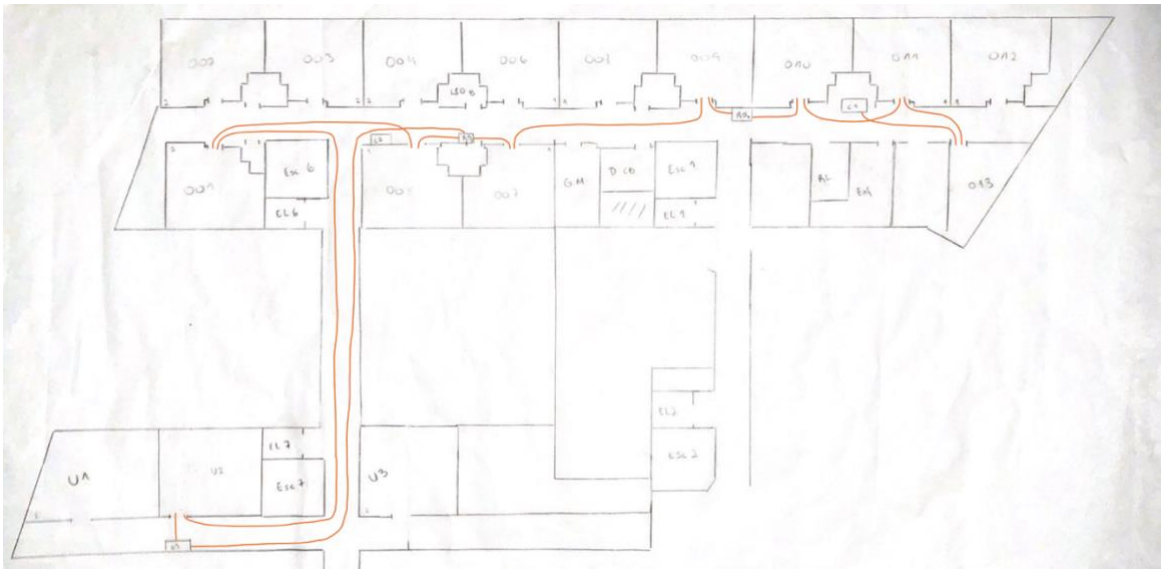
RS4-C5	5,5	RS5-C6	6,5				
C5-111	10	C6-101	18				
111-RS4	16,5	101-C6	18				
RS4-C5	5,5	C6-RS5	6,5				
C5-111	10						
111-RS4	16,5						
RS4-C5	5,5						
C5-103	36,5						
103-RS5	17,5						
RS5-C6	6,5						
C6-102	17						
102-RS5	23,5						
RS5-C6	6,5						
C6-101	18						
101-C6	18						
C6-RS5	6,5						
TOTAL (meters)	361		252,5		220		92
TIME (seconds)	301		210		227		95

M8+9							
Current Scenario		**Proposal III_1**		**Proposal III_2**		**Proposal III_3**	
Path	**Meters**	**Path**	**Meters**	**Path**	**Meters**	**Path**	**Meters**
C4-121	9,5	C4-121	9,5	CI-110	2,5	CI-110	2,5
121-RS3	10,5	121-RS3	10,5	110-RS5	10	110-107	13
RS3-C4	3	RS3-C4	3	RS5-107	4,5	107-106	1
C4-118	12	C4-118	12	107-RS5	4,5	106-104	13
118-RS3	10	118-RS4	10,5	RS5-106	3,5	104-101	7,5
RS3-C4	3	RS4-C5	5,5	106-RS5	3,5	101-105	13
C4-118	12	C5-117	10	RS5-104	16,5	105-RS4	36
118-RS4	10,5	117-RS4	4,5	104-RS5	16,5	RS4-116	3,5
RS4-C5	5,5	RS4-C5	5,5	RS5-105	11,5	116-117	1

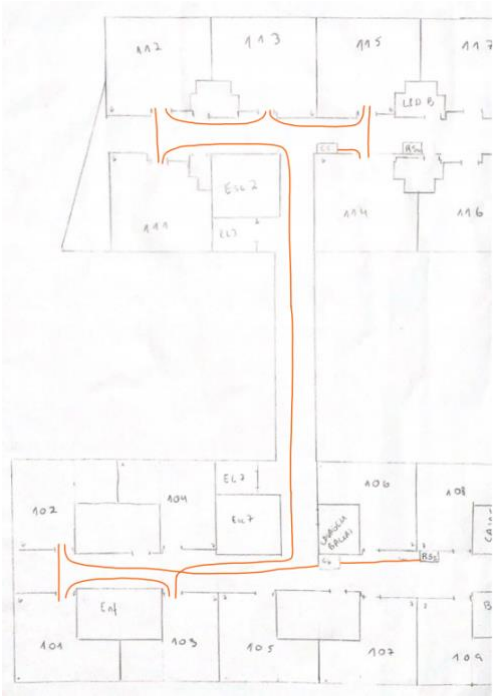
C5-117	10	C5-116	9	105-RS4	36	117-118	6,5
117-RS4	4,5	116-RS4	3,5	RS4-117	4,5	118-RS3	10
RS4-C5	5,5	RS4-C5	5,5	117-RS4	4,5	RS3-121	10,5
C5-116	9	C5-104	35	RS4-118	10,5	121-C4	9,5
116-RS4	3,5	104-RS5	16,5	118-RS3	10	C4-RS3	3
RS4-C5	5,5	RS5-C6	6,5	RS3-121	10,5		
C5-104	35	C6-101	18	121-C4	9,5		
104-RS5	16,5	101-RS5	24,5	C4-RS3	3		
RS5-C6	6,5	RS5-C6	6,5				
C6-101	18	C6-105	5				
101-RS5	24,5	105-RS5	11,5				
RS5-C6	6,5	RS5-C6	6,5				
C6-105	5	C6-107	2,5				
105-RS5	11,5	107-RS5	4,5				
RS5-C6	6,5	RS5-C6	6,5				
C6-107	2,5	C6-106	1,5				
107-RS5	4,5	106-RS5	3,5				
RS5-C6	6,5	RS5-C6	6,5				
C6-107	2,5	C6-110	16,5				
107-RS5	4,5	110-C6	16,5				
RS5-C6	6,5	C6-RS5	6,5				
C6-106	1,5						
106-RS5	3,5						
RS5-C6	6,5						
C6-110	16,5						
110-C6	16,5						
C6-RS5	6,5						
TOTAL (meters)	322		283,5		161,5		130
TIME (seconds)	268		236		167		134

Annex F – Spaghetti diagrams of M3+4, M6 and M8+9, upon implementing Proposal III_3

M3+4



M6



M8+9

Annex G - Expected results of implementing Proposal IV to M3+4, M6 and M8+9

Legend for the hereafter tables: C1-C6 – hygiene carts; CI – new hyiene cart. RS1-RS5 – laundry carts; numbers 001-123 and U1-U2 – rooms.

M3+4			
Proposal IV_1		**Proposal IV_2**	
Path	**Meters**	**Path**	**Meters**
C1-013	8	C1-013	8
013-RS1	15,5	013-011	4,5
RS1-C1	7,5	011-010	6,5
C1-011	3	010-RS1	4
011-RS1	10,5	RS1-009	2,5
RS1-C1	7,5	009-007	14
C1-010	3,5	007-RS2	3
010-RS1	4	RS2-005	3
RS1-C1	7,5	005-001	13
C1-010	3,5	001-U2	46
010-RS1	4	U2-C3	1
RS1-C1	7,5	C3-RS2	46,5
C1-009	9,5		
009-RS1	2,5		
RS1-C1	7,5		
C1-009	9,5		
009-RS2	16,5		
RS2-C2	5,5		
C2-007	8,5		
007-RS2	3		
RS2-C2	5,5		
C2-005	1,5		
005-RS2	3		
RS2-C2	5,5		
C2-001	11		
001-RS2	16,5		
RS2-C2	5,5		

C2-U2	37,5		
U2-RS2	45,5		
RS2-C2	5,5		
C2-U2	37,5		
U2-C3	1		
C3-RS2	46,5		
	366,5		152
	305		157

M6				**M8+9**			
Current Scenario		**Proposal II**		**Current Scenario**		**Proposal II**	
Path	**Meters**	**Path**	**Meters**	**Path**	**Meters**	**Path**	**Meters**
C5-114	1,5	C5-114	1,5	C4-121	9,5	CI-110	2,5
114-RS4	2,5	114-115	1	121-RS3	10,5	110-107	13
RS4-C5	5,5	115-113	6,5	RS3-C4	3	107-106	1
C5-114	1,5	113-112	6,5	C4-120	2	106-104	13
114-RS4	2,5	112-111	1	120-RS3	4,5	104-101	7,5
RS4-C5	5,5	111-103	44,5	RS3-C4	3	101-103	6,5
C5-115	2	103-101	6,5	C4-118	12	103-105	6,5
115-RS4	5,5	101-102	1	118-RS3	10	105-RS4	36
RS4-C5	5,5	102-C6	17	RS3-C4	3	RS4-116	3,5
C5-115	2	C6-RS5	6,5	C4-118	12	116-117	1
115-RS4	5,5			118-RS4	10,5	117-118	6,5
RS4-C5	5,5			RS4-C5	5,5	118-RS3	10
C5-113	5,5			C5-117	10	RS3-120	4,5
113-RS4	3,5			117-RS4	4,5	120-121	6,5
RS4-C5	5,5			RS4-C5	5,5	121-C4	9,5
C5-112	11			C5-116	9	C4-RS3	3
112-RS4	17			116-RS4	3,5		
RS4-C5	5,5			RS4-C5	5,5		
C5-112	11			C5-104	35		
112-RS4	17			104-RS5	16,5		
RS4-C5	5,5			RS5-C6	6,5		
C5-112	11			C6-101	18		
112-RS4	17			101-RS5	24,5		

RS4-C5	5,5			RS5-C6	6,5		
C5-111	10			C6-103	11		
111-RS4	16,5			103-RS5	17,5		
RS4-C5	5,5			RS5-C6	6,5		
C5-111	10			C6-105	5		
111-RS4	16,5			105-RS5	11,5		
RS4-C5	5,5			RS5-C6	6,5		
C5-103	36,5			C6-107	2,5		
103-RS5	17,5			107-RS5	4,5		
RS5-C6	6,5			RS5-C6	6,5		
C6-102	17			C6-107	2,5		
102-RS5	23,5			107-RS5	4,5		
RS5-C6	6,5			RS5-C6	6,5		
C6-102	17			C6-106	1,5		
102-RS5	23,5			106-RS5	3,5		
RS5-C6	6,5			RS5-C6	6,5		
C6-101	18			C6-110	16,5		
101-RS5	24,5			110-C6	16,5		
RS5-C6	6,5			C6-RS5	6,5		
C6-101	18						
101-RS5	24,5						
RS5-C6	6,5						
C6-101	18						
101-C6	18						
C6-RS5	6,5						
TOTAL (meters)	519		92		366,5		130,5
TIME (seconds)	433		95		305		135