

HOW CAN THE USE OF TECHNOLOGY IMPROVE THE HUMAN
CONDITIONS OF REFUGEE CAMPS ACROSS EUROPEAN BORDERS?

THE INTERVENTION OF FRUGAL INNOVATION IN THE IMPROVEMENT OF LIVING
CONDITIONS

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Dissertation submitted in partial fulfilment of requirements for the MSc Master in Management
of Services and Technology at ISCTE Business School

October 2018

Abstract

The world is experiencing the greatest refugee crisis ever since the Second World War. The numbers are frightening and surpass the acceptable barrier.

European Refugee camps strive hard to asylum those who arrive and escape the war, but it also violates some human rights in different aspects.

From this context, the present dissertation proposes to work this challenge with the use of technology in the improvement of human conditions lived in refugee camps.

Several people were interviewed in order to ascertain the main difficulties experienced in the European refugee camps. These people have direct access to these problems and therefore have the knowledge and experience to opine on the subject, being able to point out possible solutions.

The results point to the urgency of resolving human conditions of dignity - privacy, access to sanitary structures, safety in sleep and lack of occupation of the adults.

Based on literature and official documents' research, frugal innovation - concept explored throughout this study - is a constantly evolving concept, capable of satisfying needs at low cost, sustainability and great quantities, being possible to fill the necessities of a great number of people.

3D printing and cork bricks have proved to be solutions that meet the concept defined as the basis for this study. Both technologies may allow to solve many of the problems found at refugee camps, and represent solutions that are sustainable, economical and easy to implement, requiring reduced resources, compared to the quantity currently required.

Keywords: Frugal Innovation, Humanitarian Logistics, 3D Printing, Cork.

JEL Classification: Y40; O30

Resumo

O mundo vive actualmente a maior crise de refugiados de todos os tempos depois da Segunda Guerra Mundial. Os números são assustadores e ultrapassam a barreira do aceitável.

Os campos de refugiados espalhados pela europa esforçam-se arduamente para oferecer asilo àqueles que chegam e tentar fugir da guerra, mas ainda assim, violam alguns direitos humanos em diferentes aspectos

A partir deste contexto, a presente dissertação propõe trabalhar este desafio com o uso da tecnologia na melhoria das condições humanas vivenciadas em campos de refugiados.

Foram entrevistadas várias pessoas de forma a averiguar os principais problemas e dificuldades vividos nos campos de refugiados europeus. Estas pessoas tiveram acesso directo a estes problemas e desta forma têm o conhecimento e a experiencia para sugerir possíveis soluções.

Os resultados apontam para a urgência em resolver condições de dignidade humana - privacidade, acesso a estruturas sanitárias, segurança e falta de ocupação dos adultos.

Baseado na literatura e documentos oficiais, a inovação frugal - conceito explorado ao longo deste estudo - é um conceito em constante evolução, capaz de satisfazer necessidades a baixo custo, de forma sustentável e em grandes quantidades, sendo possível preencher as necessidades de um grande número de pessoas.

A impressão 3D e o uso da cortiça provaram ser soluções que satisfazem o conceito definido como base para este estudo. Ambas as tecnologias permitem resolver muitos dos problemas encontrados nos campos de refugiados, e representam soluções sustentáveis, económicas e fáceis de implementar, exigindo recursos reduzidos, em comparação com a quantidade actualmente exigida.

Palavras-chave: Inovação Frugal, Logística Humanitária, Impressão 3D, Cortiça.

Classificação JEL: Y40; O30

Acknowledgements

I would like and dedicate my thesis to all the people that were present in this path. I feel truly blessed to have them in my life. This thesis is a very important milestone in my professional and academic life and all of the below mentioned had an essential role to make it happen.

First, I thank to my parents that educated me and grew me up with ethical values and orientation to conquer by myself all my goals and dreams. They taught me that helping others is the most amazing thing to do and I learned with them the pleasure of making the difference with actions. My love for Humanitarians came from them.

Secondly, I thank to Eduardo, my boyfriend. He supported me, believed in me since the first Word Document I opened to start writing the thesis, and cleaned up all the blood, sweat and tears this research demanded from me.

My friends are also very important to mention. All of them were crucial when it came to encouraging me to focus on the research, as well as stop it and have some fun. Special thanks to my best friend, Catarina Burguete.

All of this would be impossible without the infinite patience, calm and knowledge of my supervisor. Professor Teresa Grilo was truly the best professor I have ever had, full of life, things to teach and enthusiasm. It was always amazing whenever I reached out any result. And I feel we dreamt together about the possible future of this investigation.

A huge thank to all the interviewees that contributed to this thesis with great inputs, suggestions and experiences. They made me want to leave everything and join them on their work. Distinctive thanks to Francisco Tenente, AMI, Catarina Reynolds Brandão, Santa Casa da Misericórdia and Plataforma de Apoio aos Refugiados.

Finally, I deeply want to thank to all the people that, quoting them, said “*Working at Deloitte and writing a thesis is literally impossible*”. They made me want to show them they were wrong and it is, indeed, possible.

Thank you, very much.

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Everyone has the right to seek and to enjoy in other countries asylum from persecution.

Article 14° from The Universal Declaration of Human Rights

United Nations General Assembly

1. Introduction

This chapter aims to put in context the reader, providing a global vision about the research in question. It includes a context on the situation, the mains goals of this thesis, a resume of the methodology used, the scope and the structure of the entire document.

1.1 Setting the context

The United Nations embrace crisis management in various domains and at complicated levels of emergency over its main agencies and delegations (Jeong & Yeo, 2017).

According to Shaluf *et al* (2003), there are two types of crisis: Community and Non-Community crisis. The first one includes natural crisis, industrial crisis (that consist in man-made disaster – Chernobyl, for example) and non-industrial crisis (that integrate internal and external conflict situations; and non-conflict type situations). Non-community crisis contain mostly transportation accidents, which do not affect or threat a community. The following figure – figure 1 – details the types of crisis.

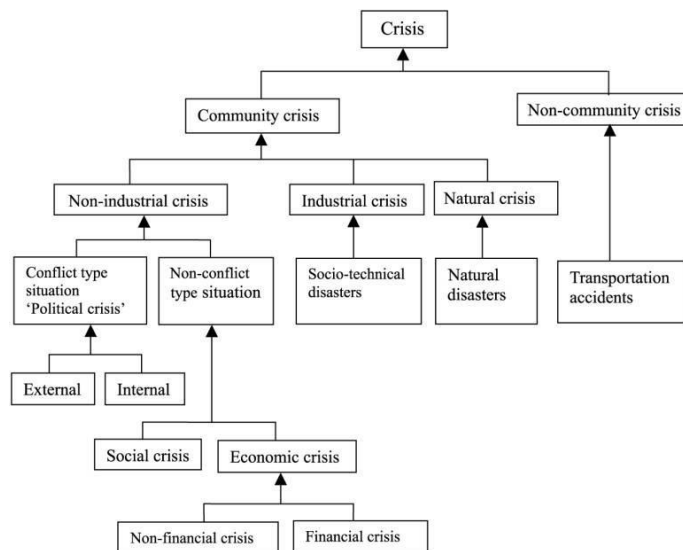


Figure 1 | Types of Crisis (Shaluf *et al*, 2003)

Humanitarian Crises – or community crisis - are demanding, exigent, stressful, originated by multiple factors and complex to a point that United Nations (UN) have significant difficulties in supplying assistance and help to victims. The main reasons for this to happen is that the Government of the country concerned or a strong non-state entity rejects to UN the entrance to these unprotected and unsafe communities (UN Chronicle, 2011).

Accordingly to the UN, in its OCHA Report of 2014 (p. 24), Humanitarian Crisis is defined as “*an event or series of events that represents a critical threat to the health, safety, security or well-being of a community or other large group of people, usually over a wide area*” These occurrences may be conflicts provoked by internal or external factors. Local, national and international responses are necessary and urgent in such occasions.

Each humanitarian crisis depends on a specific response, addressed to the exact factors affected since different causes generate different crisis. There have been several humanitarian crisis, including the civil war in Syria which started in 2011 and has created one of the worst humanitarian crisis (Yemen is now considered the worst Humanitarian Crisis of all time). Syrian Refugees Crisis continues to be, by far, the biggest driver of migration (BBC Europe, 2016).

The number of refugees and displaced persons now stands at more than 65 million, the largest global displacement of people ever recorded (BBC Europe, 2016). Hundreds of thousands of families and individuals are fleeing to other countries, trying to avoid deplorable and inhumane conditions, both inside their origin countries and in host countries border's refugee camps. More than 1,011,700 arrived by sea, and almost 34,900 by land, passing through Turkey and Albania (see Figure 2). (BBC Europe, 2016).



Figure 2 | Migrants detected entering the EU illegally, 2014-2015 (Frontex on BBC)

Refugees look for a better future in Europe, where peace, wealth and perspectives of job exist, compared to the violence that characterize their home countries.

After allowing the entrance and giving shelter to around 50,000 of people, Greece – the first stop in Europe to people fleeing from Middle East - started to close some refugee camps. Germany is considered the first choice country in Europe and accepted the top number of asylum applications in 2015 - more than 400.000 - (see Figure 3); and Hungary positioned itself in second place in this

matter, with more than 100.000 asylum application in the end of December, considering migrants made their entrance by land through Greece (BBC Europe, 2016).

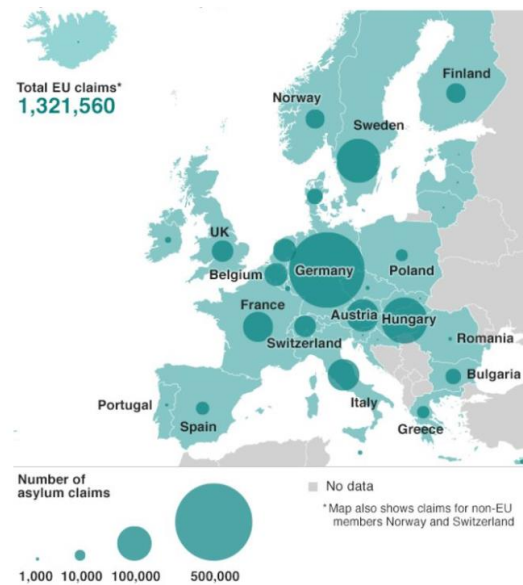


Figure 3 | Asylum claims in Europe, 2015(Eurostat on BBC)

However, before getting an asylum in one of these countries, refugees stay in a camp, located in a country border with thousands other families and individuals that are looking for the same - a Visa, a legal job, an asylum and a society to be integrated. Every day, huge numbers apply for asylum, but the amount of applications approved is far lower. This procedure takes a lot of time, and individuals and families remain in the refugee camp between 2 and 3 months, waiting for their turn to have lucky (BBC Europe, 2016).

This creates a major consequence - poor human conditions in the camps, even though better than in refugee origin's countries. Under these circumstances, the European Refugee Crisis turns to be one of the biggest challenges facing humanity today, so it becomes necessary to intervene in this emergency with decisions that reflect good resource management, investment, and human relations. In this way, humanitarian logistics plays a key role when taking decisions as the ones above mentioned.

Humanitarian Logistics aims at alleviating the suffering of vulnerable people based on a series of processes that involve the management of goods, services and materials, from its origin to its consumption (Thomas & Kopczak, 2005). Its responsibility consists on bringing in and delivering

requested supplies and services when and where they are needed (Christopher & Tatham, 2011). Humanitarian Logistics is thus vital for the success of response of the humanitarian programs, such as health, food, shelter, water, and sanitation (Thomas & Kopczak, 2005).

A suitable utilization of an agile supply chain *“improves the operational efficiency and effectiveness of humanitarian logistic operations”* (Christopher and Tatham, 2011).

In the context of the crisis mentioned, humanitarian agencies are operating with reduced resources with constant rising of demand. *“Technological advancements have played an important role in improving the efficiency and effectiveness of Humanitarian Actions”* (Meier & Leaning, 2009). Thus, there is scope to explore the role of technology in improving living conditions in refugee camps, and in particular the use of technology in the context of scarce resources.

The result of a succeeded humanitarian action stitches on access. *“Technological advances that have recently emerged or become more widely available offer promising opportunities to support and improve humanitarian access”* (Belliveau, 2016). Technology can be used to identify urgent needs and get the basic things to those who need them, which broads the extend of access options, mainly in zones where conflict exists (Belliveau, 2016). *“The use of technology is a must in order to achieve success in humanitarian logistics operations”* (Özdamar & Ertem, 2015).

The Logistics Cluster, an Inter-Agency Standing Committee (IASC), defends that the usage of technology makes the life of refugee's easier, achieving better coordination in relief operations (Logistics Cluster Annual Report, 2017).

To upgrade the impact of humanitarian response, as well as its efficiency and effectiveness humanitarians are gradually opting and twisting their way of work to technological advancements. Several of these technologies have also the ability to assist in suppress some of the challenges of humanitarian access. *“Humanitarians can harness new technologies to provide shelter and other physical structures, as well as transport and even create essential humanitarian items”* (Belliveau, 2016).

Still, technology is not completely explored and has a lot to offer, over than communications, informatics systems, and others. It may help in various ways, to achieve and overcome several challenges faced by humanitarian agencies, increasing the impact of their response.

In light of this trend, this thesis will have its focus on innovative technology as a solution to humanitarian conditions of refugee camps.

Allying the use of technology to a context of scarce resources seems to be in line with the concept of frugal innovation. Having a hard exploration on literature, there is a gap of information.

This is the scope of this thesis.

1.2 Research Question

Focusing on the European Refugee Crisis as the main problem and in the poor and unacceptable human conditions lived in refugee camps across European borders, this thesis will have a deep dive study in the field of logistics, specifically in humanitarian logistics, and will propose and evaluate the usage of alternative technological solutions to solve this problem.

The research question of this thesis thus consists on: ***How the use of technology may improve the living conditions of refugee camps under a context of limited resources?***

1.3 Goals

The general aim of this thesis is to propose alternative solutions, involving technology, to improve the humanitarian conditions in the refugee camps where individuals and families are living to escape from the war in their countries.

There are five specific goals that contribute to achieve the general goal – that goes on with the research question. These goals are shown in the table below.

GOALS OF THESIS

General	Specific
UNDERSTAND THE IMPACT OF TECHNOLOGY TO IMPROVE THE LIVING CONDITIONS OF REFUGEE CAMPS ACROSS EUROPE	› Characterize the European Humanitarian Crisis
	› Identify challenges and difficulties within the life of a refugee in a camp
	› Explore the available technologies with potential to tackle the previously identified challenges and difficulties
	› Evaluate the proposed technological solutions

Table 1 | General and Specific Goals

1.4 Methodology

The research in progress is written under a Case Study methodology.

In accordance to Yin, 2018, a case study method should be used when the type of research answer questions like “*how*” or “*why*”, the extent of control the investigator has over behavioral events is little or does not exist; and the focus of the study is a contemporary or real-life phenomenon. Since the entire investigation covers all these characteristics, the right methodology to use is the Case Study.

In view of the scope of this dissertation, its goals and its research, the steps taken to achieve an answer to the research question in force were divided into three research steps.

The first step contemplates the characterization of the European Humanitarian Crisis – the problem. This characterization involves a description, through different perspectives, of the living conditions in refugee camps, as well as the challenges and difficulties faced by those who live there.

The second step consists in an analysis and exploration of the market to evaluate its offer in terms of technology appropriate to the problem. Under this step, the aim is propose solutions based on the use of technology to solve or improve the problems and difficulties identified in the first step.

Finally yet importantly, the third step falls on the evaluation and validation of proposed solutions throughout the gathered data.

1.5 Scope

The scope of this study is to focus on overall landscape of poor human conditions lived in the European Refugee Camps, provoked by the enormous amount of people living in it, and the possible solutions for these conditions with technology and innovative solutions.

1.6 Thesis Structure

This thesis is organized in six chapters.

On the first chapter, it is presented the context, goals, research question and scope of this dissertation.

The second chapter displays a review of the literature on logistics, humanitarian logistics, humanitarian crisis, the importance of logistics and technology in humanitarian crisis, and the definition of the Frugal Innovation Concept.

In the third chapter it is detailed the methodology used to collect data. This chapter is divided in three sections and all sections use interviews as method for data collection.

The fourth chapter presents an exhaustive description and a chronological explanation of the Refugee Crisis in Europe, clarifying its causes and consequences.

The fifth chapter consists in the Case Study. It characterizes the problem and presents possible solutions based on innovative technology based on the results coming from the data gathered in the first and second sections of the previous chapter – methodology. Over this, the research question under this thesis will be answered.

Finally, the conclusion chapter highlights the viability of this investigation – in reference to the third section of methodology chapter -, along with main findings, possible, concrete and realistic opportunities to contribute to the problem solving, as well as directions for future research.

2. Literature Review

This chapter consists in the definition of crucial concepts that must be explain in order to understand the context of this study.

The literature review falls on the theory of logistics, humanitarian logistics and Frugal Innovation. There is also a deep dive notion on the importance of logistics in humanitarian crisis. The goal of researching these concepts is to bring the author up-to-date with current literature on the topic and other research, as well as determine the gap between what happens in refugee camps, and what should happen there. *“In a review, which forms part of a study, any gaps in knowledge that have been identified should lead logically to the purpose of the proposed study”* (Cronin et al, 2008).

The present chapter is separated in two subchapters – the first one centers on the definition of the concepts that shape this study; the second one solution concept that turns to have potential in the context of the present dissertation – Frugal Innovation. In this last mentioned, it is also presented a parity between the use of Frugal Innovation in crisis and resource problem solving.

2.1 Logistics

Logistics is the concept that defines if a business operation succeeds or fails (Heskett, 1977). This notion performs a crucial part to the greater efficiency and effectiveness in the management of the storage and transportation of materials and final products (Christopher, 2011). Logistics aims to design and define the coordination between all events and actors integrated that are needed to accomplish the ultimate goal of service and quality, *“at the lowest possible cost”* (Fuller et al., 1993).

Actually, logistics may be the strategy key for value creation for customers. The needs of customers are always changing and variating, so companies must customize the logistics process to serve the customers in best way possible. In fact, each industry strive for the best channel of transport, warehousing, handling, and control, which are all delivery characteristics of logistics pipelines (Fuller et al., 1993).

Broadly defined, *“logistics is the process of strategically managing the procurement, movement and storage of materials, parts and finished inventory (and the related information flows) through the organization and its marketing channels in such a way that current and future profit-ability are*

maximized through the cost-effective fulfillment of orders” (Christopher, 2011). Logistics integrates the information, material, communication and control systems, gradually complex, that business required nowadays (Van Wassenhove, 2006).

The Council of Supply Chain Management Professionals defends logistics as a component of the supply chain management which role is to plan, implement, and control the efficiency and effectiveness of storage of goods, services and related information from its origin to its consumption, aiming to meet customer’s needs.

Chang and Xiang-bin defend that urgency and uncertainty arising from sudden and unpredictable events is what separates logistics from emergencies when compared to the business sector (2010).

However, for humanitarians, the definition of logistics falls on another perspective. Essentially, *“logistics is the processes and systems involved in mobilizing people, resources, skills and knowledge to help vulnerable people affected by disaster”* (Van Wassenhove, 2006).

The importance of Logistics in Humanitarian Crisis

Logistics is the most essential part in emergency relief operations (Cozzolino, 2012). It defines if the operation of assistance is a success or a failure (Van Wassenhoven, 2006).

Humanitarian operations contexts involve several actors and parts. Each of these members of the operation have a different role and mission, giving a different logistic contribute to the operation’s success (Balcick *et al*, 2010).

Logistics represents a heavy expenditure in all disaster relief operations: *“it has been estimated that logistics accounts for about 80% of the total costs in disaster relief”* (Van Wassenhoven, 2006).

All the money used in humanitarian aid operations originate from donors (individuals or governments) and logistics companies. As a result, to consume those resources donated in the better and cleaner way possible, it is required for humanitarians to have efficiency and effectiveness in its logistics operations, (Van Wassenhove, 2006). Hence, coordination in humanitarian operations among all participants in the process is a crucial component for the success of the operation, since logistics is concerned with coordinating the delivery of goods and getting the necessary resources to the operation’s needs. (Overstreet *et al*, 2011; Balcick *et al*, 2010).

The actors involved in this operation does not have necessarily to be logisticians or humanitarian logistics managers. Another strategy to improve logistics awareness and response capacity in humanitarian aid is “*involve the local populations and manage coordination between individuals. It will indeed lead to greater efficiency and effectiveness*” (Sheppard *et al*, 2013).

To a successful and efficient usage of the limited resources, that humanitarian organizations have access to, it is fundamental to reach coordination in the relief sector (Balcick *et al*, 2010).

Fritz Institute proposes three crucial motives why logistics has a central role in relief operations (Thomas, 2003; Sauer, 2016; Thomas and Kopczak, 2005):

- i. Logistics has a function of connector among being prepared for a disaster and responding to it. Having active relations with suppliers, prepare stock, have clear notions on local transport conditions and clear procurement procedures are fundamental pillars for this function;
- ii. The capacity of logisticians to carry and obtain the needed resources at the center humanitarian operation will define how fast the humanitarian organizations may response and relief the disaster;
- iii. The information received and obtained by logistics departments offer fundamental notions and knowledge for next events.

Humanitarian logisticians face numerous challenges when dealing with emergencies. Some of these challenges fall on the constant doubt about the existence of resources and its agility on delivering those resources (Kovács & Spens, 2009).

In the general statement, in an emergency relief situation, is central to guarantee efficiency and effectiveness in all the logistic process for a great management of resources in such way that right help and right people focus and reach the victims of the emergency (Cozzolino, 2012).

2.2 Humanitarian Logistics

Humanitarian Logistics – the concept deeply explored in the current subchapter – has recently been the epicenter of investigators attention. This happens due to the ultimate natural and man handed emergencies that naturally lead to the “*recognition of the central role of logistics in responding to relief supply chains*” (Kovács & Spens, 2012).

Multiple definitions about Humanitarian logistics are available in the literature, and presented in the list below.

1. *“Humanitarian Logistics examines challenges faced by those whose role is to organize and distribute resources in difficult situations. It examines the key issues, including warehousing, procurement and finance. It places special emphasis on pre-disaster preparedness rather than post-disaster assistance.”* - Christopher & Tatham, 2011
2. *“A process of planning, managing and controlling the efficient flows of relief, information, and services from the points of origin to the points of destination to meet the urgent needs of the affected people under emergency conditions”* – Sheu, 2007
3. *“The process of planning, implementation and control efficiently, focus on low cost flow and storage of goods and materials, as well as related information, from point of origin to point of consumption for the purpose of relieving the suffering of vulnerable people. Its role encompasses a range of activities, including the planning, preparation, transportation, and acquisition, storage, monitoring and tracking.”* - Kopczak & Thomas, 2005
4. *“The processes and systems involved in mobilizing people, resources, skills and knowledge to help vulnerable People affected by disaster.”* - Van Wassenhove, 2006

Humanitarian relief logistics aims to assure that the right amount of goods and resources are delivered at the right place at the right time to save lives and reduce human suffering, even with economic limitations (Beamon & Balcik, 2008). Supply Chains of humanitarian relief focus on dealing with “*large-scale risks*”. Therefore, its essential skill rests on diverse forms of adversities (Wallace & Webber, 2004). The first principle of *The Principles and Good Practice of Humanitarian Donorship* describe that relieve emergencies and save lives guaranteeing human dignity, during and after tragedies, is the primer goal of humanitarian organizations, as well as prepare the world for the possibility of occurrence of crisis situations (GHD, 2003; Scott, 2014).

Logistical decisions in relief operations must be taken in brief time. Humanitarian logistics include numerous activities, similarly to general business logistics. Among these, one can find planning, transport, inventory, warehousing, and others decisions (Gustavsson, 2003; Thomas & Kopczak, 2005). The fundamentals set by business (or commercial) logistics – that fall in managing

information, available resources and the flow of goods - are also principles for humanitarian logistics (Kovács & Spens, 2007). Nevertheless, some dissimilarities between humanitarian and business logistics must be referred. (Balcik & Beamon, 2008).

In one hand, logistics applied to business allows a better forecast of the demand, although with variable levels of uncertainty associated (Balcik & Beamon, 2008). Commonly, it works with certain factors that are unfamiliar for humanitarian logistics, but already known and expectable for commercial logistics. Those factors are better prediction of demand, predetermined set of suppliers, manufacturing sites, among others (Cassidy, 2003). Commercial logistics is driven by quantity of demand (in form of customers), while humanitarian logistics is determined by availability of supply (in form of donors) (Tomasini & Van Wassenhove, 2004; Roh *et al*, 2015; Balcick & Beamon, 2008).

Nogueira et al. (2007) describe that the main goal of business logistics supply chain is to deliver the right products in the right locations.

In the other hand, humanitarian logistics has a highly uncertain demand with reduced response periods, and it usually relies on a scarcity of a large diversity of funds, such as people, technology, transportation capacity and money (Kovács & Spens, 2009). Humanitarian supply chain uses a similar scheme so that the flow of resources, donations, can arrive by means of distribution of people in difficulties, such as shelters, relatives, churches, among others.

Distanced from commercial supply chain, the humanitarian supply chain has donors and governments as suppliers, instead of retailers and costumers, is the normal and known way (John *et al*, 2012). The figure 4 follows a typical Humanitarian Supply Chain.



Figure 4 | Typical Humanitarian Supply Chain (John *et al*, 2012)

Humanitarian agencies and organizations guarantee that the necessary demand is met at all necessities. They also focus on anticipating other disasters and its response. Any reduction in the lead-time has a significant impact for the whole operation and its success. The plan of any humanitarian operation should spotlight on getting “*maximum response and minimum loss*” (Safeer *et al*, 2014).

Humanitarian aid has great economic impact (Thomas & Fritz, 2006). Developed countries that have the possibility to donor funds to humanitarian aid, stipulate about six billion dollars per year of their budget to help on reducing lost lives and relieve misery and grief. Among these donors are the United States Agency for International Development and the European Commission Humanitarian Office, which have a weigh of 33% and 10% of total humanitarian aid, respectively (Thomas, 2003). In addition, as a complement to these donations from governments of developed countries, some foundations, individuals or private sector companies contribute with capital or other resources (Thomas, 2003).

Among the receiving organizations from this mentioned community of donors, are United Nations entities, International Organizations, Global non-governmental organizations as well as regional and country-specific NGOs.

2.2.1 Humanitarian Logistics – Core Challenges

Humanitarian operations are mostly challenging due to various factors and conditions.

According to Van der Laan, *et al.* (2016), there are three types of factors that characterize the challenges faced by humanitarians: i) endogenous factors relate to the way operations are managed and are factors controlled by the humanitarian supply chain actors; ii) non-situational exogenous factors are features of relief context that are not related with the affected zone; and iii) situational exogenous factors are out of control of the supply chain actors, since these are from the outside of the operation. These factors are listed below.

1. **Endogenous Factors** - Factors related with human resources (a), technology usage (b) and coordination of activities (c) are the main examples.
 - a. Finding logistically qualified staff is a challenge. The available human resources with supply chain responsibilities often do not have skills in logistics, which blocks an efficient use of resources (VanWassenhove, 2006; Thomas & Kopczak, 2005). In

addition, high turnover rates turns the knowledge transfer a difficulty to overcome (Kovács & Spens, 2009; Van der Laan *et al.*, 2016).

- b. Inadequate access information systems and technology leads to major challenges on data analysis and information collection, being difficult to create performance indicators (Lee & Lee, 2007; Van der Laan *et al.*, 2016; Thomas & Kopczak, 2005).
- c. Coordination deficit between supply chain actors (Thomas & Kopczak, 2005; Kovács & Spens, 2007; Samii, 2010) and donors or providers (Van der Laan *et al.*, 2016) results in a lower level of demand satisfaction, and, consequently, an oversupply in some regions and under-supply in others (Thomas and Kopczak, 2005; Van der Laan *et al.*, 2016).

- 2. **Situational Exogenous Factors** - Situational Exogenous factors are determined by infrastructures. Access to local transportation, its capability, socio-economic factors and governmental factors are all out of control of supply chain actors. In countries with conflicts, rebels often stop vehicles full of humanitarian material (Kunz & Reiner, 2012; Van der Laan *et al.*, 2016).
- 3. **Non-situational Exogenous Factors** - The size, time and location of demand for aid is mostly uncertain (Beamon, 2004). The intensity and nature of the situation complicates and defines the *modus operandi* of aid response (VanWassenhove, 2006).

The main challenge of this dissertation is related with the poor human conditions that currently characterize Refugee camps in Europe, and so this challenge is related with endogenous factors, since human conditions are highly dependent on the direct influence of different humanitarian supply chain actors.

2.2.2 Human Conditions improvement in Humanitarian Logistics

In this sector, examples of the improvement of living conditions on crisis situations will be explored.

Dabaad, the largest refugee camp on the world, situated in Kenya, was constructed to shelter refugees from civil war in Somalia. Nowadays, 25 years after the war, the camp still hosts more than 300.000 people. Humanitarian crisis such as Syrian, Yemen and Ethiopian civil wars are driving a new humanitarian term - long-term refugee life – which also drives to new generations

that grow up as refugees. In Dabbad, to make sure refugees participate in the life at the camp and feel that have a role in it, it was agreed to make some changes in order to improve the life at the camp. It was defined as key priorities the creation of *“a better system for finding political solutions to conflicts and ensuring that people affected by crises are themselves able to participate in the planning and delivery of emergency assistance”* (Lee, 2016). With these decisions, it was concluded that refugees life were valuable.

The second example shown focus on the Zaatari refugee camp. This camp is located in the Jordanian desert and shelters around 40.000 people. Due to the camps closeness to the Syrian border, it received thousands of people every day during the hot times of the war. Initially, the living conditions at the camp were severely inhuman and violated the human rights. For that reason, tents were substituted by prefabricated houses and concrete toilets with shower facilities replaced portable toilets. There are also common zones with activities to children. To make sure the residents were occupied, the humanitarian at the camp encourage the refugees to set up informal businesses or volunteer at the camp. Now, *“they do not need to worry about finding employment to pay rent or buy food and other necessities”* (Beszterczey, 2014).

When studying how to ensure the humanitarian aid that a community or a specific situation needs, humanitarians must reflect the most efficient way to utilize the resources available, and it is proved that technology is able to support them in numerous ways (Belliveau, 2016).

Numerous technologies are able to assist on defeat some challenges faced by humanitarian organizations and practitioners. If well used and appreciated, technology may help of proving *“shelter, physical structures, as well as transport and even create essential humanitarian items”* (Belliveau, 2016).

Technological progressions are successfully seducing humanitarian to boost the *“efficiency, effectiveness and impact of humanitarian response”* (Belliveau, 2016). The use of technology in conditions with limited resources is closely related to the concept of frugal innovation, considering that frugal innovation has the potential to be used to improve living conditions in refugee camps.

This is to say here that, according to the review, the use of technology has been the target of a large number of studies aimed at improving living conditions in the context of crisis in general, which leads to the conclusion that it will be relevant to explore its use within the scope of the dissertation.

In particular, in the context of the refugee crisis where there is a great shortage of resources, the use of technology turns out to be much related to the frugal innovation, which will be described next.

2.3 Frugal Innovation

Frugal innovation – the concept launched in 2010 by *The Economist* - is considered more than a strategy. This concept defines the attitude of the ones that see “*resource constraints not as a liability but as an opportunity*”. Organizations that follow frugal innovation focus on creating good-quality products and services that concentrate on “*deliver the greatest value to customers at the lowest cost*”, opening entirely new markets (Radjou & Prabhu, 2014). The basic philosophy of frugal innovation is to offer keys to solve problems that are cheaper and better (Gabriel, *et al.*, 2016).

The curiosity in this concept have been increasing. While it was almost unknown between 2006 and 2009, with only few articles published, it now stands over 500 articles with public access (Gabriel, *et al.*, 2016).

Frugal innovation has origins in emerging economies and developing countries that live an austere lack of resources. As a result, it is frequently linked to products and services for ‘base of the pyramid’ consumers (Gabriel, *et al.*, 2016).

Before having a clean and certain definition on Frugal Innovation concept, it is necessary to know the notions of Innovation and Frugality. These both concepts lead to Frugal Innovation definition, which is in fact, the main concept of this thesis (Imhof & Mahr, 2017). Several definitions on concept *innovation* are presented below. All of these definitions conducted to the classification used for the understanding of Frugal Innovation.

- “By *innovation* is meant the generation, acceptance, and implementation of new ideas, processes, products or services. Innovation implies the capacity to change or adapt.” (Thompson, 1965).
- “Innovation is the multi-stage process whereby organizations transform ideas into new/improved products, service or processes, in order to advance, compete and differentiate themselves successfully in their marketplace.” (Baregheh *et al.*, 2009).

- “*Innovation is the implementation of a new or significantly improved product, or process, a new marketing method, or new organizational method in business practices, workplace organization or external relations*” (Piperopoulos, 2012).
- “*The process of creating value from ideas*” (Tidd & Bessant, 2014)

Summarizing all the definitions presented, a simple and clean clarification is achieved: *Innovation is the process of creating value from new ideas in terms of developing a new or different product and/or service, implying the capacity to adapt in the current market and change it.*

After focusing on the first antecedent of Frugal Innovation (Imhof & Mahr, 2017), the concept of frugality should not be forgotten, since it is also part of the way to achieve the end. Once more, numerous definitions of *frugality* were collected to accomplish the one that contributes to understanding of Frugal Innovation.

- “*Frugality is the degree to which consumers are both restrained in acquiring and in resourcefully using economic goods and services to achieve longer-term goals*” (Lastovicka et al., 1999).
- “*Frugality is the careful use of resources and avoidance of waste.*” (DeYoung, 1986).
- “*Frugality means not just lowering the cost of the product, but also in how it is designed to operate in the resource constrained context in which it functions*” (Bhatti, 2012).
- “*Frugal in a literal sense generally refers commonly to resource-constraints resulting in major savings of resources*” (Rao, 2013).
- “*Frugality defines a concept of a generation of products created in more frugal ways that satisfy the needs of potential consumers, mostly based in emerging countries*” (Horn & Brem, 2013).

After a review on *frugality* literature, a simple definition proposed: *Frugality is the creation of products in a low cost perspective, using the available resources in a conscious way, avoiding waste and over production, to meet the customer needs.*

Now that the concepts of *frugality* and *innovation* are distinguished and it is understood how they, together, create Frugal Innovation concept definition, it is now viable to develop an appropriate

and correct definition for the main concept of this study. However, it is essential to have a deep dive in the existing literature about the theme, to identify an overall definition for frugal innovation. The following table presents the definitions for frugal innovation according to several authors.

Definition	Authors
<i>“Innovative, low-cost and high-quality products and business models originating in developing countries and exportable to other developing countries or even the developed world”.</i>	George <i>et al</i> , 2012
<i>“Economical use of resources to provide products affordable by those on a lower income.”</i>	Ernst and Young, 2011
<i>“Frugal Innovation is a new management philosophy, which integrates specific needs of the bottom of the pyramid markets as a starting point and works backward to develop appropriate solutions which may be significantly different from existing solutions designed to address needs of up market segments”</i>	Gupta, 2011
<i>“Frugal Innovation is a design innovation process in which the needs and context of citizens in the developing world are put first in order to develop appropriate, adaptable, affordable, and accessible services and products for emerging markets”</i>	Basu <i>et al.</i> , 2013
<i>“By economizing the usage of resource-use and aiming for simple products and services, albeit sometimes using cutting edge technology, frugal-innovations have a lot to offer for sustainable-development”</i>	Rao, 2013
<i>“Frugal innovation can be defined as a product, service or a solution that emerges despite financial, human, technological and other resource constraints which meets the needs of those customers who otherwise remain un-served”</i>	Simula <i>et al.</i> , 2015
<i>“Frugal innovation refers to those innovative products and services which are developed under conditions of resource constraints.”</i>	Agnihotri, 2015
<i>“Frugal innovation means renewing the way that resources will be used. It aims to generate more business and social value than ‘traditional’ innovation”</i>	Angot & Plé, 2015
<i>“Frugal innovation refers to products, services or combination of them that are affordable, sustainable, easy-to-use, and have been innovated under the resource scarcity. In general, frugal innovations are developed in and for low-income market contexts and are seen to differ from innovations in developed markets”</i>	Hossain <i>et al.</i> , 2016

<i>“Frugal innovation can be defined as the practice of simplifying product components and manufacturing processes into basic elements, in order to redesign both the product and the processes to become more efficient and cost effective. The economic relevance of frugal innovation is the creation of low-cost mass market products that are affordable to all social strata including the less affluent segments”</i>	Tanya Sammut-Bonnici & John McGee, 2015
<i>“Frugal innovation is a means and ends to do more with less for more people”</i>	Bhatti & Ventresca, 2013
<i>“Well-designed, good-quality products that are developed cost-effectively and sold at affordable prices to deliver best customer value. The ability to create significantly more business and social value while minimizing the use of diminishing resources such as energy, capital and time”</i>	Radjou & Prabhu, 2015

Table 2 | Literature Review on Frugal Innovation

Summed up, Frugal Innovation is “do more with less for more people” (Prahalad & Mashelkar, 2010). According to Mahmood (2014), the three pillars that support frugal innovation concept are “deliver more value, efficiently reduce costs and target a greater number of customers”.

According to Roland Berger, in its *Think Act* report (2015), Frugal Innovation is associated with six key attributes that mean the concept’s acronym.

F unctional	Frugal products must be useful and convenient. The product should focus on solving the customer’s needs with easiness and simplicity (Basu <i>et al</i> , 2013).
R obust	Robustness, durability and reliability are essential design characteristics for the product to handle adverse conditions (Basu <i>et al</i> , 2013).
U ser-friendly	Frugal products must be <i>easy-to-use</i> so customers can naturally use it with little or no previous training required (Slade, 2007).

G rowing	The main purpose of frugal products is to fulfill unmet demand. Since these products are innovations mostly created in emerging markets, they face a high growth rate of customers (Tiwari & Herstatt, 2013)
A ffordable	Since fundamental features of frugal products are low price and low cost of operation and maintenance, this innovation can reduce the price from 50% to 97% (Rao, 2013). In addition, the ability to produce singular parts (as a piece of a whole product) that can be easily replaced, is preferable and cheaper (Petrick & Juntiwassarakij, 2011).
L ocal	Roland Berger reports (2015) defends that applying local resources for production is the greatest mode to find affordability. Frugal solutions supports local resources, reducing costs and risks. More than employing local people and using equipment and materials it enables the manufacturing to be close to customers (Engel & Sabau, 2014).

Table 3 | Frugal Concept's Acronym

Frugal Innovation in relief operations

As mentioned above, frugal innovation is becoming a central part when a country or a market faces a situation of resource scarceness, such as is the case of developing and emerging markets (Gardiner, 2013; Basu *et al.*, 2013).

Refugee camps and shelter contexts have limited resources and various needs, which become frequent universes for frugal inventions (Basu *et al.*, 2013).

The high growth rates of these countries and markets leads to entrepreneurship and viable evolution for all actors. Frugal Innovation rests in its capacity to be efficient in scarcity situations. Because of this capacity, there are presented three examples – based on the study of Basu *et al.*, 2003 – that illustrate emergency relief situations where frugal had a fundamental role. There are not only three examples of frugal innovation instruments, but the ones presented were perceived to be the most important and the ones that better demonstrate the frugal innovation role.

1. The first example is *ToughStuff* - a charging system fed by solar energy. It was produced to support on abolishing with energy scarcity of low-income families in the developing countries (ToughStuff, 2010). *ToughStuff's* numerous products that are supplied by solar

energy are available and affordable solutions to families with insufficiency or inexistence of energy. *ToughStuff* has, as principal focus, the developing markets and emergency relief situations and its products satisfy the needs in both circumstances. This technology has the capacity to charge mobile phones, radios, *LED* lamps, among others (Marlow, 2009). This innovation covers the frugal essence since the panels used “*are flexible, waterproof, and small*”.

2. The second example is NRK – *NetReliefKit*. Net Hope and Cisco Systems – two entities highly skilled in technology – joined forces to create a kit with emergency relief in mind that is, basically, a “*communications hub in a box*” for NGOs that work in the ground. The kit offers communications via voice and includes internet with satellite. A common car battery is enough to charge the kit at full. As main characteristics, it presents easiness in transport, due to its lightweight and size, adaptability and suitability for all communications needs. The *NetReliefKit* revolutionized the way NGOs operate with a simple solution of frugal innovation.
3. A third of Frugal Innovation in relief operations focus on water treatment. In Ahmedabad population, a city of six million people in northwest India, about 88% of the population treat its own water. An MIT study was able to demonstrate that domestic water filters work as a result for populations with poor water supplies, if applied in a correct, consistent and continuously way (Goentzel, 2015). These domestic water filters use low cost reverse osmosis technology and the entire process includes the active role of Ahmedabad citizens as co-producers, allowing locals integration in the operation and small companies to “*customize their products and services to the needs and price expectations of their customers*” (Wehn & Montalvo, 2018).

As seen in the mentioned examples, among the technologies used in the field of frugal innovation, several technologies exist, such as communication kits, energy and water treatment solutions. Decreasing surplus of manufacturing is possible reusing parts and components in design, production and distribution of the new products. Products are continuously produced, reutilized, and then reused, being part of a cycle and a circular economy. Consumers are searching a new way to personalize products and services, being its own producers – this is becoming the developed work commercial routine and customers are becoming used to own their own choice. 3D printing

and DIY platforms are two enablers of this evolution, which cut costs and reduces waste. A fresh time of consuming will be focus on sustainability, reduction of resource usage and affordable prices, yielding high quality and mass-customization products and services (Radjou & Prabhu, 2015).

3D printing has been referred to in the literature as having great potential in this context. The increasing use of 3D technology in this context proves the potential that this technology will also have in improving the conditions of refugee camps

2.4 Conclusion of the chapter

The concepts explored during this chapter work as an integrated mechanism, contributing in a severe way to the understanding of the situation, enabling the researcher to better perceive the environment of the problems and letting the reader to be contextualized and emerged in the state of art. The use of technology plays a key role in supporting humanitarian logistics, particularly in improving human conditions. In addition, that in the context of scarce resources, the use of this technology turns out to be closely related to the concept of frugal innovation, considering therefore that the frugal innovation has potential of use to improve the conditions of life in the refugee camps. In particular, 3D technology.

Considering the gap on the literature about technology as tool for improving refugee's life, specifically 3D printing technology, this thesis will have its focus in completing the existing information as well as add value to it.

3. Methodology

The methodology of any research study should illustrate the questions that are intended to investigate, since they determine the conceptual framework and methodology to be followed.

This chapter is divided in two parts – Case Study Methodology and Research Steps.

3.1 Case Study Methodology

In line with the methodology described in the introduction chapter, this study is a dissertation based on a case study methodology. A gap has been identified in the literature, so there is a lack of studies related to what is proposed in this thesis, and according to the Yin, an exploratory study case is an approach to follow in these situations.

The goal of Case Study methodology is to analyze and explore current real-life occurrence of a specific setting or situation (Dudovskiy, 2016). The Case Study research method is described by Yin *“as an empirical inquiry that investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used.”* (1984). Dudovskiy (2016) states that the event can be intensely investigated since the case study method provides *“the ability to capture complexities of real-life situations”*.

According to Yin (2018), is essential for a case study to include various factors. First, it should be used when the study points out to answers of *“how”* and *“why”* questions, which is the case in this dissertation. Secondly, when the investigator is not able to conduct the performance of whose is involved in the research, which is also the case. Third, when the limits between the event and context are not clear. The case study methodology was chosen because the proposed solutions cannot be considered without the context - European Refugee Crisis – particularly the problems and difficulties felt in human conditions of refugee camps.

Relative to its design, according to Dudovskiy, (2016), case studies may adopt three categories - **explanatory, descriptive and exploratory:**

- a. Explanatory category intends to meet ‘how’ or ‘why’ questions with researcher’s no control over occurring events. This category of case study focus real-life situations;

- b. Descriptive case studies investigate “*the sequence of interpersonal events after some time has passed*”;
- c. Exploratory case studies intends to meet questions of ‘what’ or ‘who’.

This case study in particular is an Exploratory and Descriptive Case Study since it covers all the characteristics its category demands.

Considering the context of the Case Study, it may be single or multiple (Yin, 2018). These two options differ because in a multiple case study, the investigator examines several cases to perceive the differences and semblances between those cases, comparing them. In a single case, the investigator examines only one case (Baxter & Jack, 2008). A single case study is better than a multiple one because the first mentioned produces better and extra theory, when it comes to creating high quality content (Dyer & Wilkins, 1991). For this to happen, it is possible to make a single case study with embedded units. The researcher is able to investigate the case, crossing data of different perspectives (Gustafsson, 2017). For this reason, the Case Study in question is a single case study with embedded units, since the context of the case is all the same, but with different perspectives.

3.2 Research Steps

Three stages are proposed as research steps, as shown in the figure below – figure 5. This section describes the chosen tools to collect information and explains in what consists each stage.

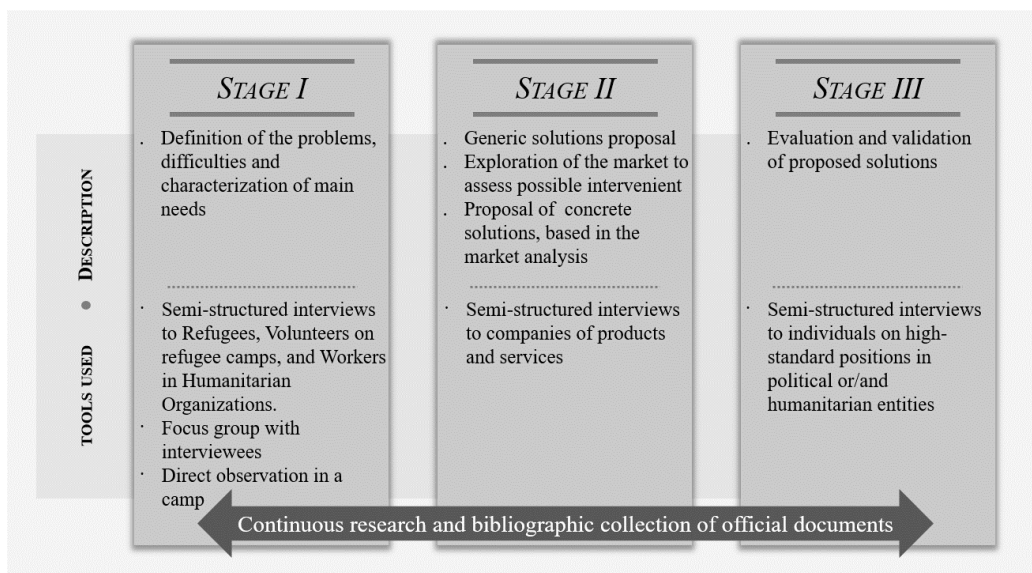


Figure 5 | Research Steps

3.2.1 Used Tools

In view of the scope of this dissertation, its goals and its research, the instruments defined for data collection were semi-structured interviews to key interlocutors and focus groups. To go along with these methods, a bibliographic collection of official documents – such as scientific articles, books, news in international newspapers and research in official websites – was also conducted during all the phases of methodology.

It is defended that qualitative data is mostly collected through interviews and questionnaires (Dörnyei, 2007). Nevertheless, from these two options, interviews have more power when generating narrative data, since it allows researchers to investigate people's views in greater depth (Kvale 1996, cited in Alshenqeeti, 2014).

Qualitative research intends all types of investigation that generates results and findings from conversations, interviews, and other kind of real world moments, and not from statistical procedures, calculation or other methods of quantification (Golafshani, 2003).

Furthermore, the use of non-numerical data seeks to explore and describe the 'nature' of how people behave during conversations, experience and understand.

Qualitative research has, as primary characteristics, the appreciation of the problem and its analysis by different perspectives, the researchers' reflections and considerations on the research as part of the process of summarizing ideas, and the variety of techniques, procedures and methods (Flick, 2009, p.14).

To have a valid study, it is essential to ensure reliability and guarantee its connectivity with validity in qualitative research. In its wider context, validity refers to the depth to which a research contemplates the concepts it aims to study. Reliability refers to the results that a specific research instrument reveals on the concept of the study.

As cited in Golafshani, Lincoln and Guba state that *"since there can be no validity without reliability, a demonstration of the former [validity] is sufficient to establish the latter [reliability;]"*.

It indicates that the first one does not exist without the second, being the consequence of each other, since only the authentic studies are trustworthy, concerning the researcher's ability and skill to analyze any qualitative research (2003).

If these issues define the quality of a research and differentiates it between the good and the bad, then the quality of a research depends in its trustworthiness and rigor.

Qualitative research aims to analyze concrete cases starting from people's expressions and activities in their local contexts (Flick, 2009).

3.2.1.1 Interviews and Focus Group

Dörnyei (2007) objects that interviews, as a method for collecting data, are spontaneous, real, natural and socially acceptable, since it can be used in various conditions and circumstances, going through a variety of topics, besides being a cheap method.

The goal of using this method - interview – is to have a real picture about the problem, being able to define it properly. Several interviews should be made to diverse intervenient involved in the crisis, and these should be carried out from different points of view and levels of engagement with the crisis. These different perspectives should be gathered from Refugees, Volunteers on refugee camps, and Workers in Humanitarian Organizations. Having first-hand testimonials and opinions about the problem from individuals that saw, felt and lived this reality in a direct way, enables and contributes for a more realistic characterization of the problem.

As stated in Alshenqeeti (2014), there are four types of interviews that are used in social sciences. These are as follows:

1. **Structured** – Simplest type of interviewing. It occurs around a set of planned questions that are directed to the topic itself.
2. **Open-ended (unstructured)** – Type of interview that offers a great flexibility to both sides of the conversation because it allows interviewer to do the questions he wants with no plan and lets the interviewee to answer by himself. It focus more on the participant's thoughts, feelings, experiences, knowledge, skills, ideas and preferences (Gubrium & Holstein, 2002).
3. **Semi-structured** – Type of interview that provides a deep understanding of the topic because it allows the interviewer to explore the interviewee's responses and reactions, conducting the end of the interview. Cohen & Crabtree (2006) state that on semi-structured interviews, the interviewer has the opportunity to modify the questions whilst the

conversation. In addition, it also has advantages for the interviewees - it gives them autonomy to explicit their opinions and views on the subject. Furthermore, a semi-structured interview empowers the researcher to understand how the individuals involved perceive the reality in study and how they explain it. (McMillan & Schumacher, 1993).

4. **Focus Group** – Type of interview where the attendants are selected to be part of a population that fills certain characteristics and answer some questions about the topic, giving to researcher the opportunity to interview a group that is focused on a given theme. In addition, the focus group allows the interviewer to observe the interaction between the participants, who can express a collective opinion or divide into subgroups with opposite ideas, being very useful when reaching a consensus within the group (Bauer & Gaskell, 2000).

For that reason, in this thesis, semi-structured interview is considered the ideal, effective and practical option to collect data.

To have a complete overview of the reality and life conditions lived in the refugee camps across Europe, three levels of interviews should take place. These moments are explained in detail further in this chapter.

Focus group is also a tool important to use in the current study. It is defined as a group discussion about a certain theme or associated matters among a group of individuals that share comparable views and related interests. This method should stimulate participants to share points of view during the conversation (Schurink & Schurink, 1998, p.2). “*Identify the opinions and views of the individual group members within the dynamics*” (Flick, 2009, p.202) may be a challenge in a focus group.

This approach to collect data is, as mentioned above, a type of interview.

To address and complete the data collected during the previous method, after the interviews, there is a focus group activity, which should include participants of the three levels of Stage I of research steps. This activity aims to bring them to achieve a common solution that can satisfy the principal needs felt by each of them, having as input the first hand experiences of each participant.

For that reason, the focus group is essential for this study.

3.2.2 Research Steps in Detail

Data collection, proposals, and its evaluation and validation are divided into three stages, as already mentioned. This separation meant to define the pillars of this study and to determine the entities that could illustrate, in the best way, the problem, the solution proposed and its validity.

3.2.2.1 Stage One | 1

This stage aims to explore the problems and difficulties experienced in refugee camps. It consists on the problem description, defined by testimonials from individuals that have different levels of engagement with this problem. Three levels of engagement are considered in this study: Refugees, Volunteers and workers at Humanitarian Organizations. The levels and its position can be illustrated in a pyramid, as shown in figure below.

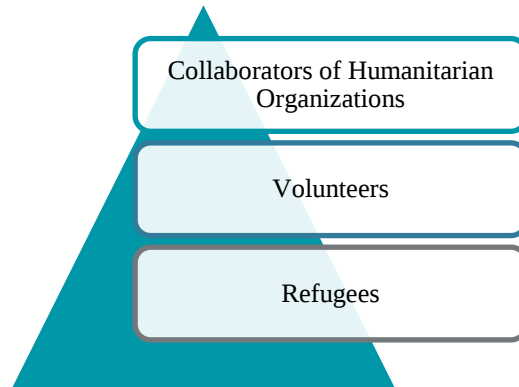


Figure 6 | Pyramid of Stage 1

- i. Refugees lived the crisis in their own country, interrupting their own life. Some lost their life, or families. They are the ones that have no shelter and no answers. Refugees are the ones who can give a better testimonial about living in a camp – and everything associated. That is why refugees are the first level of engagement with the crisis;
- ii. Volunteers are the second level of engagement with the crisis. Volunteers decided to leave their homes, routine, families and comfort to stay with refugees for a while, helping them to restructure their hope. Volunteering is intended to promote goodness or to improve human quality of life. Volunteers are very important inputs for this study since they listen testimonials from other refugees, became friends of them, saw and lived the tragedy from a different perspective, having the notion on what may change

to improve life conditions on camps and knowing – from relations created - what individuals and families need the most;

- iii. Volunteers and workers at Humanitarian Organizations – third level of engagement with the crisis - should include collaborators and volunteers of Non-Governmental Organizations (NGO's). These organizations perform a variety of services and humanitarian functions, providing analysis and expertise, serve as early warning mechanisms and help monitor and implement international agreements. These organizations are the entities that make volunteers work possible and its collaborators have a pure notion about the resources that exist. For these reasons, their testimonials are important inputs for this research.

In this stage of methodology, the focus group should be followed after performing individual semi-structured interviews to individuals of each of the above-mentioned levels of engagement. The semi-structured interviews aim at analyzing the context of a refugee camp, which are the difficulties and problems felt on that, and evaluate the opinion of each participant about the living conditions of the camps where they experienced this reality, since each participant lived in a different background. The Focus Group should consist on a debate about key problems faced in the refugee camps and existing possibilities on how to improve life condition of several refugee camps. The main goal is to evaluate if the participants could reach a common idea, together. It should be based on the participation of volunteers, refugees and collaborators at NGO's, since all of them are able to opine about the subject.

3.2.2.2 Stage Two | 2

The stage two consists on market analysis, followed by the proposed solutions.

This stage is divided into three main phases. First, there is an identification of generic solutions. Second, market analysis, where it is made a survey of possible solutions existing in the market or with potential of use to operationalize the solutions previously identified. For this second phase, official documents were consulted, and semi structured interviews were taken as tool. Based on the conclusions drawn in stage 1, where problems and difficulties within refugee camps are identified, the second phase (stage 2) aims to explore solutions (with products or services) to solve these problems and difficulties previously identified. To reach this goal, the semi-structured

interviews to take are with professionals with proven activity in sectors related to the potential solutions found based on this market analysis.

Following the conclusions drawn from the literature review, the solutions herein proposed should be focused on Frugal Innovation, which is based on the use of innovative technology, with low cost and low utilization of resources on the production process.

3.2.2.3 Stage Three | 3

After exploring the main needs and scopes of intervention in refugee camps (according to Stage 1) and after having an idea how it human conditions in these camps can be improved in practice (according to Stage 2), it is vital to hear a valid opinion about the possibility of concretization of the solutions proposed. To accomplish this goal, semi-structured interviews with representatives of high committees for humanitarian causes should be conducted to evaluate the viability of the investment needed and its availability.

4. The European Refugee Crisis Explained

This is the third chapter of this thesis, divided in three subchapters. The first subchapter focuses on crisis root causes. It aims to explain how we are now witnessing the highest levels of displacement on record. The second subchapter clarifies the agreements the European Union made to manage the crisis and Mediterranean deaths. The last subtitle is a resume on all the numbers that are important to remind to understand better this reality.

4.1 What is driving this crisis?

Since the Second World War, there was no influx of refugees like the one Europe felt in the summer of 2015 (The Economist, 2015). Arab Spring collapsed and millions of people have escaped from terror and conflict in their own countries (Guéhenno, 2016; European Parliament News, 2017). Syria War has become the world's top cause of refugees (The Economist, 2015).

In December of 2010, the world assisted to the beginning of the Arab Spring¹. This phenomenon resulted in a flood of disputes and fights in the Arab world that fell with many dictators and regimes (Abulof, 2017). Bashar Al-Assad (that comes from the family that leads Syria since 1960) refused to surrender, so started a ruthless civil war. Almost suddenly, it became one of the most violent conflict on earth, with mass executions, torture and deadly attacks on civilians and innocents. A third of the Syrian population became displaced, while over four million have fled the country in hope to find peace. The majority of them found it in refugee camps in the neighboring countries (The Economist, 2015).

As a result, the civil war in Syria has created one of the worst humanitarian crisis, being the biggest driver of migration (BBC Europe, 2016).

In 2016, over a quarter of the 1.2 million applications for asylum in the EU came from Syria, with Afghanistan and Iraq in second and third place, respectively (European Parliament News, 2017). Along with these top three sources of refugees, we can cite the ongoing violence in Albania,

¹Arab Spring was a revolutionary wave of demonstrations and protests that occurred in the Middle East and North Africa from 18 December 2010 (Guéhenno, 2016). There have been revolutions in Tunisia and Egypt, a civil war in Libya and Syria; there were also major protests in Algeria, Bahrain, Djibouti, Iraq, Jordan, Oman and Yemen and minor protests in Kuwait, Lebanon, Mauritania, Morocco, Saudi Arabia, Sudan and Western Sahara. (Ruthven, 2016; Abulof, 2017)

Pakistan, abuses in Eritrea, and poverty in Kosovo (see Figure 7). All of these factors are leading people to look for new lives elsewhere (BBC Europe, 2016).

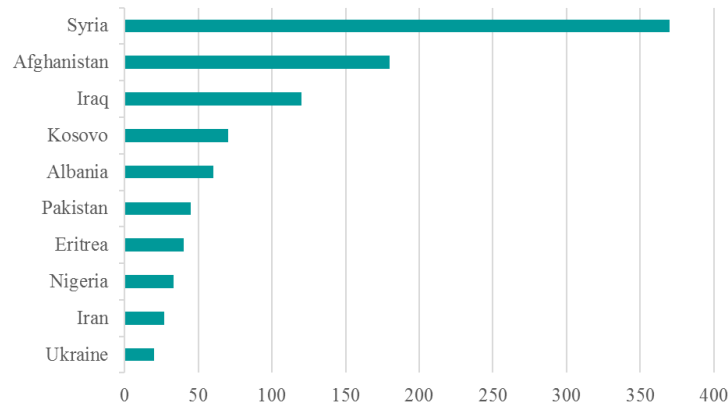


Figure 7 | Top 10 origins of people applying for asylum in the EU (Adapted from Eurostat on BBC)

In 2015, EU borders reached a record on the number of arrivals. More than 160,000 migrants escaped from terror of war and oppression in their home countries, making their way to Europe (The Telegraph Journal, 2015).

The number of refugees and displaced persons now stands at more than 65 million, the largest global displacement of people ever recorded. Hundreds of thousands of families and individuals are fleeing to other countries, trying to avoid deplorable and inhumane conditions, both inside their origin countries and in host countries border's refugee camps. In 2015, there were more than one million individuals crossing the Mediterranean that felt to 362.753 in 2016. In 2017, 170.000 and 45.000 in the first six month of 2018 (Verhofstadt, 2018). Still in 2015, almost **34,900** passed

through Turkey and Albania by land. However, more than 3,770 migrants died trying to cross the Mediterranean in 2015 (see Figure 8) (BBC Europe, 2016).

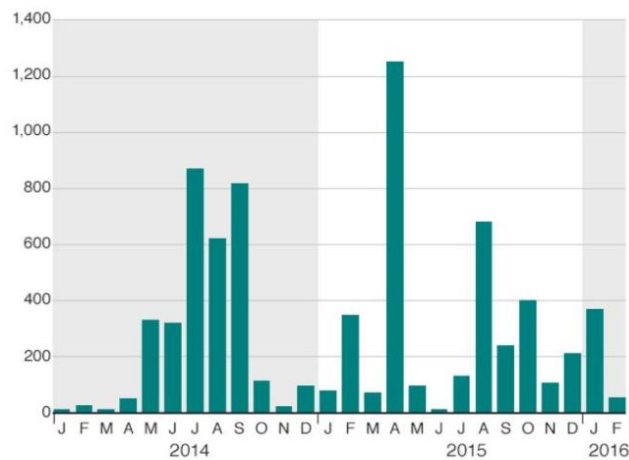


Figure 8 | Migrant deaths in the Mediterranean by month (IOM on BBC)

The UN and the World Food Program were not prepared for a refugee crisis on this scale. As a result, many refugee camps are crowded and undersupplied subjecting people to cold, hunger and disease (The Economist, 2015).

As a result, their only chance to have a safe life is going to a refugee camp, hoping to find relocation in another country. Even with poor conditions, camps can be safer than their home countries. (Coletta, 2018).

Refugees look for a better future in Europe, where peace, wealth and perspectives of job exist, compared to the violence that characterize their home countries. European Union is the wealthiest bunch of economies on earth. Well-organized states with functioning social systems, infrastructure, democracy and huge industries. Refugees prefer firstly neighbor countries of the Middle East to resettle and start a new life (see Figure 9). However, Jordan, one of those neighbor countries, is struggling to provide essentials like food, sanitary services and health care to all refugees since it has only 6.5 million citizens and a low GDP per capita². It represents a constraint for the country that already received 20 percent of its population, almost busting if not for UN and USA support (The Telegraph Journal, 2015).

² 3,300 US Dollars per year. Source: Trading Economics

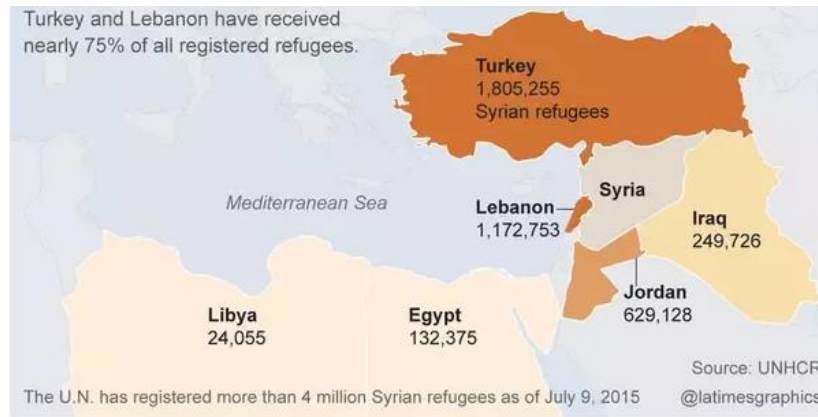


Figure 9 | Where are Syrian refugees going? (UNHCR)

After allowing the entrance and giving shelter to around 50.000 of people, Greece – the first stop in Europe to people fleeing from Middle East - started to close some refugee camps. Germany is considered the first choice country in Europe and accepted the top number of asylum applications in 2015 - more than 400.000; and Hungary positioned itself in second place in this matter, with more than 100.000 asylum application in the end of December, considering migrants made their entrance by land through Greece (BBC Europe, 2016).

Nevertheless, even Germany being the number one host country in Europe, Hungary occupies the podium in proportion - nearly **1,800** refugees per 100,000 of Hungary's local population claimed asylum. Sweden is just after with **1,667 refugees** per 100,000 Swedish citizens (see Figure 10) (BBC Europe, 2016).

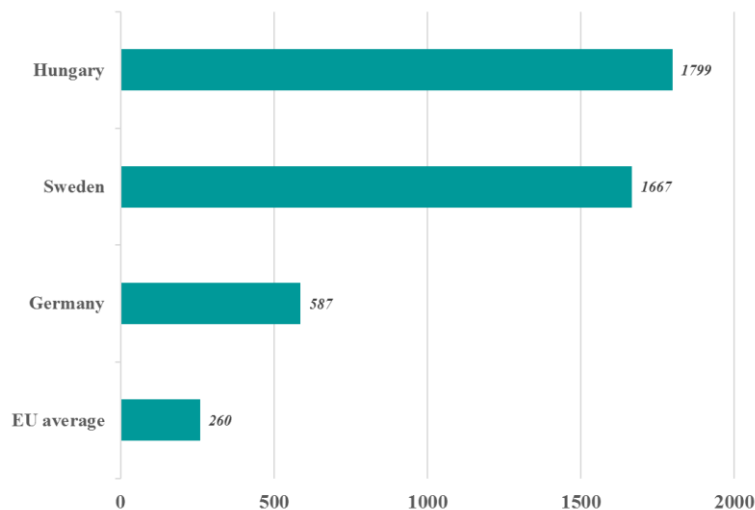


Figure 10 | Asylum application per 100.000 local population, 2015 (Adapted from Eurostat on BBC)

Although some EU countries are open to negotiate the entrance of refugees, the failure of European governments to manage the influx of refugees in 2015 is still a loop problem. In exchange of letting refugees in, Turkey receives financial aid, but the unbalanced load carried by the other European countries where the majority of migrants arrive - Greece, Italy and Hungary – rise tensions in the EU (BBC Europe, 2016).



Figure 11 | Asylum applications approved 2015 (Eurostat on BBC)

This creates a major consequence - poor human conditions in the camps, even though better than in refugee origin's countries (International Rescue Committee, 2016).

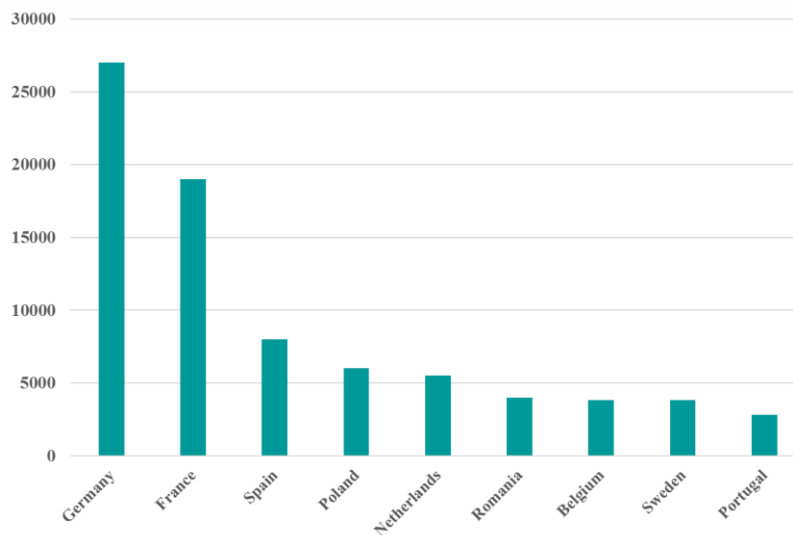


Figure 12 | EU member state migrant quotas – Number of people countries have agreed to relocate from Greece and Italy (Eurostat on BBC)

The Calais Jungle, for instance, even illegal is a refugee camp in the north of France, and it was an example of this bottleneck. Refugees arrived in France and attempted to enter the United

Kingdom via the Port of Calais by trying to get into cars, ferries or trains leaving to the UK, so the French Authority started to expulse refugees when the number of people increased drastically. The conditions in the camp were beyond inhuman and poor. The food was provided by volunteered and kind organizations and there were no sanitary or washing facilities. The accommodation structures were improvised in tents (The Guardian, 2015).

The European Refugee Crisis is one of the biggest challenges facing humanity today, so it becomes necessary to intervene in this emergency with decisions that reflect good resource management, investment, and human relations (Berry *et al*, 2016).

4.2 EU agreements for refugee's integration

The world needs to join forces, but it appears to be more divided. Many states refuse to take in any refugees leaving the Border States alone in their struggle and in 2014; the UK stopped the Italian rescue operation - *Mare Nostrum* (The Economist, 2015).

Operation Mare Nostrum was a sea operation of the Italian government that started in October 2013. Its goals was to stop the illegal immigration to Europe by Mediterranean canal. During the operation, more than 150.000 people reached harmlessly to Europe. (A. Travis, 2014). The operation lasted for one year. It drop its activities due to political issues and cur in its budget. However, the necessity for control in the Mediterranean Sea remained. (Magugliani, 2018).

In 2014, Frontex created *Operation Triton* (that now is called *Operation Themis*) – the result from the change from a single-State operation to a community project. (Magugliani, 2018). Operation Themis aims to assist Italy in tracing criminal activities in border. As part of *Operation Themis*, Frontex has its presence in Italy, where officers support Italian national authorities in migrant's registration. In 2017, 38.000 individuals were rescued by this operation (Frontex News Release, 2018).

Frontex - European Border and Coast Guard Agency – has the role of helping European Union countries and Schengen associated countries to succeed in external borders control. (Frontex Official Website, 2017).

4.3 EU – Turkey Statement

In March of 2016, Heads of all states of European Union (EU from now on) and the Government of Turkey agreed on a statement – the so-called EU-Turkey Statement. This agreement had the

goal of stop the illegal migration flows from Turkey to the Europe, improve and guarantee living conditions for refugees in Turkey and open a prepared, nonviolent and authorized passage to Europe for Syrian refugees. With these measures, in 2018, illegal influxes declined in 97% and the number of lives lost at sea decreased as well. For its effort to received and host refugees, Turkey received from EU 3 billion euros (European Commission, 2018).

All EU member states need to make continually efforts to deal with this crisis. Nevertheless, the EU-Turkey Statement became a crucial part for EU to understand and manage its approach on migration (Gkliati, 2017)

The European Commission and its member states are supporting Greece on the management of migration and improvement of reception conditions (European Commission, 2018).

4.4 Numbers at a Glance

68.5 Million	People forcibly displaced from their home due to war, persecution or violence. <i>Source: UNHCR; The Refugee Project</i>
From these	
→ 40 Million	Internally Displaced People. <i>Source: UNHCR</i>
→ 25.4 Million	Refugees (over half of whom are under the age of 18; 102,800 are resettled). <i>Source: UNHCR</i>
→ 3.1 Million	Asylum Seekers. <i>Source: UNHCR</i>
85%	Of the world's displaced people are being host in developing countries. <i>Source: UNHCR</i>
57%	Of refugees come from Iraq (2.4 millions), Afghanistan (2.6 millions) and Syria (6.3 millions). <i>Source: UNHCR</i>
10 Million	Stateless people. <i>Source: UNHCR</i>
44,400	People a day forced to flee their homes because of conflict and persecution. One person is forcibly displaced every two seconds. <i>Source: UNHCR</i>
1.569	Number of refugees welcomed in Portugal. These refugees come mostly from Ukraine, Syria and Eritrea. <i>Source: European Parliament Infographic</i>
1.015.078	Number of people that, in 2015, arrived to Europe, by sea. Record number. <i>Source: UNHCR Operational Portal</i>
3.771	Number of people that, in 2015, died crossing the Mediterranean Sea. <i>Source: UNHCR Operational Portal</i>
58.475	Number of people that have risked their lives reaching Europe by sea so far in 2018. <i>Source: UNHCR Popular Statistics</i>
12.476	Number of Syrian refugees that have been resettled from Turkey to EU Member States. <i>Source: European Commission, 2018</i>
6.360	Daily average of arrivals to Turkey in October 2015. <i>Source: European Commission, 2018</i>
80	Daily average of arrivals to Turkey, in March 2016, since the EU-Turkey Statement. <i>Source: European Commission, 2018</i>
439,505	Number of people which EU entry was denied, in 2017. <i>Source: UNHCR Operational Portal</i>

Table 4 | Numbers at a Glance. Multiple Sources

Overall, from the information gathered for this chapter and the conclusions drawn from it, it is concluded that the European crisis of refugees leverages several challenges that need to be

overcome. The numbers of this crisis are frightening in terms of loss of human life and violation of their rights, thus making it urgently necessary to find a solution.

5. Case Study

The Case Study is the fifth chapter of this thesis and aims to demonstrate the outcomes accomplished from data collected with the methodology followed.

It is divided in three stages, according to the stages mentioned in the methodology chapter. Each stage contains the goal of its existence, the participants in the interviews to achieve the results with a brief description of them, and the limitations of the process.

5.1 Stage 1

As mentioned in the Methodology chapter, the first stage focus on defining and characterizing the problems and difficulties felt in refugee camps. The description and definition of these challenges assent on collected information through semi-structured interviews and a focus group to individuals that had direct contact with the refugee camps: either lived or worked there.

As also pointed out as methodology, the individuals that contributed to data collection are divided in three levels of engagement with the European refugee crisis: first levels are refugees; second level are volunteers; and third level are collaborators of humanitarian organizations.

Observation is not a method to be used in this investigation, but its utilization would bring several advantages for final conclusions, since the investigator could has a perspective for himself.

Semi-structured interviews and Focus Group

Semi-structured interviews

Participants of all the before-mentioned levels answered to the semi-structured interviews and contributed with inputs for the investigation. In the process of data collection, it was possible to interview one refugee, five volunteers and one collaborator of an organization. This high number of volunteers participating in the interviews is purposeful. Volunteers have an important role on understanding the problem as a whole, since they create strong and deep relationships with refugee, as well as with organizations, during their volunteer journey. As a result, they can perceive the needs from the first level and the possibility to fulfill those needs from the third level. However, the focus group only counted with participants from second and third level of this stage.

It would be advantageous, for a clearer description of the problem and difficulties felt in Europe refugee camps, to have the participation of a refugee in the focus groups and more than only one

individual answering the individual semi-structured interview. Nevertheless, the crisis itself and every factor related to it, is perceived to be a particularly delicate and sensitive theme to talk about. Hence, for moral and ethical reasons, it was not possible to include more than one refugee in this first round of interviews.

Another challenge (or limitation) felt during the collection of data for this stage was the schedule of volunteers and workers, since they spend a lot of time working in the field, with no space in their agenda for non-humanitarian work. Even with these constraints, the interviews done accomplished the goals and the desired results were obtained.

At last, it is also important to note that, even though the majority of participants contribute with testimonials of what they saw and loved in Greek camps, this study remains to focus on the overall refugee camps in Europe. The abundance of contributions from Greece is because the country is in fact, the epicenter of the refugee crisis we are currently living.

The next table offers a brief description of the individuals interviewed. The names are not published since there is no formal authorization for its divulgation.

Level	Participants	Description
First Level Refugees	1	25 years old refugee, from Syria. Currently working in Lisbon, at an association focused on community integration. Refugee for two months in the Mytilene camp, in Lesbos island.
	2	Two students with 23 and 20 years old. In 2017, they decided to go walk from Lisbon to Athens, where they stayed for two months helping the refugees of Elefsina camp.
Second Level Volunteers	3	25 years old volunteer. In 2015 was in Kos island, in Greece, where the participant stayed for one month. The function was receiving the refugees that arrived by boat. Also in 2015, the participant was in Keleti's station, in Budapest, assisting a high concentration of refugees.
	4	Volunteer in Calais Jungle – the illegal refugee camp in the north of France - for two months, in 2016. The camp sheltered more than 9.000 men, 2.000 children and 500 women.

	5	23 years old student. The participant was with a Portuguese association in Kara Tepe and Moria, two camps in Lesbos island, Greece, from December 2017 to April 2018.
Third Level Collaborators at Organizations	6	The participant worked for three months in Eleonas camp, in Athens, as Coordinator of a Portuguese volunteer's mission. The role was teams and financial management, as well as all the activities of their mission.

Table 5 | Interviews on Level 1

Since the interviews were semi-structured type, the entire conversation between the investigator and the participants was based on a group of questions that drove the gathering of information. The number of questions of each interview was the same and they were adapted to the level each participant occupies, and are available in appendix A, B and C. All of these conversations were conducted in Portuguese language, except for Ahmed. The questions that guided the interviews focused on collecting information about the humanitarian difficulties experienced in the camps, and logistics of food and meals, as well as sanitarian and bath conditions.

The following table is divided in principal points according to respective levels, and presents the main findings of the interviews that defined the difficulties and problems felt by those who live or work in the refugee camps across Europe.

Levels	Main problems felt by each level
Refugee	• Small camp for a high quantity of people • Bad food • Inappropriate conditions to sleep, particularly for young people – <i>lot of people was sleeping in tents</i> • Few toilets • Poor security
Volunteers	• Too many people living, for too long, in a small area – <i>Moria as capacity for 2.000 people and at the moment it shelter about 6.000</i> • Poor hygiene and sleeping conditions, food, security and support for the youngest - <i>Every three days, they had a bag with food. During the seven days after, they had one meal per day, per person. They slept inside rooms and used bed sheets to divide it, and have more privacy. In the case of single men, the two men shared a bunk.</i>

	• <i>In Moria, three families shared container (regardless of number of persons per household) and there were open sewers</i> • <i>At the jungle – there were distributed 500 bath tickets per day. With a population of 10.000, each person could take one bath every 20 days.</i> • <i>Lack of warm clothing and warm infrastructures - A huge problem is the cold in winter in most of these camps. I know that, in Serbia it was so cold that people died for sleeping in tents, with no shelter</i> • <i>Absence of things to do - The desperation of not knowing what is going on with the entrance process and what will happen, leads many people to psychological exhaustion</i>
Collaborator at an Organization	• <i>Lack of basic sanitation and security (rape, robbery, disturbances)</i> • <i>In some places problems with the food supply chain</i> • <i>Occupation for adults - The days were only an absolute succession of days awaiting for news of asylum, placement, or family reunification. While children are naturally distracted by playfulness, adults tended to isolate themselves, spend the day sleeping and do not occupy time with rigorously nothing. This led to many cases of depression and anxiety and a significant absence of meaning.</i>

Table 6 | Main problems felt by each level

Since the goal of this stage is to perceive and detect the major difficulties and problems of refugee camps, from the information above described, the main problems that were mentioned more often are as follows:

1. Housing conditions – that includes sleeping, privacy and temperature conditions;
2. Sanitary conditions, that may provide good access to hygiene – bath and toilets;
3. Occupation for adults.

The focus group, as stated before, counted with the presence of participants from second and third level. It was a group conversation via skype calling, since one of the participant is in a mission in the United States of America. It aimed to evaluate if all the contributors agree on the problems and difficulties identified in the individual semi-structured interviews. The discussion included 6 participants.

Focus Group

During the focus group, the volunteers and Tiago, contributor of the third level, discussed about the available resources, the detected problems and shared experiences with each other, exchanging

ideas and opinions about the future of this crisis. The group discussion changed the azimuth for a debate about the possible solutions and needed investment, right after all of them agree in the main problems and difficulties perceived through interviews.

The participants agreed that it is fundamental to focus on housing conditions that complement privacy for families and warm control; sanitary infrastructures that may improve hygiene and access to it; and ensure that people have more contact with the outside, dynamic and educational activities. Essentially, it is a priority to give people something to do.

It is also unanimous that, besides the very low income that exists for humanitarian relief, there is investment to improve the living conditions of refugee camps and that this is an urgent measure. However, the governments, United Nations and other international organizations and Europe Union show a lack of commitment to assume that this is a transversal problem that became a reality. As a result, the funds for humanitarian organizations are considered to be badly distributed.

5.2 Stage 2

This thesis is sustained in the use of technology to solve key problems identified. Since there is a clear global issue on the low income for humanitarian work, from the results gathered and literature review conducted, it was concluded that the solutions might fall on technology based on frugal innovation. It is stated that frugal innovation is all about *do more with less for more people*, so it is essential to find a solution that is cheap, fast and available for a big quantity of people.



Figure 13 | Stage 1 thinking process

After defining the primary problems and difficulties, and accomplishing the goal of the first stage, it is time to spotlight the stage 2.

Based on the conclusions drawn in stage 1 and in all bibliographic analysis, several problems and difficulties within refugee camps are identified, and so this second phase (stage 2) aims to explore solutions to solve these problems and difficulties. These solutions are based on the use of technology, and since we are dealing with a context of scarcity of resources, proposals herein presented are based on technological solutions within the scope of frugal innovation.

5.2.1 Proposal of generic solutions

Based on the problems identified in 6.1, this section presents general proposals of what can be done to address these problems.

On housing problems, there are several issues that deserve attention. The issue of sleeping cares for better conditions of beds, security and temperature control, that happen to be also other issues, so it is necessary to improve insulation or provide more blankets.

On hygiene problems, it is urgent to provide privacy, sufficient and decent infrastructures, running clean water and guarantee safety for both genders when using the toilets, since security in toilets is another issue.

At least, since people are staying in the refugee camps to wait for their future, it is desired to maintain them happy and hopeful. For that reason, integrate them in the camp activities or find other activities for them to do, would be crucial to combat the issue of desperation due to absence of things to do.

5.2.2. Exploration of the Market

To identify solutions on how to operationalize the proposals presented above, an exploration of the market to assess the available and possible technological solutions that had the characteristics and capabilities to fulfill the needs with Frugal innovation - low cost and low utilization of resources on the production process – was performed. In addition, based on this analysis, a possible solution was found – 3D printers.

3D printing technology, also known as additive manufacturing, is considered an entirely new production process that, from a digital file that is inserted in the printer, generates an object through layers – the printer drops the plastic (or other used material) from a holder and it is fabricated layer by layer. This is why it is additive manufacturing (Maric *et al.*, 2016).

The digital file used to send the data to the printer is able to be reutilized numerous times, which means that many individuals with various necessities is able to manufacture a product that efficiently satisfies their needs.

Developing countries are gaining trust in 3D printers as frugal innovation. The increasing importance is due to mass customization and low production costs that 3D printing technology offers (Maric *et al.*, 2016).

It is becoming unanimous that 3D printers turn consumers to makers of their own products (Maric *et al.*, 2016). As Radjou and Prabhu state in *The Economist* (2015), consumers are searching a new way to personalize products and services, and 3D printing technology, among others, is an enabler of costs and waste reduction, focusing the consumers on sustainability, reduction of resources usage and affordable prices.

Implementing this frugal solution provides non-experts to access expert capabilities, which immediately meets the need something to occupy adults. That is why this innovation is so interesting.

A 3D printer and a product printed using this technology may seem simple, poor quality or even too random to fulfill a need from an emergency relief situation like this. However, this technology encourages creativity and repair skills, besides being able to produce everything autonomously, at reduced costs.

Knowing that 3D printers may be the solution for the crisis, and after studying the market to find a 3D printers company, for the second time in this research, a semi-structured interview method was used, which enabled to have a conversation with the interviewee, completing all the information received. This interview aimed to explore the market and the industry of 3D printing technology and what it can offer to this crisis, enabling to find a solution.

The next table describes the company on 3D printing whose CEO accepted to be interviewed, and the script of the same interview may be consulted on appendix D.

Company	Description
 - <i>Production made Perfect</i> (The interviewee was Francisco Tenente, CEO of 3DWAYS)	3DWAYS is a Portuguese start-up based in Amadora, Lisbon. Its core is manufacturing and distribution of professional 3D printers that are remotely controllable. To deal with 3DWAYS printers, one does not need for 3D printing know-how, since they are user friendly and developed with characteristics that meet the customer's specific needs. 3D ways has also 3D technology training courses. With its expertise in all areas of this technology, 3DWAYS supports any project's production, management, maintenance or finishing processes.

Table 7 | 3DWAYS Description

3DWAYS was the company chosen for the interview because the company and its entire team is currently preparing a project based on frugal innovation. This project is based on collecting and reutilize the plastic, inserting it in the printer and using it to manufacture new products. This project aims to produce more, for more people, with existing low cost resources – which is also focused on humanitarian logistics. For these reasons and driving concepts – Frugal innovation and Humanitarian Logistics – 3DWAYS is becoming a high experienced company in the field. The materials used in 3DWAYS production are various plastics, from different components. However, there is a common characteristic: the material is recyclable to be scrapped and reused in other prints being always easy to carry and replace, if needed. That is why 3DWAYS was chosen.

Another technology is proposed as solution to the problems assisted on stage1. This technology is based on a Portuguese company, which focus on cork and sustainable production. Since 3D printing technology was not able to fulfill all the needs, it was necessary to find more on the market that could achieve the best solution possible, and CORKBRICK was found. The interview made to the second company is available at appendix E.

The table 8 describes the company.

Company	Description
 <i>Sustainable Dynamic Structures and Furniture</i> (The interviewee was Catarina Reynolds Brandão, one of the CEOs of CORKBRICK)	CORKBRICK is Portuguese start-up company that focus on a concept inspired in Lego pieces. It is a natural solution, based on only seven pure Portuguese cork pieces that can be used repeatedly while providing benefits from nature such as better indoor climate and sound isolation. With these pieces, any individual or family can build infinite configurations. CORKBRICK empowers everybody, with no age restriction, to build walls or furniture, inside or outside, with no tools, no screws and no glue. It is easy to use and simple to change. The structures created through pieces offer thermal and acoustic insulation, creating comfortable and more privacy spaces.

Table 8 | CORKBRICK Description

CORKBRICK is a Portuguese start-up, always looking for innovation. It is currently focusing in a project specifically focused in refugees. This new project is ready to be launched soon, so Catarina was not able to give much information about it. Sustainability is one of the key concerns of the company, as well as simplicity and the development of *do-it-yourself* products, using entirely natural materials. For that reason, CORKBRICK was seen as ideal for data collection of this dissertation, chosen to be interviewed and contributing with inputs, besides supporting its market.

CORKBRICK produces pieces of cork. Its catalog has only seven pieces that are made with Lego forms, so all the pieces fit together. With 7 pieces of CORKBRICK anyone can build spaces of infinite configurations and sizes because a person may assemble a structure with only 3 pieces and the next day change his mind and create something totally different by adding or subtracting pieces. The structures built with these pieces offer thermal and acoustic isolation creating comfortable and

more privacy spaces. Cork itself offers conditions of unique thermal comfort and privacy. Still, it refers to nature that always evokes a peace and tranquility.

The production of the pieces is frugal at its highest level - the cork is crushed and compressed. Therefore, there is an opportunity to reuse corks, which increases the amount of raw material available, reducing costs and production. The products are 100% recyclable, with no transforming processes, which pollutes the environment and create a lot of waste. The material used is always cork from Portugal.

All the pieces can be in contact with water. CORKBRICK attaches great importance to the sustainability of a product. The company offers lifetime warranty, which in itself shows the durability of the product.

One of the great advantages of CORKBRICK is the flexibility and versatility that it offers, and the ease of assembly and disassembly allied to these characteristics. There is the possibility of daily turning a wall into a bed, for example, or vice versa, among many other possible configurations. In this way, each person is free to build the space that best suit her.

5.2.3 Operationalization of proposals for solutions

5.2.3.1 3D Printing Technology – 3DWAYS

Based on the problems found in stage 1, 3DWAYS was interviewed in order to identify what solutions could be developed in the company, as well as what other solutions could make sense, even though they could not be produced by their printers. In this interview, it was also tried to understand all the logistics associated with the production process of 3D printing.

Based on this interview, it was possible to find several solutions for the problems identified under stage 1, with these solutions being offered by 3D printing technology (see table 9). Those solutions are concrete and viable productions from a 3D printer.

General Need	Specific Need	Solution
Housing conditions	1. Sleeping conditions	Print a house: many of sleeping problems arise from lack of shelter or too many people sleeping in the same space.
	2. Privacy	Division panels
	3. Temperature control	1. Thermal isolation panels 2. Fan 3. Rotary holders for solar panels (that accompany the sun in order to retain more energy): the energy collected will be used for hot water and/or heat the homes
Sanitary conditions	1. Bath	1. Sanitary infrastructure
	2. Toilets	2. Water-pipes 3. Water filters
Occupation for adults		Since, 3D printers do not need previous and specialized knowledge, using this technology in refugee camps would fulfil the problem of lack of occupation for adults, since it would imply the integration of adults in the process of printing. It will require little supervision, but creativity and strong arms for the process.

Table 9 | Needs and Solutions

After understanding the possible solutions offered by this technology, 3DWAYS was asked to show a price range for each product, as well as measures (size) each product should have, based on their experience and knowledge. The table 10, following next, shows in detail the features of each product, including their prices.

Product	Measures (Size)	Time to print	Price (€)	Notes
Division Panel	2,5 m x 1 m	71 hours and 45 minutes	237.20	The size of each panel will depend on what type of privacy and division each family or individual wants. The size considered is a standard size for cost calculation purposes.
Thermal Isolation Panel	0,5 x 0,5 m 15 cm thickness	123 hours and 20 minutes	407.60	Again, the size and thickness of each panel will depend on the need and heat it needs to retain. For that reason, the size

				considered is for calculation purposes.
Fan	0,3 x 0,3 m	12 hours and 9 minutes	40.20	The electronic system has to be developed by a company external to 3DWAYS.
Rotary holders for solar panels	Depending on the model, the time can be estimated more accurately; for a standard sized solar panel – 164.5 x 100 cm - a rotating bracket would take about a week and a half.		873	Should be produced in a material that supports high temperatures. The electronic system will have to be developed by a company external to 3DWAYS.
Sanitary Infrastructure	1,10 x 1,12 m x 2,26 m	To be defined, depending on the size	20,000	-
Water-pipes	41,90 cm diameter; 10cm height	2 hours and 30 minutes	8.25	It is possible to model a structure of pipes and angles. In this way, the pipes are printed to the measurement of the space starting from the same models. The material used to build these tubes, if it does not carry any kind of paint, can be completely inserted into the printer again, reusing all of its material
Water filters	5 cm diameter	30 minutes	1.65	-

Table 10 | 3DWAYS Products and Prices

Based on the table, it is possible to verify that there is no way to print a house by 3DWAYS. The ideal to fight housing conditions was to build entirely new houses that would be prepared for this crisis, or for other coming crisis that will unfortunately happen. It is indeed possible to print a house – it was proved by other companies -, but the material used is cement, which cannot be easily reutilized or recycled. Moreover, if one of the main goals of humanitarian logistics, *per si*, is to decrease the number of refugee camps, it would never be a dream to have permanent infrastructures, creating everlasting refugee camps. Additionally, knowing that 3D printing is an emerging technology, the innovation used around it is still developing, which makes the complete process yet expensive.

Furthermore, based on the information shown in table 10, division panels, thermal isolations panels, rotary holders for solar panels and sanitary infrastructures present costs that do not accomplish the frugal concept if printed.

Nevertheless, it is possible to use the other products to complement the structures and small solutions that currently exist on camps, and respond to other necessities.

The water pipes of sanitary infrastructures of refugee camps are often spoiled, or broken, in need to be changed. The same happens with the water pipes that feed the bath structures. To get cheap, volunteers and organizations have no choice but to use a little tape around the pipes, because changing a piece of them is often expensive. Printing a pipe in a 3D printer makes the process, in fact, cheaper. If a pipe gets shabby and needs to be replaced, in two hours and a half it is produced, and only costs 8,25€. In addition, 3DWAYS produce the water pipes in a material that is entirely recycled, so the plastic used can be inserted all over again in a filament wheel to be reused so as to produce another product.

The same happens with water filters. Not that it needs to be replaced, because there are no water filters in camps, for now, but the material used is 100% reutilized. One filter takes thirty minutes to print, and it is indeed, very cheap. In Moria refugee camp, it is necessary to take about 4 hours to get water or food, and sometimes it is not enough to every individuals and families. There are many water nozzles, but it is to clean or improper to drink so it is used for bath. However, it is a problem with an easy solution – water filters. If a water filters could be applied in these nozzles, the access to water would definitely increase.

Nevertheless, is not only to water solutions that 3DWAYS is able to respond. Families and individuals that live on camps sleep in isoboxes or Refugee Housing Units that were arranged by UN or humanitarian organizations. A Refugee Housing Unit (RHU) is a housing solution, created and designed in Sweden, as a result of a collaboration between the Office of the United Nations High Commissioner for Refugees (UNHCR) and IKEA Foundation. The roof, walls, door and floor covering are panels that are assembled. Each RHU has four windows and one door, one lamp and telephone charger, powered by solar energy, generated by a solar panel, enough to keep the light on and to charge one phone. From December 2014 to June 2016 30.000 RHU were purchased, and each of those costs 1.150 US dollars. RHU is made of multiple pieces so it can be easy to ship and carry. All the pieces assembled create a shelter. RHU can be ready in 6 hours with four trained

people, and needs no tools. Each RHU has 17.5m². It is an empty space with no walls or rooms defined. The following images show in detail the features of an RHU. Figure 14 shows how it is assembled; figure 15 demonstrates how it is packed; figure 16 shows an RHU completed, and ready to use; and figure 17 shows an RHU from the inside.



Figure 14 | How an RHU is assembled

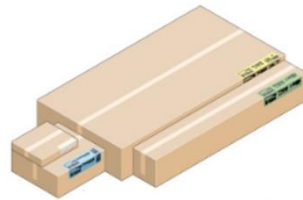


Figure 15 | How an RHU is packed



Figure 16 | Ready to use RHU



Figure 17 | An RHU from inside

The RHU are manufactured by different compositions of plastic and metal, with no isolation. This provokes huge heat in sunny days and cold in winter days, since the shelters are exposed to outside temperatures. Each shelter has four openings for ventilation and cooling purposes.

The isoboxes, the term used for containers are other solution that humanitarian organizations found to be better than tents. It has not the same characteristics of RHU, but they look alike in many features. An isobox is an open space as well, with no walls. Each ISOBOX has 11.8 m² and it is manufactured in galvanized steel. The containers are produced to be easy to assemble and transport. They provide rapid solutions in disaster relief situations and meet the urgent needs of refugees and displaced people. Each ISOBOX has four windows and one door. It has isolation, but not the one that covers the needs and difficulties felt in winter and sunny days inside an ISOBOX. The figure 18 demonstrates an ISOBOX from outside.



Figure 18 | ISOBOX from outside

Within this setting, the products that 3DWAYS offers and that have an affordable purchase cost, are able to complement some of the needs that are still felt with these infrastructures, namely isolation. The fan, for example, could be a precious item to combat heat and lack of ventilation inside an RHU or a container.

There is also a need that clearly remains in these structures. These needs have been pointed out both by refugees and by voluntaries: there are no privacy in these spaces. People are often placed with others who are not in their family or even acquaintances. They are organized according to the language they speak or the religion they believe. Small families or individuals, who wait there alone, are placed in the same division.

Once listed all the products that 3DWAYS is able and available to produce, a question remains - how to produce? In Portugal, and then ship it to the camps? Or produce it *in loco*, shipping the printers?

One 3D printer costs 15.000 €, 1000 kilograms of reels for the printer³ cost 1.000 € and its shipment costs 2.000 €. On the other hand, one maritime container costs around 5.000 euros, per shipment. There is no data concerning transport special conditions for humanitarian agencies. Although incurring in these costs, shipping the printer seem to be a better option. Having, at least, one printer in a camp, becomes possible to teach and train adults to use it, work with it and produce from it, which makes them feel useful. It also allows to reuse plastics in the camp, since it can be recycled, and integrated again.

A 3D printer does many things by its own, but not everything. It requires someone to attend on changing the filament wheels and maintenance, as well as take out the final products and order a new production. One adult is enough to make all of these tasks, but it is already one person that is occupied, being useful and feeling wanted. For that reason, and because occupation of adult is a big problem felt in the camp, and an urgent arena to attack, it is better to have a printer instead of shipping the final productions.

There is a lot of trash and garbage in the camps, which are refugee's home. If it is not clean, another problem emerges. Therefore, if there is the possibility to recycle it, reducing the costs of replacement, it should be done.

5.2.3.2 Cork Solutions – CORKBRICK

Therefore, it is necessary to create division panels. In this way and since 3DWAYS presents a very high price for both partition panels and isolation panels, a new market research was done to find a company that could satisfy these needs in a frugal way. In the end, CORKBRICK was met, to whom a semi-structured interview was again made.

³ The reels on a 3D printer are the mechanism that carry the plastic filament, which will give form to the object that is being printed. The wheel holds the plastic.

The pieces and respective prices are shown in the table 11.

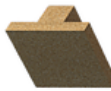
Piece	Image	Selling price	Weight (Kg)	Volume (m ³)
Base		3,35 €	0,84	0,0058
1D		2,65 €	0,56	0,00446
Double		5,45 €	1,68	0,0116
2D		4,40 €	1,26	0,00893
4D		5,80 €	1,82	0,01335
3D		5,10 €	1,54	0,01113
T		1,95 €	0,28	0,00223

Table 11 | CORKBRICK Products and Prices

There are several vendors available. The cost of transportation of CORKBRICK pieces is 60€ per square meter.

Corticeira Amorim, the world leader in the cork industry and the largest supplier of this material in the world, argues that cork has three great advantages of isolation (Corticeira Amorim Website):

- i. First of all, thermal isolation, where the material has the ability to withstand the passage of heat or cold, thus causing very effective insulation;

- ii. Secondly, the anti-vibration isolation, which consists on the cork's ability to avoid the propagation of vibrations produced on a certain surface.
- iii. Finally, the sound isolation, which dictates the ability of the material to absorb sound waves, avoiding its dissipation.

5.2.4 3DWAYS *versus* CORKBRICK Solutions

After analyzing in detail the both solutions proposed to solve the problems found in stage 1, it is necessary to systematize the information to conclude which solution fills better the needs perceived.

The following table shows the needs, the 3D printing and the CORKBRICK solutions that solve those needs, as well as the advantages of solving each necessity with one of the solutions.

Need (size in meters)	3DWAYS	CORKBRICK	Advantages
Division Panel (2.5 x 1)	237.20€	200€ Price inside the refugee project	As mentioned, CORKBRICK has a project under development that is focused on refugee camps. Hence, the price of a division panel, since it is already need perceived from them, is 200€, using 13 base blocks, 30 1D's, 32 Doubles and 6 T's.
Thermal Isolation Panel (2.5 x 1)	407.60€	200€	Since cork is a greatly insulated material, the thermal isolation panel is the same as the division one. This way, the price is the same.
Fan	40.20€	-	It is not possible to have a fan or rotary holders made of cork. For this need, the 3DWAYS fulfills it better.
Rotary holders for solar panels	873€	-	
Sanitary Infrastructure (1,10 x 1,12 x 2,26)	20,000€	325€	With these size, and since cork is able to have constant water with no damage, CORKBRICK has, as solution, a support that serve as base for sanitary infrastructure. For this need, CORKBRICK fills it better.
Water pipes	8.25€	-	It is not possible to have water pipes and filters made of cork. For this need, the 3DWAYS fulfills it better, and it is cheaper.
Water filters	1.65€	-	

Table 12 | Needs and Best solution

The lack of occupation for adults is not contemplated in the above table because both solutions – 3DWAYS and CORKBRICK – meet this problem. In one hand, 3DWAYS needs a supervisor for the printer, and if the printers gains a public access in the camp, any person is capable of producing the thing he wants, with no training needed. Moreover, if one gains training working with 3D printing he is able to reproduce it in the future. In the other hand, CORKBRICK's core is too offer total freedom to build. The pieces are made to adapt to any necessity, so one must invent and reinvent whatever he wants.

In general statement of stage 2, where the goal was to find solutions for the problems named by the refugee, volunteers and collaborator of organizations in their interviews and focus group, 3D printing technology and cork in form of Lego bricks, are presented as two big proposals:

- i. 3DWAYS is able to accomplish needs related to temperature control – production of a fan – and water recycling – water pipes and water filters, helping on reduction of costs in pipes and providing major access to water;
- ii. CORKBRICK has potential to be used for solutions related on thermal isolation, privacy and big structures. With its pieces, the company offers the ability to construct whatever is needed in a home – this case, an isobox or an RHU – with a material that guarantees temperature, sound and vibration control. In addition, the construction made with the pieces maybe a wall, so it is indeed a source of privacy.

5.3 Stage 3

To validate the proposals presented under stage 2, and to achieve a concordance of high committees and member of humanitarian organizations that are positioned in high levels, two interviews were conducted. For the third time in this study, a semi-structured interview was the chosen, since it was crucial to have freedom to add and adapt questions throughout the interview.

After defining the scopes of intervention in refugee camps (according to Stage 1) and how the problems herein identified can be solved or dealt with (according to Stage 2), it turned to be vital to hear a valid opinion about the possibility of concretization of the solutions proposed. That is the goal of stage 3.

For credibility purposes and strength of opinions, it was chosen to interview two sources: firstly, an individual of a high position in an international humanitarian organization; and secondly, an individual that was in charge of a great mission in a camp.

The interviewed are described below, on table 13. The names are not revealed since there is no formal authorization for its divulgation.

Participants	Organization to whom the interviewee belongs	Description
1	AMI Assistência Médica Internacional (<i>International Medical Assistance</i>)	Ivo is AMI's Director of the International Department. He works at AMI since 2003, cooperating with countries in development. Ivo was the leader of an exploratory mission to Greece and Italy to evaluate the conditions of refugee camps and what could be done there.
2	PAR Plataforma de Apoio aos Refugiados (<i>Refugee Support Platform</i>)	Margarida is a 26 years old worker of PAR. She lived for five months in Lesbos and worked as coordinator of PAR's mission on the island. The project was in KaraTepe, a camp of families. The missions consisted in personal development. Margarida says that <i>“Europe has shut itself out of this crisis and pushed the problem into that European corner that cannot (as no other country could) deal with alone. The way people are treated is beyond inconceivable”</i> .

Table 13 | Interviews on Stage 3

It was indeed important to have an input from someone that is totally inside the world of international humanitarian missions, in this case with AMI. AMI has been in existence since 1984 and has already participated and witnessed several humanitarian crises. Participant 1, as director of the International Department, has already lived many realities comparable to the European refugee crisis, in terms of needs, lack of investment and urgency in resources, and for this reason, he knows the world of emergency relief and what arises from it.

Participant 2's inputs were equally important. Given its key role in the management of a PAR mission team, it was essential to listen to its views. PAR is a fully Portuguese organization;

therefore, it has not had as much contact with humanitarian crises as other organizations. In this way, hearing the testimony of someone who debuted in this world was indeed important.

Both participants were interviewed in different days. The questions made during the both interviews spotted the existing investment for humanitarian purposes, their opinion about the solutions - that were previously explained - and the viability of its implementation. The details of these semi-structured interviews are presented in appendix F for both participants.

The answers of both interviewed conducted to the same end and opinion, and the two participants state the same. It is indeed urgent to attack on the outstanding issues excelled identified in the first stage of the present research, and presenting solutions that involve the refugees is the most important and crucial part of the entire proposal. It was as well agreed by both that using materials that are fully recycled or, recycling the existing ones, is critical.

Still, nothing in the humanitarian world is easy, and bring urgent to solve a problem requires much more that simply identify the problem.

It is always necessary to know what is cheaper before attempting to solve the problem in any way. The European Union shares the funds in a quite unstructured way, so there is no money at all. Ivo risked even saying, *“there is never money for humanitarian aid”*.

AMI receives € 10,000,000 per year. This value may seem great, but not enough compared to what needs to be done, bought and paid for. There are salaries, rents and aids promised in Portugal. And if we want to go beyond our country and spread our help, it is necessary to speed up and increase the financial resources.

There is a large chain of people who approves new ideas, even if innovative and immensely improving the living conditions of those who live in these situations. These people, part of the approval chain, are all different, so it is accepted for their priorities to be all different as well. It is necessary to prove all the steps taken in purchases made and money invested, and therefore, it is always necessary to evaluate if a new idea or if a new purchase makes sense to fiddle with the whole process of approvals. In this way, it is always faster to think of the most precarious solution, but cheaper, even if less comfortable.

However, the opinion of the two interviewed and the inputs they gave to this study were very relevant and interesting. *“Yes, it is feasible”* - was their reply. But at the same time, exhausting. It

is very important to innovate in these fields, but the time it takes to get the necessary investment and approval for such an innovation is so much that (hopefully), there is a global solution to this crisis, and we will see an end in it.

Still, even if it is not approved, other financing solutions must be arranged without ever stop fighting. Because there is much to do and the waiting for these authorizations seem to be, but it is not eternal.

To invest in this humanitarian action, the solution may be to get promoters or investors to collaborate with this project. In this way, the importance of implementation of solution that can easily fulfil needs that were mentioned more than once can be shown to high levels that define the investment. Another way to promote this solution is to provide the client that buys products to 3DWAYS or/and CORKBRICK, every time he makes a purchase, the possibility to contribute to the cause, by showing the project, to whom it is developed and how it will be implemented.

To summarize the stage 3, there were two interviews done to organs of well-known international and national humanitarian organizations, in order to evaluate their opinion about the proposed solutions, since they naturally have a better sense on the investment and possibilities of humanitarian crisis suppliers.

When presented the problem perceived, the concordance was transversal. Both of the interviewees agreed and recognized the issues of the camps, felt, experienced and communicated by the participants of stage 1.

The solutions are great, in their opinion – both 3D printing technology and cork bricks. In the vision of the stage 3's interviewees, the solutions will clearly fulfill some needs that need to be achieved, but there is a clear problem in the international investment for humanitarian response. The only way to integrate the proposed solutions in the camps is to change the entire investment system.

The best option will always be the combination of these two strategies.

The world is not a sea of roses; this crisis is just a sea of thorns - and you do not have time to wait any longer. You have to act.

6. Conclusions and Future Research

United Nations define Humanitarian Crisis as a situation that threatens in a critical way the health, security and well-being of the people of a certain country.

The Arab Spring originated big conflicts and wars. The Syrian civil war created a huge humanitarian crisis and it is the biggest driver of migration. The number of refugees and displaced persons now stands at more than 65 million, the largest global displacement of people ever recorded (BBC Europe, 2016).

To escape from war, conflict and constant persecution, families and individuals struggle to have a better life in other country, where peace and opportunities are real, with no danger. The countries in Middle East are the first choice, but these countries revealed scarcity in resources and difficulties on sheltering everybody that needs. For that reason, and because of safety and prospection, Europe became the favorite choice.

All of these above mentioned factors initiated the so-called European Refugee Crisis, and allied to it, a big challenge to overcome. Thousands of arrivals to Europe, per day, created refugee camps, and allied to that, enormous numbers of people living in bad and inhumanly conditions. Thus, it becomes necessary to attack and solve crucial problems that the crisis emerged, basing the decisions in good resources management and investment.

To detect the main problems affecting human conditions and to know the exact difficulties felt on camps, and to find potential solutions that could fit the problems, a methodology based on qualitative tools was conducted. The qualitative instruments taken were interviews, so the results previous from data collection are based on perceptions that people have about a certain topic, on an exact moment.

The major difficulties and problems detected on refugee camps, from the information collected from interviews, focused on housing conditions (sleeping, privacy and temperature conditions), sanitary conditions (bath and toilets) and lack of occupation for adults.

Frugal innovation revealed itself as a great solution to overcome the challenges imposed by the refugee crisis. Since it is based on do more for less, an emergency can be relieved with fewer resources. Exploration of frugal innovation concepts and examples of products conceived in other

occasions demonstrates how costs and resources minimization can be achieved without diminishing the quality of a product or a service, and it is indeed faster, and cheaper. The frugal approach presents solutions that use the scarcity of resources as an opportunity for innovation, rather than a challenge.

In this thesis, Frugal Innovation is presented as a crucial concept, the game changer, in enabling the development of solutions based on the minimal use of resources – maximum efficiency and effectiveness. 3D printing technology presents itself as an integral solution in the approach in question, seeking to reduce costs without questioning the quality of the final product; and Cork in form of Lego bricks creates numerous hypothesis of last-time solutions, able to me made by anyone else. In this way, a low-cost solution can offer high value. The potential of these solutions were supported by the in-depth literature review presented in chapter 2.

Even so, the lack of investment is constant and presents itself as a great obstacle. In the eyes of large decision-makers (it means politics and government representatives), it is not feasible to invest in innovation. There are other priorities, which they consider most important, so it is therefore concluded that the best way to integrate these solutions into the fields, and show the importance they will priority is to get investment only from donations.

From the taken investigation to write the presented thesis, and from the calculation and studies presented in chapter 6, it is concluded that there are several problems that need to have a fast solution and two major possible solutions that feel those problems. Each solution has its own way and purpose, and covers a specific need, but there are several alternatives to solve the urgencies. Both 3D printing technology (with the support of 3DWAYS) and cork bricks (with the support of CORKBRICK) fill the most needed gaps and help fighting the lack of occupation for adults. If this problem is solved, energy will exist to fights the other ones, since all help will be needed.

For future research, is suggested to start the data collection from the top, in order to construct a hierarchy of priorities. In this way, it is possible to balance the priorities and investment available, to propose a solution that could be implemented in the right time, without having to be on the process of continuous approval.

It is also highly recommended to collect more testimonies from more fields across Europe, in order to collect complete data and be aware of the problem as a whole, since it was felt as a limitation,

the abundance of volunteers experienced in Greek camps. Another suggestion is to look for alternative suppliers of the same technologies or alternative technologies, to compare benefits and costs and to define the perfect allocation of the existing budget to the proposals presented, taking into account the available investment and the costs associated with the proposals. All of these suggestions for future research are concerned with maximizing the improvement of living conditions in refugee camps in Europe.

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8. Appendix

Appendix A – Interview made to Refugees

No âmbito da realização de uma tese de mestrado, que tem como assunto principal a avaliação das condições humanas dos campos de refugiados na Europa, e dada a sua envolvimento e contacto com esta realidade, agradeço a sua participação nesta entrevista que contribuirá com grande valor para os resultados e conclusão final.

Antes de começar, vou pedir-lhe, por favor que registe alguns dados pessoais.

Nome:

Idade:

Contacto (*facultativo*):

1. Qual o seu país de origem?
2. Qual o(s) país(es) onde se refugiou?
3. Em que campo(s) ou asilo(s) esteve alojado?
4. Quando e durante quanto tempo esteve alojado no campo ou asilo?
5. Tendo em conta o sitio onde esteve e a realidade em que viveu durante esse tempo, considera que, o sitio onde esteve, é adequado à quantidade de pessoas que lá vivem e responde a todas as necessidades das pessoas envolvidas?
6. Qual acha ser(em) o(s) maior(es) problema(s) do sitio onde esteve?
7. Tem conhecimento ou percepção de dificuldades ou problemas noutros campos que não aquele(es) onde esteve envolvido?
8. Se sim, que problemas são esses?
9. Durante o tempo em que esteve em contacto com esta realidade, o que lhe fez mais falta?
10. Considerando aquilo que viu e que viveu, o que acha que as pessoas que vivem nos campos de refugiados têm mais falta?
11. Como é feita a logística de banhos? Ou seja, a quantos banhos tem direito cada pessoa ou quantos banhos tomam (por semana/por mês)?
12. Como é que as pessoas comem? E bebem?
13. Como caracteriza as condições humanas em que as pessoas vivem?
14. O que deveria mudar para tornar os campos um pouco mais humanos?

15. Daquilo que viveu, quais acha que deveriam ser as medidas/soluções mais urgente a tomar para a melhoria das condições de vida dos refugiados? Porquê?
16. Estaria disposto a participar numa atividade de *FocusGroup* via Skype (discussão em grupo) com outras pessoas que também tiveram contacto com esta realidade, para juntos debaterem uma da solução ideal para este problema?

Appendix B – Interview made to Volunteers

No âmbito da realização de uma tese de mestrado, que tem como assunto principal a avaliação das condições humanas dos campos de refugiados na Europa, e dada a sua envolvimento e contacto com esta realidade, agradeço a sua participação nesta entrevista que contribuirá com grande valor para os resultados e conclusão final.

Antes de começar, vou pedir-lhe, por favor que registe alguns dados pessoais.

Nome:

Idade:

Contacto (*facultativo*):

1. Qual o seu envolvimento nesta realidade? Ou seja, foi voluntário num campo de refugiados ou noutro âmbito?
2. Em que campo trabalhou ou em que campo esteve alojado?
3. Quando e durante quanto tempo esteve envolvido com esta realidade?
4. Tendo em conta o sitio onde esteve e a realidade em que viveu durante esse tempo, considera que, o sitio onde esteve, é adequado à quantidade de pessoas que lá vivem e responde a todas as necessidades das pessoas envolvidas?
5. Qual acha ser(em) o(s) maior(es) problema(s) do sitio onde esteve?
6. Tem conhecimento ou perceção de dificuldades ou problemas noutros campos que não aquele(es) onde esteve envolvido?
7. Se sim, que problemas são esses?
8. Durante o tempo em que esteve em contacto com esta realidade, o que lhe fez mais falta? (a nível de cuidados diários)
9. Considerando aquilo que viu e que viveu, o que acha que as pessoas que vivem nos campos de refugiados têm mais falta?

10. Como é feita a logística de banhos? Ou seja, a quantos banhos tem direito cada pessoa ou quantos banhos tomam (por semana/por mês)?
11. Como é que as comem? Quem fornece os alimentos? Como dormem? É em tendas ou casas improvisadas?
12. Como é feita a logística dos recursos (investimento, comida, água)?
13. Como caracteriza as condições humanas em que as pessoas vivem?
14. O que deveria mudar para tornar os campos um pouco mais humanos?
15. Daquilo que viveu, quais acha que deveriam ser as medidas/soluções mais urgente a tomar para a melhoria das condições de vida dos refugiados? Porquê? Acha que essas medidas seriam possíveis de aplicar?
16. Quem acha que poderia ser o(s) responsável(eis) dessa concretização?
17. Conhece algumas medidas que tenham sido aplicadas noutros campos com sucesso?
18. Estaria disposto a participar numa atividade de *FocusGroup* via Skype (discussão em grupo) com outras pessoas que também tiveram contacto com esta realidade, para juntos debaterem uma da solução ideal para este problema?

Appendix C – Interview made to Collaborators at Humanitarian Organizations

No âmbito da realização de uma tese de mestrado, que tem como assunto principal a avaliação das condições humanas dos campos de refugiados na Europa, e dada a sua envolvimento e contacto com esta realidade, agradeço a sua participação nesta entrevista que contribuirá com grande valor para os resultados e conclusão final.

Antes de começar, vou pedir-lhe, por favor que registe alguns dados pessoais.

Nome:

Idade:

Contacto (*facultativo*):

1. Qual a Organização em que esteve inserido? É uma organização governamental? Qual era o seu papel na Organização?
2. Juntamente com a Organização com quem trabalhou, em que campos trabalhou ou em que campo esteve alojado?
3. Que realidades viveu dado o seu envolvimento com esta organização? Ou seja, viu crises políticas, humanitárias, entre outros?

4. Quando e durante quanto tempo esteve envolvido com esta realidade?
5. Tendo em conta o sitio onde esteve e a realidade em que viveu durante esse tempo, considera que, o sitio onde esteve (seja este sítio campo de refugiados ou asilo), é adequado à quantidade de pessoas que lá vivem e responde a todas as necessidades das pessoas envolvidas?
6. Qual acha ser(em) o(s) maior(es) problema(s) do sitio onde esteve?
7. Tem conhecimento ou perceção de dificuldades ou problemas noutros campos que não aquele(es) onde esteve envolvido?
8. Se sim, que problemas são esses?
9. Durante o tempo em que esteve em contacto com esta realidade, o que lhe fez mais falta?
10. Considerando aquilo que viu e que viveu, o que acha que as pessoas que vivem nos campos de refugiados têm mais falta?
11. Como é feita a logística de banhos? Ou seja, a quantos banhos tem direito cada pessoa ou quantos banhos tomam (por semana/por mês)?
12. Como é que as pessoas dormem? Em tendas, em casas improvisadas,...?
13. Como é feita a logística dos recursos? Quem fornece alimentos?
14. Como caracteriza as condições humanas em que as pessoas vivem?
15. O que deveria mudar para tornar os campos ou asilos um pouco mais humanos?
16. Daquilo que viveu, quais acha que deveriam ser as medidas/soluções mais urgente a tomar para a melhoria das condições de vida dos refugiados? Porquê? Acha que essas medidas seriam possíveis de aplicar?
17. Quem acha que poderia ser o(s) responsável(eis) dessa concretização?
18. Conhece algumas medidas que tenham sido aplicadas noutros campo com sucesso?
19. Estaria disposto a participar numa atividade de *FocusGroup* via Skype (discussão em grupo) com outras pessoas que também tiveram contacto com esta realidade, para juntos debaterem uma da solução ideal para este problema?

Appendix D – Interview made to 3DWays

No âmbito da realização de uma tese de mestrado, que visa investigar as condições humanas dos campos de refugiados na Europa, foram feitas várias entrevistas junto de testemunhas que viveram esta crise em primeira mão, com o principal objetivo de avaliar as condições em que os cidadãos refugiados vivem nos campos das fronteiras europeias.

Desta forma, detectaram-se como principais problemas, as condições em que as famílias e os indivíduos dormem, cuidam da sua higiene pessoal e a privacidade que lhes é concedida.

Para tal, é proposto, como solução, a impressão de infra-estruturas que, da melhor forma possível, resolvam as necessidades iminentes nos campos de refugiados e melhorem circunstancialmente as condições vividas nos mesmos. Avaliar-se-á o custo desta impressão e o tempo que a mesma leva, e para tal, serve esta entrevista para explorar a realidade associada à aplicação das impressões 3D.

Agradeço desde já a sua participação nesta entrevista.

1. Que tipo de impressões a sua empresa produz? Em grande escala, média escala, entre outros (...)
2. Existem protótipos desses produtos? (se sim, posso vê-los?)
3. É sempre o mesmo material usado e todas as impressões, ou este pode/tem de adaptar-se consoante o objetivo da impressão? Ou seja, usar um recurso mais abundante, mais económico, ou tem mesmo que ser um material específico?
4. Acha possível integrar a impressão 3D nos campos de refugiados e usar esta tecnologia para preencher algumas necessidades e condições em falta?
5. É possível construir uma estrutura sanitária a partir de uma impressão 3D? O material usado pode estar em contacto com a água?
6. É possível usar a tecnologia de impressão 3D para infraestruturas de tratamento de água? – limpeza, desinfecção, entre outros. (Se for possível o material usado estar em contacto com a água, esclarecer se é possível que uma impressão 3D tenha características de limpeza suficientes para usar em tratamento de água, dado que a água tratada tem que sair de facto, impecável. Senão, pergunta inválida.)
7. E para aquecer água? (Ou seja, o material pode incluir ou estar em contacto com uma resistência de aquecimento de água, ou pode envolver um esquentador?)
8. Eu sei que a vossa empresa não produz impressões de grande escala, mas é possível ter acesso a informação acerca da estrutura de custos deste tipo de produtos?
9. Que tipo de matéria prima é usada nas impressões? O preço é variável? Posso ter acesso a um precário dessa matéria prima?
10. Essa matéria prima está disponível facilmente? É fácil transportá-la? Ou carece de processos logísticos que podem aumentar o preço?

11. É possível reaproveitar os materiais usados e impressos? Ou seja, é possível reinserir, reciclar ou usar para fins biológicos ou de valor acrescentado, o material que foi usado na construção das infraestruturas, um dia que essas infraestruturas já não sejam necessárias?
12. (Portanto). É possível imprimir uma casa? (posso ter acesso à planta de uma casa já impressa, se existir?)
13. É possível construir uma estrutura sanitária a partir de uma impressão 3D? O material usado pode estar em contacto com a água?
14. É possível usar a tecnologia de impressão 3D para infraestruturas de tratamento de água? – limpeza, desinfecção, entre outros. (Se for possível o material usado estar em contacto com a água, esclarecer se é possível que uma impressão 3D tenha características de limpeza suficientes para usar em tratamento de água, dado que a água tratada tem que sair de facto, impecável. Senão, pergunta inválida.)
15. E para aquecer água? (Ou seja, o material pode incluir ou estar em contacto com uma resistência de aquecimento de água, ou pode envolver um esquentador?)
16. Quanto tempo demora a imprimir cada infraestrutura destas?
17. É possível transportar uma impressora?
18. Qual é o custo de aquisição de uma impressora destas? E o custo de manutenção?
19. É possível transportar uma impressão em grande escala? Por exemplo, se for possível imprimir uma casa, e no futuro essa casa é necessária noutro lugar, é possível transportá-la, em vez de a destruir e voltar a imprimi-la?
20. É possível adequar os produtos, isto é, as impressões, às necessidades da realidade em questão? (por exemplo, se for uma família grande, será necessário talvez fazer uma casa um bocadinho maior para pôr mais camas ou mais casas de banho)
21. Um dos campos de refugiados na Ilha de Lesbos, na Grécia, aloja 990 pessoas. Já alojou 5.000, e a sua capacidade é, oficialmente, para 200 pessoas. É o campo de Kara Tepe e é de facto um exemplo da sobrelotação que se vive nos campos de alojamento desta crise. As pessoas ficam em média 3 meses neste campo e são distribuídas por contentores ou *Refugee Housing Units*. Cada contentor/casa de plástico tem direito a uma luz e uma entrada USB. Mas para que isso possa ser distribuído a todas as pessoas, a eletricidade é alimentada a partir de energias renováveis. É possível usar a tecnologia de impressões 3D para as

energias renováveis? Ou seja, para apoio de painéis solares, ou para a condução dessa energia às casas?

22. As RHU's têm 17,5 metros quadrados, custam 1.150 US dólares (este preço não inclui o transporte, montagem e armazenamento do material) e demoram 6 horas a ser montadas com a ajuda de 4 pessoas. São consideradas muito boas e inovadoras, ideais para famílias com 5 pessoas e completam as necessidades de *housing* de uma família. Mas é apenas um espaço, em que as divisões são feitas com cortinas, mas não tem casa de banho. É uma estrutura com duas janelas, tipo grade, por isso não abrem. Não tem isolamento nenhum e pesam 160kg. Seria possível incluir ventoinhas, ou ar condicionado na casa, a partir da impressão 3D? Para efeitos de aquecimento ou de arrefecimento da infra-estrutura. Esta questão serve apenas para averiguar a possibilidade de complementar as infra-estruturas que já existem, no caso de a solução não passar por novas construções.
23. Pensando agora de forma um pouco mais concreta, seria possível contruir uma casa, com um tamanho aproximado, mas com uma casa de banho incluída? Desta forma, a família estaria unida, com privacidade e sem perigos.
24. Quanto tempo e quanto custaria produzir essa casa?
25. Se um dos maiores objetivos em propor esta solução é garantir que as famílias não são separadas, seria possível adaptá-la aos agregados familiares? Se uma família fosse apenas de 3 elementos, não seria necessária uma casa igual a uma família com 7 elementos, por exemplo.
26. Qual o custo e tempo que demoraria a construir um cubículo com 2,5 metros de altura, e 1,20 metros quadrados de *floor área*? Seria possível então fazer 50 estruturas destas em linha para efeito de casa de banho de comum?
27. Acha possível reduzir os custos e o tempo de produção se houver constrangimentos a esse nível?
28. Já foi realizada uma primeira fase de entrevistas com pessoas que tiveram contacto em primeira mão com esta crise, com os campos de refugiados e com as dificuldades e problemas sentidos. Os problemas mais referidos foram as condições em que as pessoas dormem, as estruturas sanitárias a falta de privacidade que as famílias tinham, dado que muitas vezes tinham que dividir quartos ou casas de banho com outras famílias que não

conheciam. Desta forma, acha possível imprimir infraestruturas produzidas pela 3D ways e que completem necessidades específicas? Quais os custos associados a esta produção?

Appendix E – Interview made to CORKBRICK

No âmbito da realização de uma tese de mestrado, que visa investigar as condições humanas dos campos de refugiados na Europa, foram feitas várias entrevistas junto de testemunhas que viveram esta crise em primeira mão, com o principal objetivo de avaliar as condições em que os cidadãos refugiados vivem nos campos das fronteiras europeias.

Desta forma, detetaram-se como principais problemas, as condições em que as famílias e os indivíduos dormem, incluindo a temperatura sentida no espaço destinado a este efeito e a falta de privacidade, e forma como cuidam da sua higiene pessoal.

Para tal, é proposto, como solução, a integração de infraestruturas que, da melhor forma possível, resolvam as necessidades iminentes nos campos de refugiados e melhorem circunstancialmente as condições vividas nos mesmos. A presente entrevista visa e explorar as vantagens associadas à integração de produtos da CORKBRICK nesta situação, avaliando o custo dos produtos e o tempo associado à sua concretização.

Agradeço desde já a sua participação.

1. A CORKBRICK oferece produtos feitos em cortiça. A ideia de integrar esses produtos nos campos de refugiados vai ao encontro surge como resultado das temperaturas sentidas dentro das casas e contentores onde as pessoas desses campos passam grande parte do seu tempo. Acha possível a CORKBRICK construir produtos com medidas específicas que se integrem nestes espaços?
2. A CORKBRICK oferece produtos onde o Cliente pode escolher entre comprar as peças e construir em modo Lego a estrutura final que quer alcançar. Mas também oferece produtos acabados. Seria possível obter um produto (por exemplo, um painel) que sirva de isolador das casas ou contentores onde as pessoas vivem ou que servisse de divisória de espaços?
3. E seria possível produzir várias peças que juntas, fizessem um painel de cortiça?
4. Existe um preço com todas as peças possíveis? (se sim, posso ter acesso?)
5. Qual o custo da extração de cortiça necessária para a produção de 1 peça?
6. E o custo de transporte dessa peça?

7. É sempre a mesma matéria prima usada nas produções da CORKBRICK? Essa matéria prima está disponível facilmente?
8. As peças envolvem apenas esse material ou existe algum tipo de material adicionado?
9. A cortiça utilizada nas peças e produtos finais é apenas portuguesa ou há mais algum país fornecedor?
10. Sendo que um dos desafios a ultrapassar é o tempo livre em demasia que se faz sentir nos indivíduos mais adultos, seria possível realizar um workshop ou outro tipo de atividade, que estimule a construção de produtos com as peças CORKBRICK? De forma a fazer com que se sintam úteis na comunidade, dando o seu contributo para a melhoria das suas condições de vida nos campos
11. Os produtos são fáceis de transportar? Existe diferença nos custos de transporte consoante o número ou peso das peças/produtos acabados?
12. Os produtos podem estar em contacto com a água?
13. Qual a durabilidade dos produtos?
14. A cortiça é considerada um material amigo do ambiente?
15. Os produtos podem ser facilmente reutilizados?
16. Acha possível integrar as peças e os produtos CORKBRICK nos campos de refugiados e usar este tipo de produtos para preencher algumas necessidades e condições em falta?
17. Existem soluções específicas, já pensadas por vocês, para ir ao encontro desta realidade?
Se sim, que custos implicam essas soluções? E que soluções de transporte?

Appendix F – Interview made to AMI (Assistência Médica Internacional) - *International Medical Assistance & PAR (Plataforma de Apoio aos Refugiados) – Refugee Support Platform*

No âmbito da realização de uma tese de mestrado, que tem como objetivo principal a avaliação e melhoria das condições humanas dos campos de refugiados na Europa, é proposto, como solução, a produção de casas e outras infraestruturas que, da melhor forma possível, resolvam as necessidades iminentes nos campos de refugiados e melhorem circunstancialmente as condições vividas nos mesmos. Após pesquisa de estratégias possíveis para a produção destas soluções de forma a ter os menores custos possíveis, chegou-se a duas opções: produção através de impressão 3D e produção tendo por base peças de cortiça de portuguesa.

Neste contexto, esta entrevista tem como objetivo principal aferir a sua opinião acerca da possibilidade de inserção destas infraestruturas nos campos, como solução ao problema detetado, de forma a chegar a uma validação.

Agradeço desde já a sua participação nesta entrevista.

1. Em que campo esteve presente?
2. Quantas pessoas estão aí alojadas e qual a capacidade do campo?
3. Qual considera serem os principais problemas e dificuldades vividos nos campos, pelas pessoas?
4. Quanto tempo acha que esta crise humanitária ainda dura?
5. De forma geral, qual é a sua opinião em relação às condições oferecidas aos refugiados que chegam à Europa? (aqui falo de condições humanas, entre elas as infraestruturas sanitárias, as casas, a privacidade e respeito familiar)
6. Acha que existe um problema de quantidade de pessoas, de quantidade de voluntários, de infraestruturas, de organizações ou de investimento?
7. Ou todos estes problemas juntos?
8. Há orçamento disponível para investir nos campos de refugiados?
9. No caso de existir, esse orçamento é apenas o suficiente para travar a situação sem que haja agravamentos, ou haverá espaço para investir em soluções que promovam a dignidade e bem-estar das pessoas e preservação da sua cultura nos campos de refugiados?
10. Na sua opinião, vale a pena investir nesta crise? Ou seja, dado que não é possível resolvê-la nem evitá-la no curto prazo, vale a pena investir em infraestruturas que visem melhorar as condições humanas nos campos de refugiados?
11. Qual seria, na sua perspetiva, a solução para combater as más condições em que os refugiados vivem nos campos?
12. O que diria a uma proposta de solução baseada na produção de infraestruturas variadas com base em cortiça portuguesa ou em impressões 3D – para combater esta falha aos direitos humanos? A proposta consiste, em parte, em construir casas para substituir os contentores e para famílias que estejam desalojadas ou alojadas em condições muito graves. Sei que existem as RHU's (*Refugee Housing Units*), consideradas inovadoras e de

encontro a algumas necessidades pessoais. Mas existe um grande problema de temperatura nestas casas e nos contentores. Há muito frio quando está frio e muito calor quando está quente. Para combater este problema, é proposto a construção de painéis em cortiça, ou em material impresso em 3D que isolem as paredes destas casas. A proposta passa também por construir infraestruturas que estejam em falta (por exemplo, casas de banho, suportes para painéis solares e outras energias renováveis, entre outros). Os primeiros campos a receber esta ajuda seriam os que têm maior afluência de pessoas, maior desgaste e piores condições. Acha possível integrar estas soluções nos campos europeus?

13. Existirá orçamento para este tipo de investimento?
14. Existe matéria prima que possa substituir a cortiça usada como solução em alguns produtos ou o plástico usado nas impressões 3D, e que seja mais barata?
15. Existe alguma solução que esteja em cima da mesa, mas que ainda não tenha estrado em ação?
16. Acha mais viável dar, através de patrocinadores, os materiais necessários para a construção das casas e usar os refugiados como mão de obra?
17. Acha que ainda vamos a tempo de implementar estas soluções?