# ANALYSIS AND OPTIMIZATION OF AN HIGHLY SEASONABLE WAREHOUSE: CASE STUDY UNIFRIGO GADUS S.P.A.

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**ABSTRACT**
The paper deals with a highly seasonable warehouse, owned and managed by Unifrigo Gadus Spa, a firm operating in the field of the salted fish supply.
This warehouse represents a crucial point for the whole salted fish supply chain in Italy.
The purpose of this work is to study the warehouse features, its management policy adopted by the company and the flow passing through it, in order to suggest a methodology to solve the highlighted criticalities. As a matter of fact, not only a rationalization and optimization of the warehouse management policies can increase the efficiency of the single company but also of the whole supply chain.

Keywords: salted codfish supply chain, warehouse management, optimization, logistics

## 1. INTRODUCTION

The dried and salted codfish supply chain consists in different steps that permit to deliver it all over Europe.
Salted codfish is produced using Gadus Morhua, which is caught in the North Atlantic Ocean and in the Barens Sea. Fishermen sell it to producers mainly located in Norway, Iceland, Denmark and Spain. Here the fish, already beheaded and eviscerated, is salted and dried ashore. Traditionally the fish was sun-dried on rocks or wooden frames, but today it is mainly dried indoors by electrical heating. Than, codfish is collocated in packs of 25 kg, which are loaded on pallets of 40 packs each one. Some suppliers use packs of 20 kg and\or pallet made up of 30 packs. Packs may contain a whole codfish or a portion of it, with or without bones. Hence goods are sold to foreign countries importers. They can purchase a single truck of 18 tons or they can stipulate contracts that provide for a number of trucks delivered to deadlines. Vessels transfer goods from Iceland to Rotterdam where they are forwarded to Italy and to the other European destinations by refrigerated trucks. The transport from the place of production to the final destination takes about 10 days. The goods coming from Norway and Denmark are, however, loaded on trucks directly in the places of production and shipped to its final destinations.

The Gadus Morhua is utilized also to produce a different kind of goods, the stockfish. It is unsalted codfish, hung on wooden racks and dried. Anyway, it has more or less the same supply chain of salted codfish but stockfish is produced only in Norway due to its particular weather conditions.

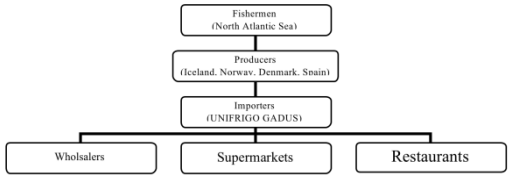


Figure 1: The salted codfish supply chain

The salted codfish and stockfish supply chain is a critical issue for several reasons.
First of all, since it is not an industrial product, it is hard to state properly the quality of each lot and to find an agreement among suppliers and customers about it. Moreover, even though the delivery time does not represent a matter, as dried and salted codfish is a long life product, it must be transported in fridge trucks or containers. Anyway, a relevant problem is the impossibility of forecasting neither the market demand nor the suppliers offer as they depend on different factors such as weather conditions and wildlife preservation regulamentations. However, the main problem is the highly seasonable sales trend, which affects salt cod. This issue involves every link of the supply chain, causing several difficulties in getting into proportions properly the work force and warehouses.
Actually, the aim of this work was to study the features of a warehouse managed by Unifrigo Gadus Spa, an Italian firm operating in the field of salt cod importation, in order to suggest a correct way to solve the pointed out criticalities.

## 2. WAREHOUSE ANALYSIS

Unifrigo Gadus Spa is a firm operating in the field of salted codfish and stockfish supply since the beginning of the last century. It represents a key link in the supply chain for these products in the Italian market. This market currently is worth around 200 million euro of annual turnover. It is a marginal sector and the players at the national level are very few, a dozen in all. However the possibilities of the entry of new competitors are very remote due to some barriers to entry such as the paucity of suppliers and the close personal ties that bind them to the importers. The business of Unifrigo Gadus consists in the importation and distribution of salt cod and stockfish on the Italian territory through a network of food wholesalers, supermarkets, markets, large retailers, etc. Unifrigo Gadus Spa trades 84 different articles in all that differ for quality, size and brand. The imported merchandise is stored, for the markets of the north Italy, into a refrigerated warehouse owned by the company in Novi Ligure (Alessandria). Conversely, goods for customers located in the south and in the centre of Italy, are stored in a cold store situated in a large industrial complex in Campania.

### 2.1. The warehouse in Campania

The analyzed warehouse consists in 4 cells that Unifrigo Gadus S.P.A. currently rents and manages. Even if it were necessary, the company cannot get more space, as it is not available. Furthermore, Unifrigo Gadus Spa is not interested in building and owning another store. The following numbers marks the cells: 16,17,18 and 38.
Next to the cells there are the company sales offices and a goods load\unload area.

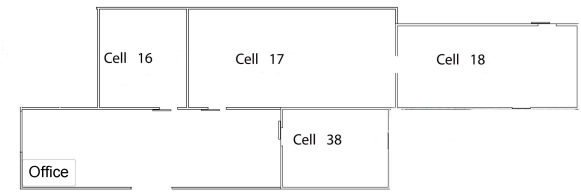


Figure 2: Unifrigo Gadus warehouse layout

Due to the salt cod seasonal sales trend, the most part of goods movement is condensed in a very short lapse of time. Actually, in 2008, the 69% of goods loads and the 80% of unloads, took place from September to December as displayed in the following pie charts.

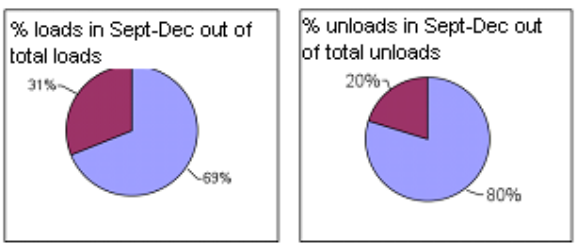


Figure 3: % Loads and unloads In September-December out of total loads and unloads

#### 2.1.1. Cell 16 features

The cell number 16 is 6,9 meters long and 7,7 meters wide and is kept at a temperature of -2 Celsius degrees. The theoretical capacity of this room is 37 500 kg. It is used to store stockfish and it is not equipped with shelves, as suppliers do not place the stockfish on pallets. Moreover, it is not possible to store here salted and dried codfish since this is characterized by a different humidity percentage.

Figure 3: Packs of stockfish in cell 16

Even though the stockfish is mostly handled in the period September-December, with the 66% of goods unloads and 52% of loads, it has a less seasonal sales trend than the salt cod.

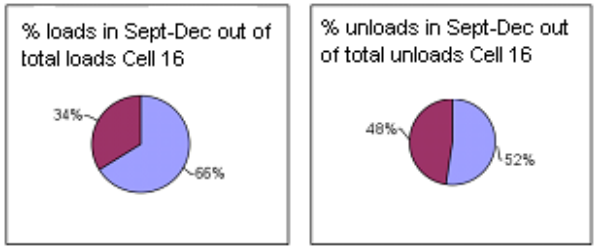


Figure 2:% Loads and unloads In September-December out of total loads and unloads of product in cell 16

In the year 2008, the stock peak was registered during the 41st week of the year and was an amount of 16 806 kg of stockfish representing the 44% of the theoretical capacity. The average stock quantity of cell 16 is 8 994 kg, the 53% of the maximum stock and just the 23% of the theoretical capacity.

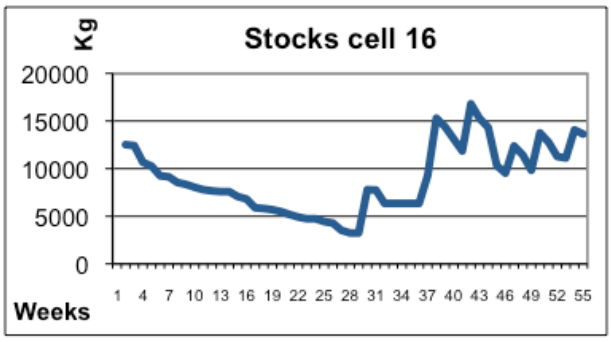


Figure 6: Stocks trend of cell 16

Hence, the cell 16 does not represent, at the moment, a problem for Unifrigo Gadus Spa as it is sized properly for the required task. Anyway, it is not possible utilize the remaining space for others duties due to the stockfish conservation peculiarities.

### 2.1.2. Cell 38 features

The cell 38 is 8 meters long and 5,8 meters wide. It is used to store dried products such as dried salted codfish and Gaspe that are both more dried than the common salt cod. The cell 38 is equipped with shelves only on the right wall. Here there are 12 slots for euro-pallets per each vertical row. There are 10 vertical rows for a theoretical capacity of 90 000 kg of goods.

Figure 7: internal view of cell 38

In the year 2008 the stock peak was registered during the 46$^{th}$ week with an amount of merchandise of 76 600 kg. This data represent the 17,5 % less than the theoretical maximum capacity. The average quantity of goods stored was 49 930 kg which is the 65% of the theoretical capacity.

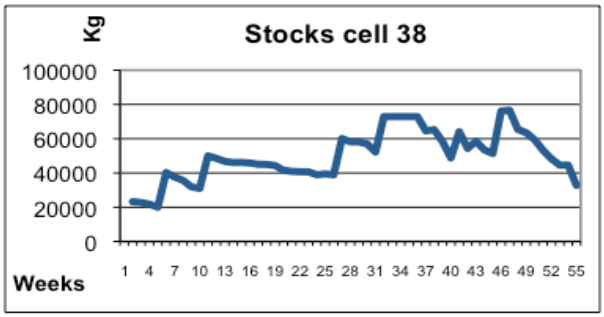


Figure 8: Stocks trend cell 38

The stock graph is characterized by an irregular trend, but it is easily explainable by the fact that in a so small cell even the arrival of just one truck of goods (20 000 kg) leads to a big shift in the stock quantity. Considering these data, the cell 38 does not matter the company and currently it does not require a specific management policy.

### 2.1.3. Cells 17 and 18 features

Cells 17 and 18 are connected through a door, so they can be considered as a single room. It measures 200 square meters and it is kept at a temperature between -2 and +2 Celsius degrees. In this area are stored the salt cod and some other products known as Ling and Brosme that are different fishes but prepared exactly as the salted codfish is. Due to the high percentage of salt and humidity that characterizes these articles, it is not possible store here neither the dried codfish nor the stockfish. Cells 17 and 18 are equipped with shelves on both sides that allow a central transit only to one forklift. The layout is *drive-in* as the shelves are close to the walls and goods can be picked just from one side.

Figure 9: Shelves and drive-in layout in cells 17 and 18

In this area, there are 441 slots for pallets for a total amount of 363 000 kg of merchandise. In the year 2008, the stock peak was registered during the 46$^{th}$ week. It was 374 363 kg, the 3,1% more than the maximum theoretical capacity. In addition it is important to underline that a number of slots are occupied by partially empty pallets. Indeed, several articles stored in the cells 17 and 18 are characterized by the sale of single boxes of goods in spite of the entire pallets. Actually, the sales of entire pallets are only the 11,44% of the total goods unloads. The average stock during the year 2008 was 194 838, the 53,2% of the theoretical capacity. The minimum stock, 111 696 kg and was registered during the 54$^{th}$ week of the year. The considerable difference between the maximum and the minimum stock quantity is explainable by the fact that salted codfish is always available and it is not necessary a particular purchase policy.

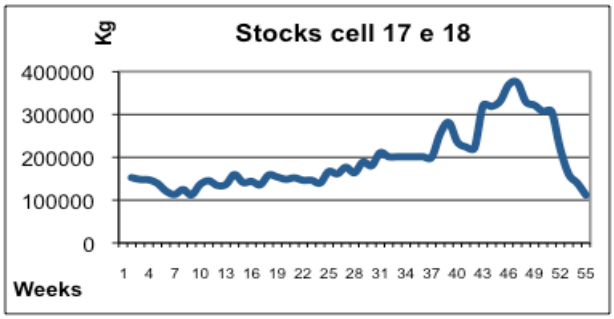


Figure 10: Stocks trend in cells 17 and 18

However, all the products stored in cells 17 and 18 are characterized by a highly seasonable sales trend. Actually, in the period September-December of the year 2008 were registered 357 loads of goods out of 497 in all, and 4 266 unloads and sales out of 5 133 in all. These data represent respectively the 72% and the 83% of the entire year movements.

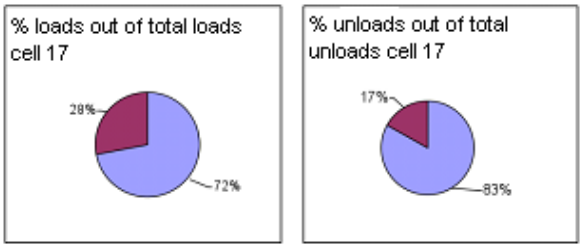


Figure 11: % Loads and unloads In September-December out of total loads and unloads

**2.2. The current state of the warehouse**

Currently three workers are employed at the Unifrigo Gadus store. There is one storekeeper, who is the responsible of the warehouse organization, and two skilled workmen. There are two different kind of operations made when it is necessary to deliver merchandise, depending on if it is required a full pallet of codfish or just part of it. In the former instance, the storekeeper, who drives the forklift, forks a pallet and puts it on the vehicle used to deliver the goods. The other two employers are totally useless in this case. In the latter instance, the forklift driver takes a pallet and puts it on the floor where the other two workmen can collect the requested packs. The warehouse is overstaffed in March-July. Hence, in this period were registered just the 18% of the goods loads and the 9% of goods download. On the contrary, the store is heavily short-staffed during the last three months of the year. Actually, the company has to pay overtime and even hire short-term workers. However, this is not a valid and effective solution, since due to the current warehouse organization, the staff has to know the different articles features. This implies a necessary training time for workers.

At the moment, is not followed a specific criterion to arrange the goods. The store man allocates these each time as he regards convenient. Usually he tends to put in close slots products commercially homogeneous. However, this means that very similar goods, but with different brands are not arranged one next to the other.

Furthermore, the store man does not make any difference among the levels of the shelves even if the pallets positioned at the ground floor are clearly easier to take. Therefore, all the goods in the store are always moved with the forklift truck and never with the transpallets. Moreover, some vertical rows are occupied by pallets and packs already sold by the company but not delivered yet. Nevertheless, from September, even this rough method is dropped. Actually, the incoming pallets are just put in the first available slot, supposing that there is one. Otherwise these are simply piled up out of the shelves as well.

**2.3. The current state analysis**

Cells number 17 and 18 represent a nodal point for Unifrigo Gadus business. Indeed are stored there as many as 62 different items out of 84 usually sold by the company. However, as the data clearly show, they are undersized to accomplish the requirements. Analyzing the data about the goods unloads in the year 2008, it come out that just the 9,26% of sales involved a full pallet. It makes clear that the company material handling policy based on the pallet movements with a forklift is useless and too slow for the most part of warehouse operations. Moreover, human resources are not optimally capitalized as each operation or movement depends on the storekeeper. Since he works with complete autonomy in storing the goods and choosing which deliver to each customer, the warehouse management is very hard when he is absent. Furthermore there is not a clear strategy carried out in order to pursue good results of traceability. Working only with the forklift and never with the transpallets it takes a long time to prepare the merchandise to be delivered. Furthermore, two of three employers are constantly underused. Since there is not an assigned warehousing plan, the different goods are not always stored in the same place. The workforce is so required to know the merchandise and to recognize it in order to collect the right article when requested. This implies a substantial difficulty in changing the workforce and employ workers for a short-term. All the refrigerated cells are set up with shelves attached to the wall. This makes not possible a *First In-First out* strategy. So the company is obliged to adopt a *Last In-First out* strategy, which is surely not indicated for food with expiration date.

Summarizing, the problems highlighted are:

1. Inadequate size of the cell number 17
2. Stocking strategy adapted only for pallets movements
3. Tight dependence on the store man
4. Workers must know the goods and recognize the different products
5. Human resources are not properly utilized
6. Too much time needed to prepare the merchandise to be delivered
7. LIFO strategy obligatorily adopted
8. Difficulties in pursuing good results of traceability

**3. SOLUTIONS**

At the moment, it is not possible to solve the problems related to the insufficient size of the cell 17 and 18. Even if this implies a number of troubles, the company do not intend leave the building where are located the cells that it has now in use. Furthermore Unifrigo Gadus does not want to build an own warehouse due to the high costs and the long time requested as already highlighted. However, as cells 17 and 18 are oversized for a remarkably long term during the year, the

company could split them by closing the internal door and sublet one of them from March to August.

### 3.1. Picking zone

A possible solution to the points 2,3,4,5 and 6 is the arrangement of zone picking system. This would sensibly facilitate the preparation of the merchandise to be delivered. In particular, the advice is to assign to each ground-floor-slot a different product that could, indeed, be collected using two transpallets instead of the single forklift. If it be so, the two workmen currently bound to the forklift driver due to the their impossibility in reaching products stored in the high shelves, could contrary work autonomously as they could take with their transpallet any kind of merchandise. Moreover, applying a *dedicated storage* strategy, workers are not obliged to know and recognize the different products and would not waste time. As the company already owns an electric transpallet, it should just buy another one capable of moving 1,5 tons since the heaviest pallet weighs 1,3 tons. Furthermore the software presently used by the company is already capable of calculating the best picking track and of printing it on a paper. In this way, everybody at the store should be able to pick quickly the product to dispatch. A test has been conducted in order to quantify the time that could be saved with this solution. The test consisted in measuring the time needed in collecting 10 different lots of goods from 5 different pallets, so 2 lots for each distinct pallet, all positioned at the ground floor. The result showed that the time required doing the job with the forklift is 27% higher than the time required to take the goods with the transpallet. This would mean a conspicuous reduction of the time used for material handling which is clearly not enough as, in the year 2008, were paid 388 hours of overtime.

At the ground floor of the cells 17 and 18 there are 43 slots available for pallets. Since the different articles here stored are 62, it seems that not every product could be allocated in the picking zone. However, some articles are characterized by only full pallet handling so are not suitable for the picking zone, while others could be put in the same slot being commercially homogeneous. Hence, the articles to be assigned to the ground floor slot are in sooth 41. It is now necessary a criterion to assign the different slots to the articles as the ones near the door are clearly more accessible. Drowning up a list where the products (article id) are ranked by the number of pickings registered during the year 2008, it is possible to allocate the most handled articles to the most accessible slots.

| article id | pos.picking | # movements | # pallet movements | # picking |
|---|---|---|---|---|
| BCI17 e BCI 17\2 | 1 | 536 | 79 | 457 |
| BCI28 e BCI 28\2 | 2 | 481 | 82 | 399 |
| FCG07 e FCN07 | 4 | 283 | 36 | 247 |
| BCI12 e BCI12\2 | 3 | 270 | 23 | 247 |
| FBA04 | 5 | 277 | 43 | 234 |
| BCI41 e BCI 41\2 | 6 | 264 | 32 | 232 |
| FLA10 | 7 | 244 | 19 | 225 |
| FCG10 e FCN10 | 8 | 240 | 16 | 224 |
| FLA07 | 9 | 206 | 10 | 196 |
| FCG04 e FCN04 | 10 | 178 | 30 | 148 |
| FBA02 | 11 | 165 | 26 | 139 |
| SLI20 | 12 | 138 | 12 | 126 |
| BCN16 | 13 | 134 | 12 | 122 |
| FBA07 | 14 | 130 | 26 | 104 |
| BCN13 | 15 | 115 | 13 | 102 |
| SLI40 | 16 | 120 | 21 | 99 |
| FLA10/20 | 17 | 106 | 8 | 98 |
| BCG17 | NO | 96 | 4 | 92 |
| BCN07 | 18 | 95 | 7 | 88 |
| BCN21 | 19 | 87 | 3 | 84 |
| BCG40 | NO | 92 | 14 | 78 |
| BCG27 | NO | 77 | 6 | 71 |
| FLA04 | 20 | 75 | 5 | 70 |
| BFM27/20 e 27/25 | 21 | 66 | 1 | 65 |
| WCP | 23 | 75 | 14 | 61 |
| FLA15/20 | 22 | 63 | 2 | 61 |
| BCN10 | 24 | 56 | 2 | 54 |
| BFM40/20 e 40/25 | 25 | 49 | 1 | 48 |
| BCG12 | NO | 50 | 4 | 46 |
| BFM17 e 17/25 | 26 | 44 | 0 | 44 |
| BFM12 e 12/25 | 27 | 43 | 0 | 43 |
| FLA15 | 28 | 35 | 0 | 35 |
| FLA20/20 | 30 | 32 | 3 | 29 |
| FLA07/20 | 29 | 31 | 2 | 29 |
| SBI17 | 31 | 40 | 12 | 28 |
| SBI12 | 32 | 26 | 3 | 23 |
| FBA01 | 33 | 18 | 1 | 17 |
| BFM28/20 e 28/25 | 34 | 16 | 0 | 16 |
| SLF40/20 | 35 | 15 | 0 | 15 |
| FLA00 | 37 | 11 | 0 | 11 |
| BFM41/20 e 41/25 | 36 | 15 | 4 | 11 |
| BFM13 e 13/25 | 38 | 9 | 0 | 9 |
| BFM18 e 18/25 | 39 | 7 | 0 | 7 |
| BFM00/20 e 00/25 | 40 | 5 | 0 | 5 |
| BFM09 | 41 | 3 | 0 | 3 |
| FCG02 | NO | 11 | 11 | 0 |

Table 1: Articles stored in cells 17 and 18 ordered by number of pickings in the year 2008

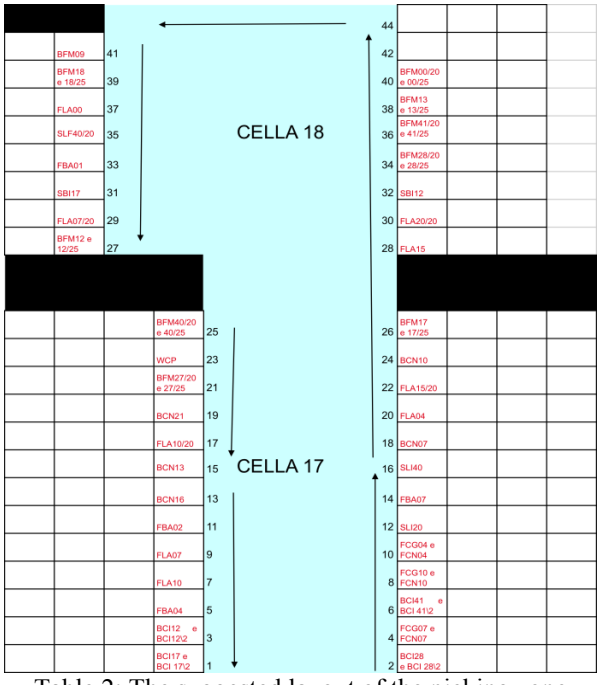


Table 2: The suggested layout of the picking zone

Once the picking area has been arranged, the attention should be focused on the goods disposition in the shelving upper floor. It is obviously impossible organize all the floors with a dedicated storage strategy, as the space would not be enough and due to the different quantity of the several stored products. Moreover, a consistent part of the goods stored in the warehouse is not available for sale because has already been purchased by customers that have not collected it yet. Anyway, analyzing the data referred to the movement of entire pallets of codfish, it comes out that there are products more involved in this kind of handling than others. It is strongly suggested to place these articles in the upper floor, as they must always be moved with the forklift. Unfortunately this solution would led to a *Last-in First-out* strategy, making the solution non entirely feasible, unless the warehouse would be redesigned applying a drive through layout.

### 3.2. Bar codes

An efficient solution to problem number 8, the difficulty in pursuing good results of traceability, is labeling with bar codes all the goods passing through the store. It is suggested the adoption of EAN-128 as standard bar code for Unifrigo Gadus because of the amount of data that it can provide. Actually, on each label can be printed information such as article code, lot and expiring date. This would make the company aware, in every moment, of which goods are in the warehouse and which were already sold and shipped and to whom. The company already owns two labeling machines and hence should just buy a barcode reader. Moreover, the best benefit of the implementation of a bar code labeling system is, as already highlighted; the possibility of pursuing excellent results in product traceability. Actually, a traceable product, gives o the customer a guarantee of quality and certainty about the goods origin. Additionally, traceability could be a powerful marketing tool as it can enhance the company brand image. Hence, in an uneasiness moment for the food industry, this is surely an important competitive edge. Consequently, the company could ask a premium price on the market and furthermore, acquire new customers attracted by the high quality of the whole supply chain.

## 4. CONCLUSION

Unifrigo Gadus Spa is by all means an efficient and cost-effective company. As a matter of fact, it has been on the market for over 100 years.

So, at the beginning of this work there were not guarantee about finding mistakes in any of its management strategies. Due to the features of the field in which the analyzed company is embedded, considering and evaluating just one-year data is a bit limiting. However the evidence and the degree of the highlighted criticalities makes them to be perforce taken into consideration. In order to came up with valid and applicable solutions, was analyzed each product flow, and simplifications were minimized. Hence it is to be hoped that Unifrigo Gadus Spa values this work and put in practice the suggested solutions. Actually, nowadays, the competitive edge cannot be based just on the product quality or on the price, especially in those markets such as the food one where brands are not always a factor and there are not exclusive representations. The optimization of goods flows, not only leads to money save and to a complete workforce capitalization, but also enhance the corporate image. This can make the difference for companies such as Unifrigo Gadus Spa as its customers frequently visit it in order to evaluate the company's logistic quality and organization.

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