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A world without pallets...
is it sustainable?

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.Introduction

Today, more than ever, all aspects of sustainability – environmental, social and financial – are a strategic core asset through which companies can grow and innovate to be more competitive while reducing their impact on our planet. Developments in the circular economy are leading companies to rethink their own logistics and production processes, adopting wherever possible, optimization strategies and eco-sustainable innovations.

Similar to the impact the invention of containers had on national maritime shipping, pallets are one of the innovations that has transformed the way logistics is managed. Given the radical changes in warehousing and shipping methods around the world, it would be impossible to do without pallets in this day and age.

In order to quantify the savings gained with the introduction of pallets, both for businesses and for the end consumer, on the 20th anniversary of the establishment of EPAL in Italy, the LIUC Business School Center for Logistics and Supply Chain Management, with the support of Conlegno, produced the following study: Imagining the surreal scenario of a world without pallets. This study illustrates how much more it would cost businesses and the national economic system to handle, transport and stock merchandise without pallets, with specific reference to the FMCG (fast-moving consumer-goods) area, which uses 60 million EPAL pallets annually.

Based on differential cost analyses of the various scenarios, a comparison model was developed that shows how, by choosing to use wood pallets, companies in the consumer-goods sector can save more than 1.8 billion euro every year.

These numbers gain even more significance if one considers the savings for businesses that a single EPAL pallet can generate during its average 9-year lifespan. Against an "investment" of only €12.50 (i.e., €9.00 purchase cost and €3.50 for repairs) more than €1,200.00 in logistics costs can be spared for the company – equal to 100-times the initial investment.

By extension, considering all of the logistic flows in Italy that "travel" on EPAL pallets, the study calculated that the overall benefit to the national economy exceeds €2.5 billion/year.

Taking into account the 25 million families in Italy, this benefit adds up to annual savings of €100.00 per family. In addition to the financial benefits, the invention of the pallet brought with it an inestimable benefit to the health and wellbeing of warehouse personnel, lifting the burdensome labor involved in handling loads manually and limiting the number of on-the-job accidents and work-related illnesses.

The study also assesses the improved efficiency of the EPAL 'exchange' model for companies that adopt it, compared to 'single-use' disposable pallets, from both the economic standpoint and in terms of environmental sustainability. The certified quality of the EPAL system is therefore added value for the entire national logistics system achieved thanks to the extraordinary efforts of the many Conlegno member companies engaged in the manufacture and repair of pallets.

The EPAL exchange system is so efficient it has been the subject of many studies conducted by the LIUC Business School Center for Logistics and Supply Chain Management, also involving a team of young researchers.

Deserving of special thanks are Martina Farioli, Camilla Marassi and Marco Palatini, for their contributions to the design and implementation of the study.

Castellanza, Italy - 14 October 2019

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1. The EPAL pallet for the FMCG supply chain

1.1. PALLETS: FROM FIRST USE TO THE EPAL STANDARD

The **first use** of pallets dates back to **World War II**, when the United States military used them to supply materiel to the troops engaged at the front. In the immediate post-war period, pallets continued to be used as a tool for handling civil and aid materials to support reconstruction work. That pallets were highly versatile and sturdy for industrial applications was immediately appreciated, first by companies in North America and then in Europe. Beginning in the early 1950s, European shipping technicians developed the **EUR standard** railway pallet, measuring **800 mm x 1,200 mm** to facilitate and optimize the transport system.
In 1961, the German, Swiss and Austrian railways formed a European Pallet Pool (EPP). With the participation of other railways, the EPP quickly led to the development of a logistics system for the circulation of EUR pallets. This system provided for goods acceptance stations scattered over a large territory and certain pallet exchange rules that allowed empty pallets to be reused immediately for new loads, which saved time and significantly reduced empty transport movements. Then, in the wake of the expanding industrialization in the 1960s, the first large pallet manufacturing companies began to emerge, as did the first pallet **repair companies**. The 1990s, along with traditional wooden pallets, saw the advent of roll containers, resealable containers, plastic pallets, resin pallets, etc., while in Italy the first pallet rental and management systems (pallet pooling) started up.
The "**Centromarca**" pallet, which was the same size as the EUR but of lower quality, was introduced in 1982. This pallet was created with manufacturing specifications, which did not provide for quality controls at its inception. Furthermore, there were no correct repair specifications, which in a few years led to a pool of poor quality pallets whose characteristics were not at all uniform, and then to a progressive phase out.
In **1991** the **European Pallet Association (EPAL)**, was established by pallet manufacturers, repair services and users from France, Germany and Switzerland. EPAL's objective was to ensure not only the uniformity of dimensions already defined with the EUR pallet, but also compliance with technical and quality specifications covering pallet manufacture and repair, valid for both national and international trade. Over the years, other national committees gradually joined the Association, including Spain and England in 1997 and the United States in 2000. Today EPAL, which can be found in 30 nations with 14 national committees, represents the international brand that boasts the most widespread pallet exchange system in Europe.
In March **1999**, the EPAL system was introduced **in Italy** by GS1 Italy (formerly Indicod-ECR), IDM Coordination Center, State Railways, shipping firms and associations of pallet manufacturers and repair services. At a national level, the control and certification of the EPAL system have been entrusted to Bureau Veritas, an impartial third party agency that monitors compliance with international standards, while the Conlegno EPAL Technical Committee works toward the association's objectives. After an extended transition period, since January 2003 the EPAL system has become fully operational throughout Italy, especially in the FMCG sector.

in 2001, ECR's work on the issue of pallet exchange led to the endorsement of "**The ECR recommendation on EPAL pallet exchange**." This document, first revised in 2009 and then again in 2016, aims to streamline pallet management and exchange by reducing inefficiencies and therefore costs, with obvious benefits for both companies and end consumers. Generally speaking, timeframes for the management of the transition and exit of non-EPAL pallets from the exchange system were set by the ECR recommendation, which also provides for the operational aspects linked to pallet exchange listed below:

- Procedure based on immediate exchange. If it is not possible to immediately exchange one or more pallets, the company receiving the goods shall issue a "Pallet Voucher", which will entitle the company producing the goods to the deferred collection of any pallets not immediately exchanged.
- Deferred exchange makes the system more flexible. The use of deferred exchange must be able to manage contingent conditions without concealing any natural lack of availability of pallets at delivery points. The issue of a Pallet Voucher should represent an exception since the system ought to be aiming toward immediate exchange as the standard solution.
- Pallet Vouchers expire in three months when they are presented to the issuer, who shall then be entitled to either return the pallets or pay for them.
- If the company decides to return the pallets this should be done within the following quarter. Pallets not returned under these terms are automatically charged. Pallet Voucher monetization should also be considered

an exceptional occurrence when the parties agree that deferred collection would objectively be inconvenient.

If applied correctly, and obviously, as long as live exchange is the goal, the recommendation ensures effective performance of the exchange process in terms of costs.

There is no doubt that over the last 80 years the pallet has played an affirmative role in the world economy. That is why, **like the container the pallet is often cited as one of the most significant "logistics innovations" ever**, since it has improved merchandise flows with much less drudgery. The advantages that the direct exchange of EPAL pallets has brought to all companies that employ them are just as clear.
It is precisely in these terms that, exactly 20 years after the introduction of the EPAL standard in Italy, this project intends to examine and quantify the actual economic benefit that the pallet has generated for the national economy. In fact, the purpose of this research is to assess to what extent pallets, as an aid for goods transport, along with the EPAL standard, have benefitted companies through their introduction.

This study was grounded on two contrasting scenarios:

- The first, in an attempt to highlight the value generated by this incredible innovation, though surreal, compares a world "without pallets" to the world "with pallets".
- The second compares a world of only disposable, single-use pallets to one employing the EPAL standard exchange model.

1.2. THE LOGISTICS CYCLE IN THE FMCG SUPPLY CHAIN IN ITALY

The study's aims were to economically quantify the impact that the introduction of pallets has had on the Italian economy. It was necessary to rigorously define the **scope of the investigation** to achieve such an ambitious objective. **FMCG (Fast Moving Consumer Goods)** was singled out as the most suitable sector for this research. Indeed, the fast moving consumer goods market is one of the largest users of wooden pallets: in Italy, **FMCG accounts** for about **75% of annual production**.

The FMCG sector is briefly outlined below to better comprehend the scope of the study.

Stores where consumers usually go to buy FMCG can be traditional retail shops or mass market retail (MMR) points of sale.

Traditional retail is carried out by independent retailers who regularly obtain their supplies through the wholesale channel. Stores tend to be family run and sales points are normally specialized in a specific product category (e.g., delicatessen, butcher, fishmonger, grocer, etc.). These stores are often small. In fact, they are mostly neighborhood businesses, whose potential demand is limited and geographically circumscribed.

The leaders of the mass consumption market are the top **Mass Market Retail (MMR)** brands, joint stock companies that sell retail products, purchased from multiple manufacturers for profit, using a set of specific sales points, served by one or more Distribution Centers (DC). The importance of MMR lies in:

- Its economic preponderance and the role it assumes in consumer procurement and consumption requirements (about 75% of all large scale retail goods is brokered by MMR);
- Highly organized logistics processes: the search for optimization of the relationship between service levels and cost controls is the objective on which the sector's logistic activities are grounded.

The figure below represents the **MMR supply chain** in Italy: it highlights the players, the network nodes and the rationales for their connections, starting from the production facilities on down to the final consumer, i.e., the logistic flows.

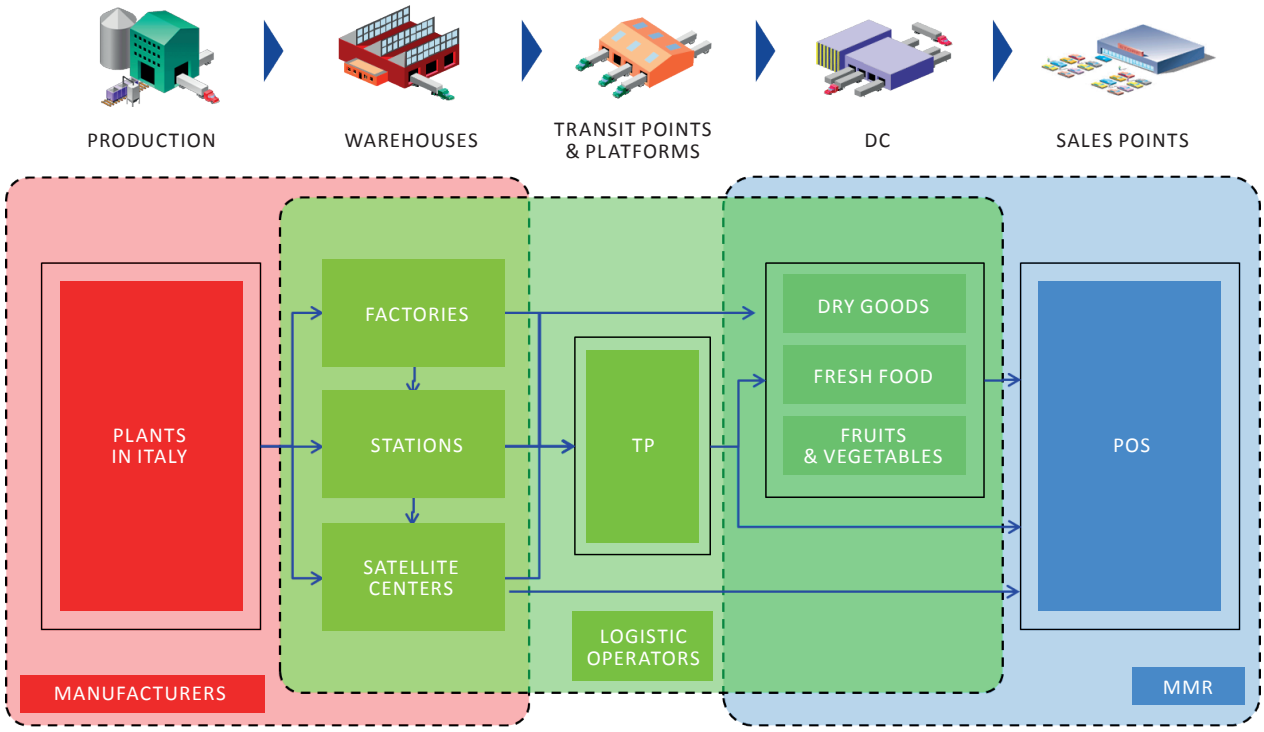


Figure 1 - Logistics of the FMCG product supply chain in the MMR trade channel.

Three main types of players operate in the FMCG supply chain: large-scale, mass market retail trade companies (**MMR**), food & beverage, personal care, health care, and home care consumer package goods (CPG) and third-party logistics operators offering services related to the handling and storage of goods (3PL). Despite the fact that each of these players has specific roles and features, their range of action and responsibilities can vary depending on the their organizational structures.

The main role of **mass market retail trade** companies is to move goods along the supply chain, from producer to consumer. These companies' business is done through an economic transformation of goods, not through the process of a physical transformation of products. The goods acquire value through the work of MMR companies, which comprises the so-called "utility of time and place", i.e., the logistics services that guarantee product availability at the times, places and in the manner desired by consumers. For this reason, the effectiveness and efficiency of MMR businesses are closely linked to the quality of the logistics activities, which make up distribution companies' core business.
MMR companies are characterized by highly aggressive commercial policies with sales prices definitely lower than traditional retail outlets. This is not to mention their frequent discounts and promotions, in light of their strong bargaining power towards the Industry and the frequent establishment of group purchasing organizations (GPOs). This is also the reason why, as mentioned above, 75% of the trade in consumer goods is brokered by large-scale distribution.
The differing distribution formulas (formats) are affected by the surface area of the sales point in MMR. The size criterion is accompanied by several different choices related to the coverage of their networks' territories and to the assortments offered, staff assistance as well as different strategies implemented by MMR companies. Three types of business can be distinguished: hypermarkets, supermarkets and minimarkets/superettes. Discount stores, which are cross-sectional in terms of sales area (in any event, generally smaller than 1500 m2), should be added to this classification.
MMR companies make use of **Distribution Centers** (DC) for the management and control of their logistics activities. DC's role is to receive goods from Producers, store those goods, prepare them and then deliver orders to points of sale. The reorganization of the Supply Chain in the FMCG sector is increasingly pushing towards highly centralized flow solutions. In fact, this distribution rationale allows major economies of scale to be obtained for management of the warehouse, which aggregates orders originating from several points of sale. These depots are generally very large (20,000-40,000 m2) and centrally located with respect to the total number of points of sale served, making the aggregation of supply orders coming from different stores viable. The Atlante research project, conducted by the LIUC Business School Center for Logistics and Supply Chain Management mapped the Distribution Centers active in Italy between 2018 and 2019. This study highlighted that there are 458 Distribution Centers in our country. They are located in 93 provinces and are mainly concentrated near the large urban centers and logistics districts (Milan, Rome, Naples), as well as along the country's main infrastructure routes (the A1 and A4 Motorways). These facilities serve over 10,000 points of sale (PoS).

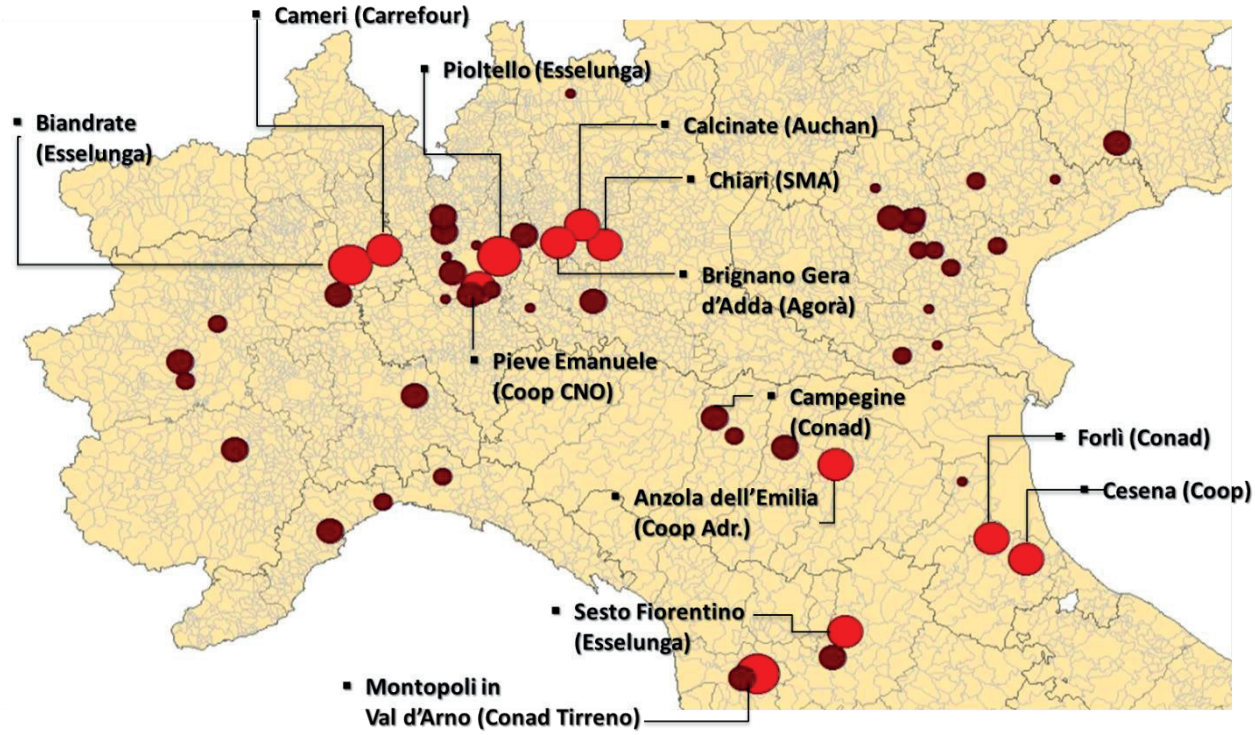


Figure 2 - Geographical location of the main DC in Northern Italy

There are very many FMCG **producers** in Italy. According to Indicod-ECR data, more than 20,000 companies are currently producing FMCGs in Italy covering many product categories (dry food, baked goods/bread, confectionery, dairy/cheese, fruit and vegetables, delicatessen, alcoholic and non-alcoholic beverages, home and personal care and pet care).

The ever-increasing incidence of logistics costs for producers (around 7% of turnover according to A.T. Kearney) and the awareness that in recent years logistics has taken on an increasingly strategic role has also pushed these companies to seek more collaborative solutions and practices to manage the supply chain more efficiently and effectively.

Typically the CPG productive logistics network comprises a network covering one or more levels, with factory warehouses, central supply depots and, in some cases, peripheral depots. Factory warehouses perform a storage function for products waiting to be shipped towards central or satellite warehouses. **Central depots**, whose main functions are to ensure the availability of the range of products sold in a certain market and to absorb excess production, are often responsible for the entire national area. **Satellite depots** are normally used to ensure greater customer service or to serve the more remote geographic areas (e.g., the islands). They do not necessarily stock the entire range of products; instead, they tend to stock the fastest-moving items.

Since logistics necessitates a capacity for investment, widespread coverage of the territory and specific capabilities that are not always possessed by a sector company, **logistics outsourcing** (i.e., assigning all or part of the logistics activities to specialized firms) has recently acquired increasing significance. In fact, logistics outsourcing can provide remarkable organizational savings and permits companies to concentrate on their core business. Therefore, more and more companies are turning to logistics operators (3PLs) who are able to provide shipping, supply-chain management and increasingly innovative logistics services. These services include the execution and planning of transport and distribution activities, warehouse management and other activities such as co-packing.

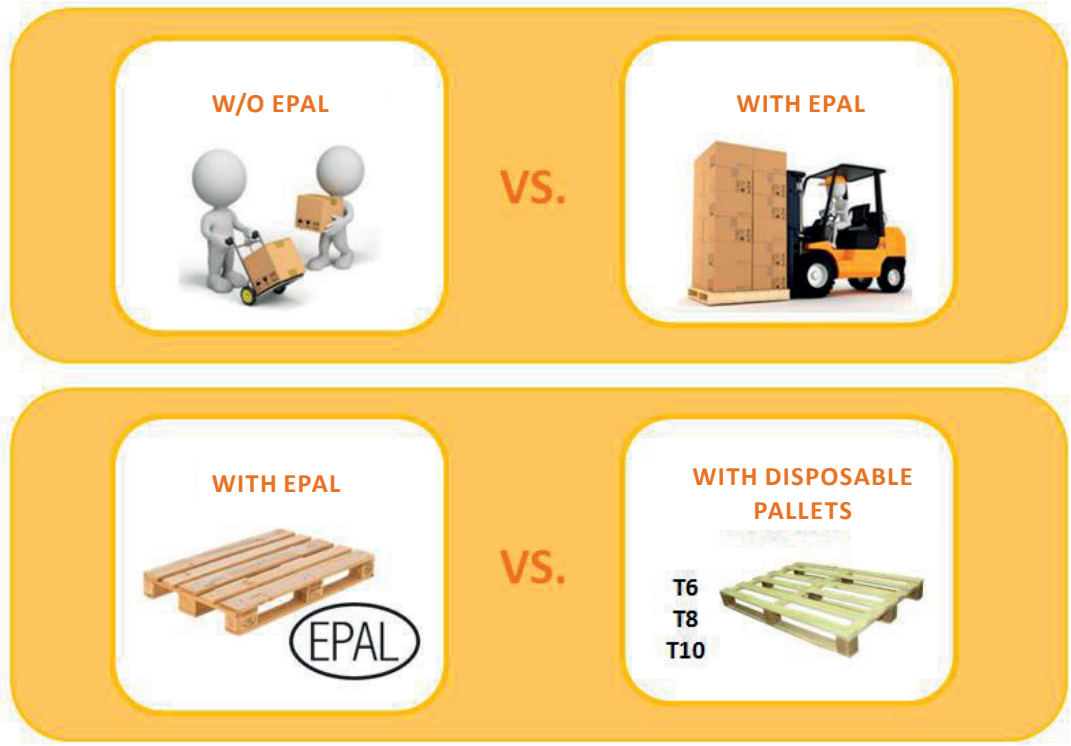
Furthermore, logistics operators can also make their network of regional platforms and transit points available for deliveries to remote geographical areas or when the size of the consignment (drop size) is not so substantial as to justify a taut flow from point of origin to destination.

Nodes operated by logistics operators include multi-producer logistics centers, distribution platforms or transit points (TP).

1.3. THE STUDY AND ITS OBJECTIVES

As indicated above, this study is concerned with evaluating the economic impact that the pallet has had on the Italian economy, starting from its effect on a fundamental sector of the country's ecosystem such as that of FMCGs.
In order to do this, we focused on contrasting scenarios. The following were compared:

- The current scenario where pallets are used versus a scenario with the same logistics flows occurring without using any kind of pallet for merchandise handling and storage
- The current scenario where EPAL exchangeable pallets are used compared to a scenario where only non-reusable disposable pallets are used.



Specifically, the discussion will proceed by first analyzing the savings generated from the introduction of wooden pallets in the Italian FMCG sector compared to the somewhat surreal scenario of a 2019 wherein no type of pallet was used to store and handle products along the entire supply chain.
The **analysis** of the main **differential cost items between the two scenarios** (cost of loading vehicles, cost of handling pallets, cost of damage to goods and cost of storage) is aimed at **quantifying the savings that each pallet generates**, for the company that uses it, during its service life and the overall savings achievable by the entire country.
Secondly, the study will quantify the impact of the introduction of the EPAL pallet, in monetary terms, comparing the situation "as is" with one in which the EPAL standard has not been established and, consequently, where goods are handled using only disposable wooden pallets. The analysis in this case will be focused on the **comparison between the costs associated** with the **EPAL** pallet and the costs attributable to the main types of **disposable pallets, T6, T8 and T10**.

2. A world without pallets

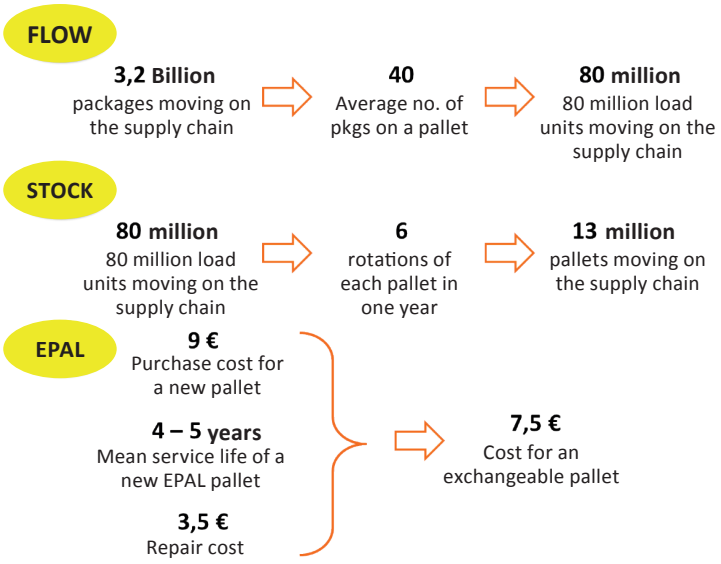
As anticipated, this chapter compares two distinct scenarios. The first refers to the world of logistics "as we know it today", where goods are handled and stored on pallets. The second, on the other hand, posits a 2019 where no wooden pallets are used and where merchandise is handled "package by package".

The comparison is based on a **rationale of differential costs** with equal flows (those circulating today, in 2019, in the FMCG supply chain) between the two scenarios and takes into account:

- **Cost of loading and unloading vehicles**: this cost refers to the loading and unloading activities carried out at the distribution and storage facilities in the supply chain. Whenever goods are moved between companies, they incur a cost for their transshipment and offloading. This cost is closely linked to the cost of accidents to warehouse staff. The more packages are handled manually, the greater the likelihood of occupational accidents and diseases, resulting in the company paying higher social and economic costs.
- **Costs resulting from damage to goods**: this cost refers to the possible damage to packages during loading and unloading activities carried out at the distribution and storage facilities along the supply chain. The more order-delivery cycles the goods are subjected to, the greater the risk that the goods will be damaged and discarded.
- **Costs resulting from the occupation of storage space**. This cost takes into consideration the coefficient of the space occupied by goods, which without using pallets can only be stored in stacks. It refers to the economic outlay required to store the annual flow of packages in the supply chain at a storage facility.
- **Costs resulting from the exchangeable pallet management**: this cost refers to pallets, which are real company assets, and their management, and applies exclusively to the "with pallet" scenario.

This cost takes into account the outlays required to purchase the wooden pallet, its repair, storage and transport, as well as its physical and administrative management. It also includes the CAC environmental contribution paid to CONAI (National Packaging Consortium).

To calculate these cost items, the following reference values for the MMR supply chain were taken into account:



2.1 COSTS OF VEHICLE LOADING AND UNLOADING

To reach store shelves, products can follow two different paths:

- **Direct delivery** from the CPG's production plant to the point of sale;
- **Centralization** of deliveries to the **Distribution Center** and then distribution of the goods to points of sale.

Direct delivery is the least used: it only concerns about 10% of FMCG flows (Source: ECR-GS1 Italy). Direct delivery to the point of sale is, in fact, convenient only when full truckloads can be delivered, i.e., when the order size is large, which is difficult to achieve for most points of sale. Instead, the choice to centralize producer deliveries at a Distribution Center is very common in the FMCG world. Today, the Distribution Center is an almost obligatory waypoint for goods, especially given the specific shape of the reference territory of some Distribution brands and/or the use of automated systems.

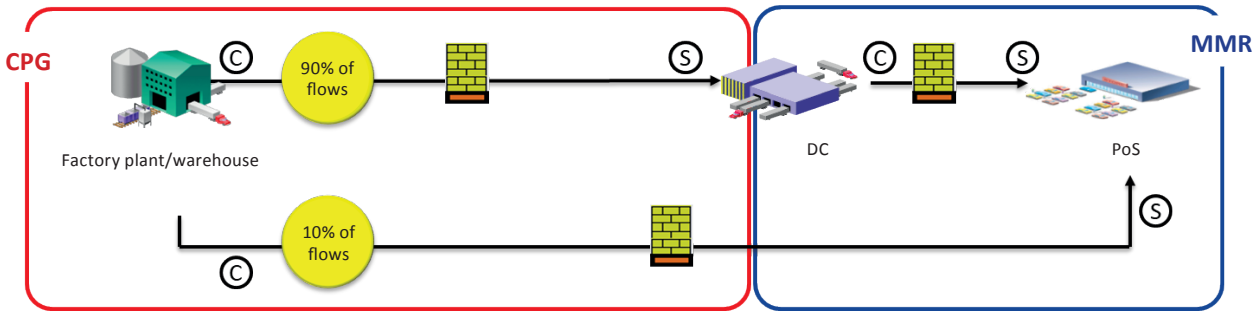


Figure 4 - Diagram of the different order-delivery cycles in case of movement from a Distribution Center or direct delivery.

Although the choice to centralize flows in Distribution Centers allows for the pursuit of clear economies of scale for management, it also implies greater quantities of goods. In fact the system is subject to **two order-delivery cycles**, one between the factory/warehouse and the Distribution Center and one between the Distribution Center and the destination point of sale. Therefore, there are **four movements of the goods**: two for unloading and two for loading. Instead, the choice of direct goods delivery to the point of sale implies only one order-delivery cycle and therefore only two movements of the goods: one for loading and one for unloading the goods from the transport vehicles.
Transport vehicle unloading and loading is an activity that requires significant time and resources inside warehouses. Before the introduction of load carriers such as the EPAL pallet, this activity was carried out by operators "**package by package**". They were not assisted by any machines, which rendered the task very onerous. Also for this reason, workers needed to take many breaks, which increased the total vehicle loading and unloading times.

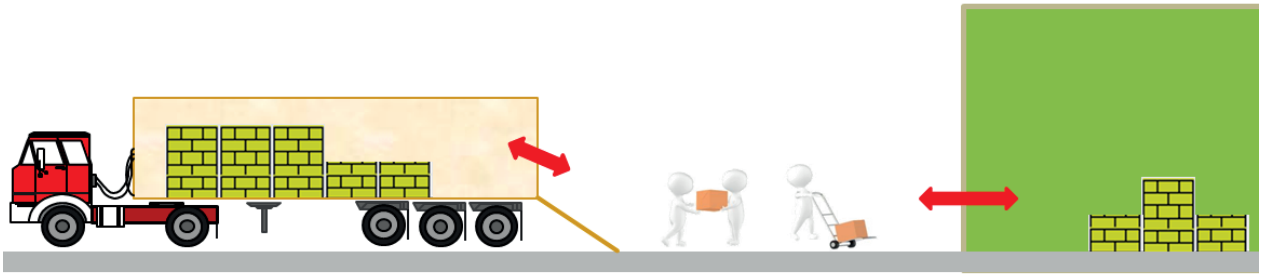


Figure 5 – Vehicle loading and unloading operations without the use of pallets

There is no doubt that pallets have made things easier: the possibility to be able to transport **many packages at the same time** and to use lifting forks on the platform with pallet jacks or forklift trucks has certainly reduced the physical drudgery for warehouse workers as well as the average times for vehicle loading and unloading.

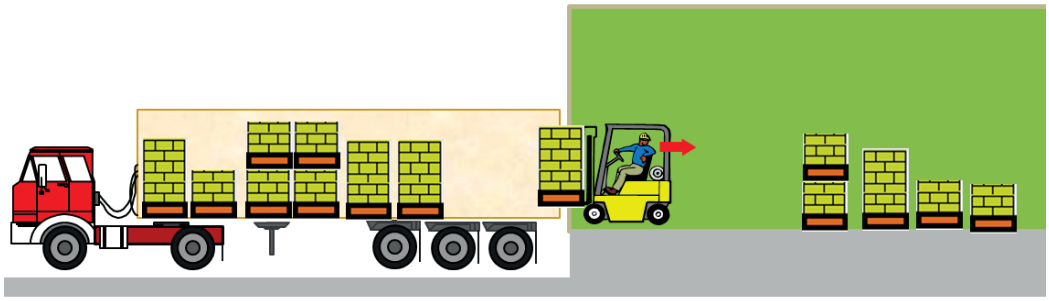


Figure 6 – Vehicle loading and unloading using pallets

Having defined the distribution network and which routes-to-market are used by companies to get their products on the shelves of points of sale, it would be interesting to assess the costs currently incurred handling goods using pallets compared with those incurred instead if pallets were not used.
Past studies by ECR Italia have shown that **the FMCG supply chain currently handles** about **3.2 billion packages**, corresponding to about **80 million equivalent unit loads** (on average, one pallet contains 40 packages).

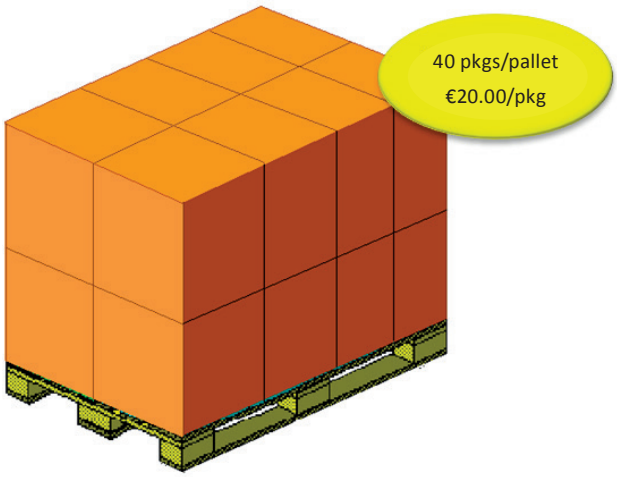


Figure 7 – A typical unit load in the FMCG supply chain

From observations conducted in the field by the LIUC Business School Center for Logistics and Supply Chain Management, it is known that it takes about 1.2 minutes (**loading time**) to load a palletized unit load on a truck. Therefore, a fork lift driver will take about 40 minutes to load a 33-pallet truck. Instead, if loading were to be carried out manually, it would take 15 minutes to handle a number of packages equivalent to those contained in a pallet (40 packages), on average. Hence, it would take 495 minutes, or just over 8 hours, to manually load a truck with 1320 packages (equivalent to 33 pallets of 40 packages).
In this case, productivity would drop to 4 equivalent pallets per hour.
The difference in **productivity** clearly implies a vastly different number of hours and employees that would be needed to load 3.2 million packages per year. In fact, assuming 225 working days per year and an 8-hour shift, we obtain:

Scenario	Loading productivity (pallet_eq/h)	Mean loading time (min/pallet_eq)	Annual loading time (h/year)	Annual no. of staff needed for loading (staff/year)
w/o pallets	4	15,0	60.000.000	ca. 3.500
with pallets	50	1,2	4.800.000	ca. 44.000

Table 1 - Productivity, average and annual loading time, and the number of employees needed in the two scenarios.

Considering that: the hourly cost of a warehouse operator paid according to the recent Logistics and Transport CCNL [National Labor Union Contract] (in force since May 1, 2019) comes to €21.50/hour; it costs €600.00/monthly to rent a forklift truck and considering the package flow, the network structure, the centralization rate and the actual working days per year noted above, calculating **how much can be saved today by using pallets for vehicle loading and unloading is simple**.

	Annual cost of vehicle loading and unloading
Scenario w/o pallets	€1,591,000,000.00 = (80 M pallets x (90% x 4 movements + (1-90%) x 2 movements)) x 15 min/ pallet_eq x €21.50/h_operator
Scenario with pallets	€151,477,000.00 = (80 M pallets x (90% x 4 movements + (1-90%) x 2 movements)) x 1.2 min/pallet x (x €21.50/h_operator + €600/m_forklift/22d/m x 8h/d)
Savings achievable using pallets	Circa €1,450,000,000.00

Table 2 - Calculation of the annual cost of loading and unloading activities in the two scenarios and savings achievable thanks to pallets.

Downstream of these purely economic considerations on the costs of goods handling and the loading and unloading of transport vehicles, it would also be appropriate to estimate the incidence of warehouse accidents, which have certainly diminished since the widespread use of pallets for these tasks began. This benefit has actually proved somewhat difficult to quantify, even if its effects are of great importance.
Actually, using pallets during handling not only guarantees greater safety for the products but, at the same time, reduces the risks the operators face doing the work. Despite the fact that today pallet handling is done using forklifts or pallet trucks, machines that in any case entail some risk for the operator, since the introduction of pallets there has been a **decrease in both the occurrence of occupational diseases** due to onerous and prolonged manual handling of loads **and in the incidence of accidents** linked to violent events.
From surveys of cooperatives that work with internal warehouse handling, and that overall employ over 2,000 workers, it is possible to calculate the different incidence of accidents and occupational diseases in recent years linked to manual and assisted handling compared to the total number of accidents.

Scenario	2014	2015	2016	2017	2018
w/o pallets	49%	33%	39%	38%	39%
with pallets	9%	27%	24%	27%	19%

Table 3 - Different incidence of accidents and occupational diseases over the last 5 years in the different scenarios.

Over the 5 years examined, the average occurrence of occupational injuries or illnesses related to handling where pallets were used is 18 percentage points lower than when they were not used (40%). The diseases that presented the greatest recurrence were those affecting the lumbar spine, which is the area most stressed during the performance of these activities. The average hospitalization time for accidents and occupational diseases related to the manual handling of loads is about 21 calendar days (Source: INAIL [National Worker's Compensation Agency]).
There is no question that accidents create costs for companies. There are direct costs (health costs, loss of production, damage to production equipment, penalties, etc.), indirect costs (reduction in workforce productivity, administrative costs, expenses for staff replacement, increased insurance premiums, etc.) and intangible or hidden costs (expenditure items that are not normally entered in company accounts and that are difficult to identify such as damage to the corporate image). Therefore, without doubt, the introduction of wooden pallets for handling has not only reduced the **human and social cost of accidents and occupational diseases**, but has also cut down on their **economic impact on companies**.

2.2. COSTS OF DAMAGED GOODS

Another differential element to be considered when evaluating the impact of the introduction of pallets is the greater safety for the integrity of goods that pallets provide during handling.
From field surveys undertaken on a sample of 10 companies in the modern distribution and logistics services sector by the LIUC Business School Center for Logistics and Supply Chain Management, it emerges that at each delivery cycle, about **0.1% of the goods, on average, are damaged due to the breakage of wooden load carriers**, causing delivery rejection and return to the sender.

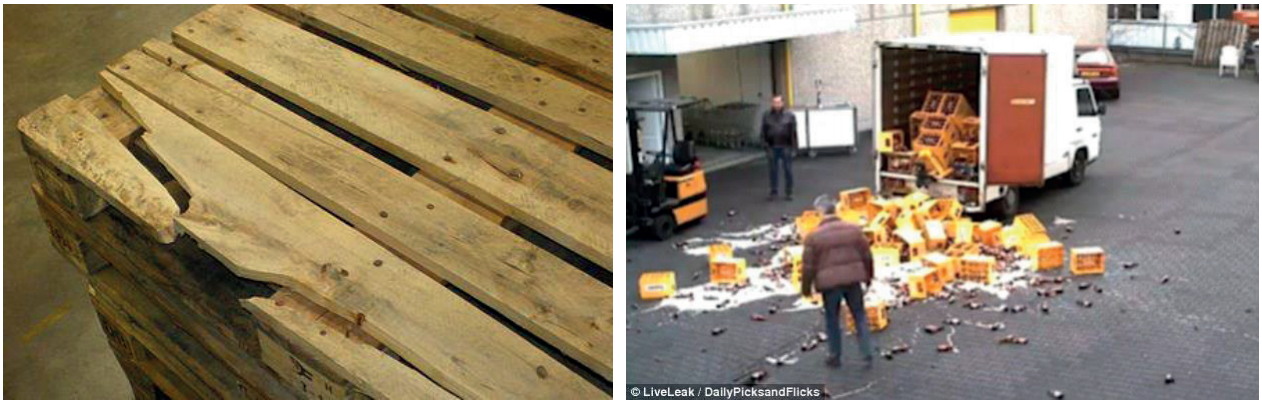


Figure 8 - Examples of breakage of a pallet top board and damage to packages of goods during vehicle unloading

The **incidence** of phenomena causing **damaged goods** is about **5 times higher** in the case of **manual handling** (5 cases of damage per 1,000 movements). Without wooden pallets, operators have to handle even more packages manually at one time: the poor stability of stacked packages and their weight, on average 6 kg each (Source: ECR-GS1 Italy), increase the probability of package breakage as well as putting warehouse operators' health and safety at risk.

As seen above, as concerns the cost of loading and unloading, although there is no doubt that the centralization of flows at DC provides benefits, it also calls for greater handling of the unit loads (2 order-delivery cycles). On the other hand, although direct deliveries are sometimes less efficient, they entail a lower risk of package breakage as they are subject to only two movements: one for loading at the production facilities and one for unloading at the points of sale.

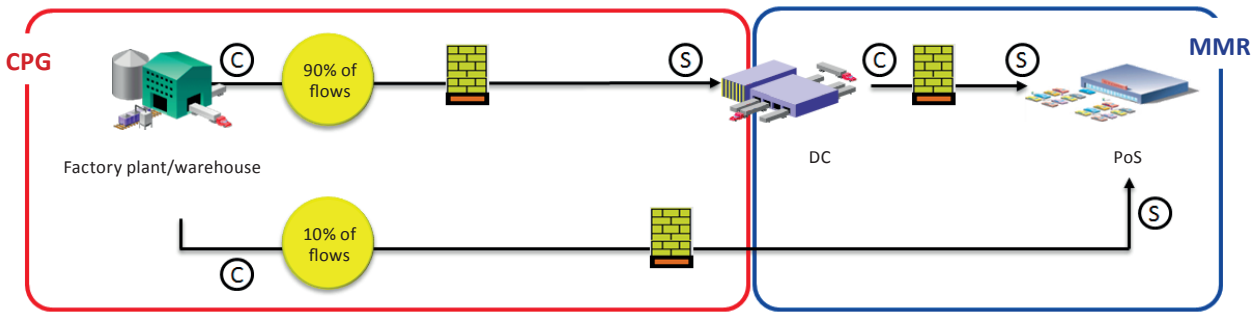


Figure 9 – Flow chart of possible route-to-market in the FMCG sector in Italy

Bearing in mind that in the FMCG supply chain the average value of a package is €20.00 and that 3.2 billion packages transit through the supply chain, it is possible to quantify the **economic benefit of using pallets**.

	Annual cost arising from damaged goods
Scenario w/o pallets	€608,000,000.00 = 3.2 B pkgs x (2cycles x 90% + 1 cycle x 10%) x €20.00/pkg x 0.5% breakage/cycle
Scenario with pallets	€121,600,000.00 = 3.2 B pkgs x (2cycles x 90% + 1 cycle x 10%) x €20.00/pkg x 0.1% breakage/cycle
Savings achievable using pallets	Circa €500,000,000.00

Table 4 - Calculation of annual costs due to damaged goods in the two scenarios and savings achievable through the use of pallets

2.3. COSTS OF SPACE OCCUPIED FOR GOODS STORAGE

Another cost item examined for the evaluation of differential costs relates to the different **use of warehouse surface space** between the two scenarios, with the storage costs associated with each.
In fact, wooden pallets makes the use of **multi-tier racking** possible in manufacturer and distributor warehouses for keeping goods in stock. This makes it possible to store a large number of load units on small surface areas while also making the most of the height of the warehouse structure. Given the considerable height of the shelving, forklift trucks are used for goods handling. Shelves must be spaced at least three meters apart to allow the passage of forklift trucks. The depth of each shelf is slightly greater than the length of an EPAL pallet to ensure enough clearance (1.3 m). On average there are six storage tiers, which is consistent with the usual height (9 m) of sub-girders in storage warehouses.

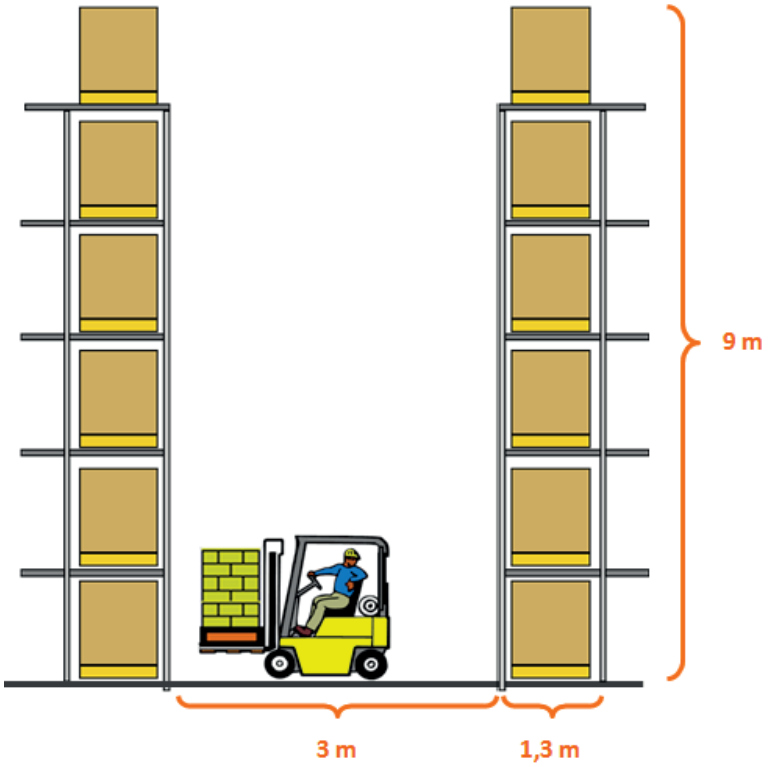


Figure 10 – Multi-tier pallet racking

Unit loads are composed of an average of 40 packages, with each about 20 cm high and a base surface area measuring 30 x 40 cm. So, eight packages per layer can be placed on a pallet measuring 80 cm x 120 cm. The average height of a whole load unit is 1.2 m (Source: ECR-GS1 Italy), including the height of the pallet. Therefore, there are usually five layers in each loading unit.

It is therefore possible to calculate the **SUC**, i.e. the **surface utilization coefficient** (packages/m2).

Scenario	packages/layer	No. of layers	Storage levels	Surface area (m2)	SUC (packages/m2)
with pallets	8	5	6	5,6	86

Tabella 5 – Calcolo del CUS nello scenario con pallet.

Qualora non esistessero supporti in legno, la **merce** non potrebbe che essere **stoccata a catasta**, ovvero impilata l'una sull'altra in strati di più colli (ricerca di stabilità). I colli, privi di supporto, necessitano inoltre di essere **movimentati e impilati manualmente dall'operatore**. Le cataste risultano per questo motivo vincolate in altezza, oltre che da problematiche di stabilità, anche per manovrabilità da parte dell'operatore.

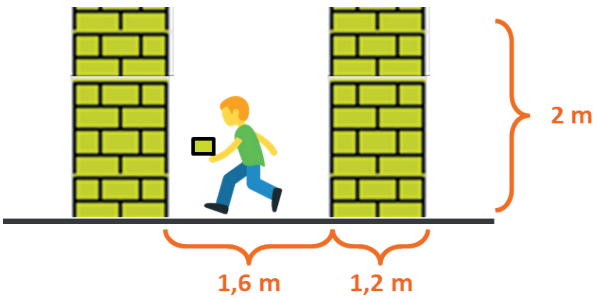


Figure 11 - Stacking goods without pallets

In questo caso risulta evidente come la distanza tra le due cataste possa essere inferiore rispetto a quella vista precedentemente; questo è dovuto principalmente al fatto che l'operatore non necessita di un muletto. Lo spazio tuttavia deve essere tale da garantire all'operatore di magazzino di muoversi liberamente senza urtare le pile contenenti i prodotti.
Considerando un'altezza massima della pila pari a 2 m, si possono ipotizzare 10 strati per catasta. Per garantire che la catasta insista su una superficie uguale a quella di un pallet, si considerano 8 colli per singolo strato.

Scenario	packages/layer	Layers/stack	Surface area (m2)	SUC (packages/m2)
w/o pallets	8	10	3,2	50

Table 6 – Calculating the SUC in the scenario without pallets.

Using pallets makes it possible to store a greater number of packages in height with a greater guarantee of stability. This translates into a greater surface utilization coefficient. Almost 35 more packages can be stored in the same surface area than in the scenario without pallets.
Better use of the storage area also converts into **lower warehouse rental costs** for FMCG players. Considering that if the annual lease for these facilities were to come to an average of €50.00/m2 with shelving and slightly less (€40.00/m2/year) for warehouse space without shelving, the savings are significant.
The "FMCG Logistics Flow Mapping" research conducted by ECR-GS1 Italy showed that on average the FMCG supply chain lays in approximately two months' supply of reserve cover, resulting in an annual rotation index of 6. Knowing that there are about 3.2 billion packages transiting through the supply chain each year and assuming that there are about 530 million packages stocked in warehouses at any given time, **the savings that can be achieved by stocking on pallets can be economically quantified**.

	Annual cost arising from space occupied for goods storage
Scenario w/o pallets	€426,000,000.00 = 533 million pkgs /50 packages/m2 x €40.00/year_m2
Scenario with pallets	€311,000,000.00 = 533 million pkgs /86 packages/m2 x €50.00/year_m2
Savings achievable using pallets	Circa €120,000,000.00

Table 7 - Calculation of annual storage costs in the two scenarios and of the savings achievable by using pallets.

2.4. COSTS OF EXCHANGEABLE PALLET MANAGEMENT

However, compared to the scenario with no pallets, there is no doubt that the use of pallets, especially EPAL pallets, entails **management costs** that cannot be ignored. Indeed, over the last 20 years, pallet exchange, whether direct or deferred, has necessitated the training of staff dedicated to pallet administration and physical management. Warehouses have been set up with areas for pallet storage, while companies dealing with their repair, replacement etc., have also been established. To calculate the management cost attributable to each pallet, the **cost items** listed in the figure below were considered.

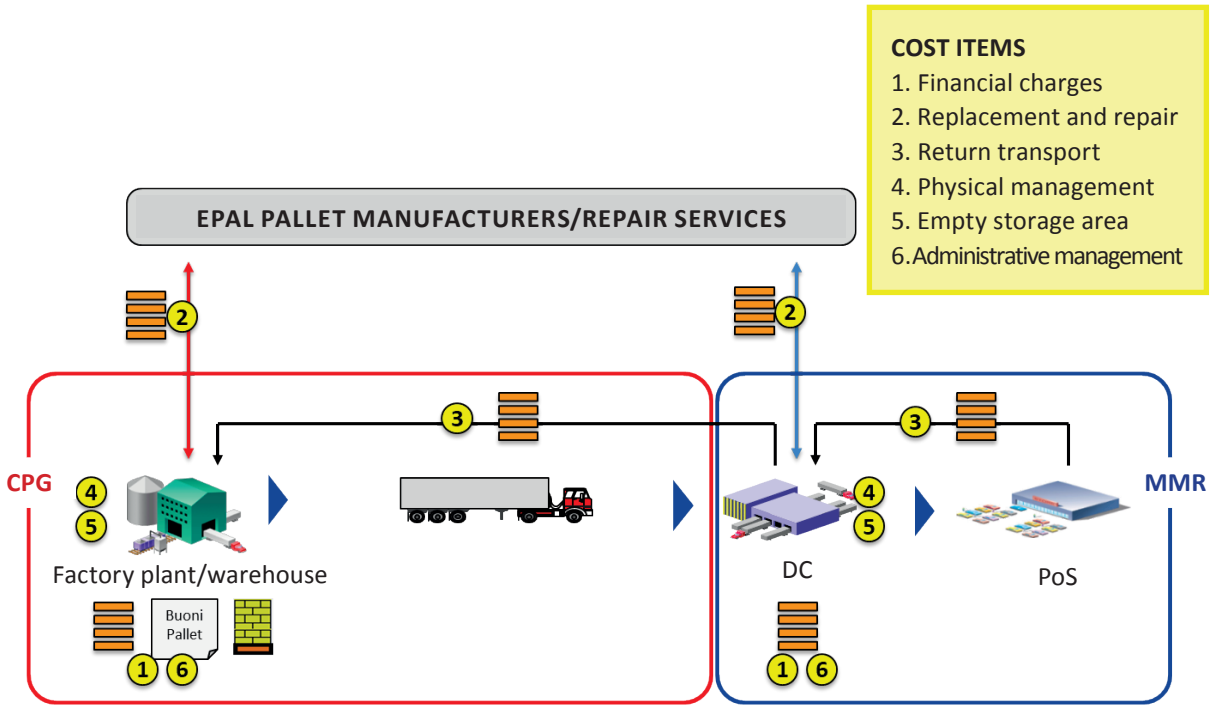


Figure 12 - Cost items that influence pallet management costs during its useful life.

It is our duty to point out that each cost item is obviously the result of an **average calculation**. Each of these items can vary greatly depending on the company being examined. These changes can be explained through the analysis of certain contextual variables.

Critical Items	Item Description	Min	Max
Loss rate (breakage and scrap)	Pallets bought + repaired / year (% of total EPAL pallets OUT)	8,5 %	14,3 %
% EPAL pallets scrapped by MMR	% of EPAL pallets scrapped by MMR because deemed unsuitable (of all pallets OUT)	3,4%	8,6%
Deductible (% of all pallets issued)	% of pallets, which by contract,3PL need not return to the CPGs	0%	10%
% exchanged immediately	Mean % of pallets contemporaneously exchanged at delivery to DCs	65%	85%
Pallet debit settlement rate	Mean time between two successive commercial settlements	Monthly	Yearly
Mean pallet purchase cost (€/pallet)	Mean EPAL pallet purchase cost to top up pallet pool	€ 6,8	€ 7,9
Repair fee (€/pallet)	Mean repair fee (including transport to/from CPG warehouse)	€ 2,9	€ 3,5

Table 8 - Cost items that determine management costs and their incidence on the total cost.

Certain important clarifications should be made concerning the "Average pallet purchase price (€/pallet)" item. Currently, a new EPAL pallet costs around €9.00. However, the pallet pool in circulation is not exclusively manufactured with new wood. Not all the pallets in circulation are the same. The pallets' state of wear and tear determines their market value, even though their functions are the same (Fiche UIC 435). It has emerged that an exchangeable pallet is worth circa €7.50, on average, according to the 2019 EPAL Pallet Value Database by ECR, drawn up semi-annually by the LIUC Business School Center for Logistics and Supply Chain Management, in collaboration with Conlegno. This figure (the weighted average between the cost of new and used pallets), which is updated every six months, is drawn from data provided on over 500,000 new and used pallets invoiced by ECR panel companies.

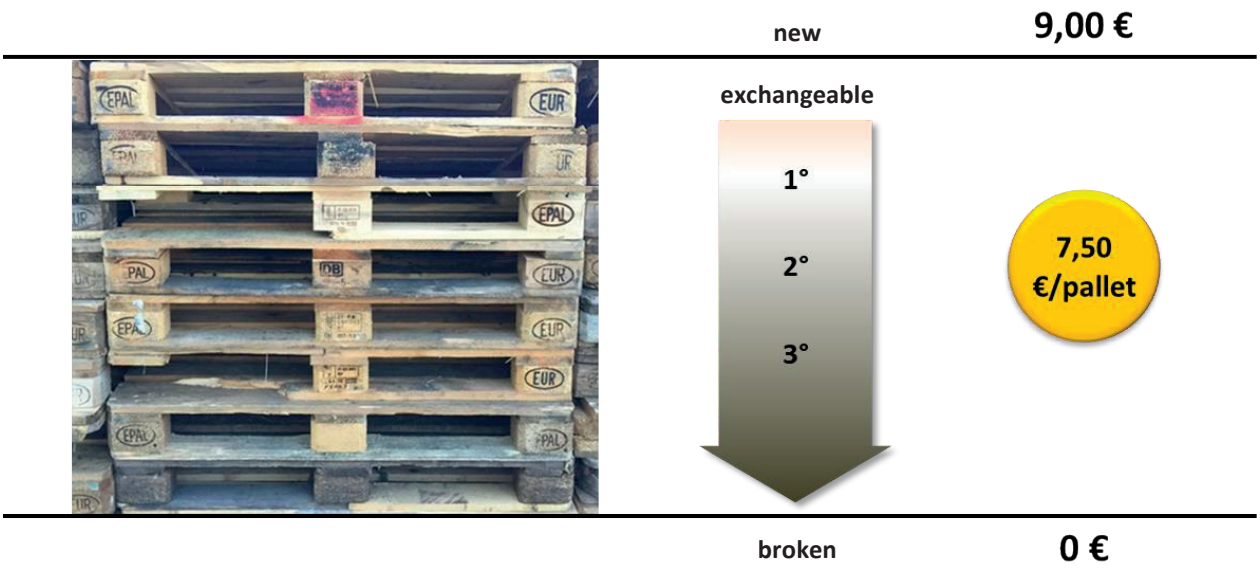


Figure 13 - Average cost of an exchangeable pallet

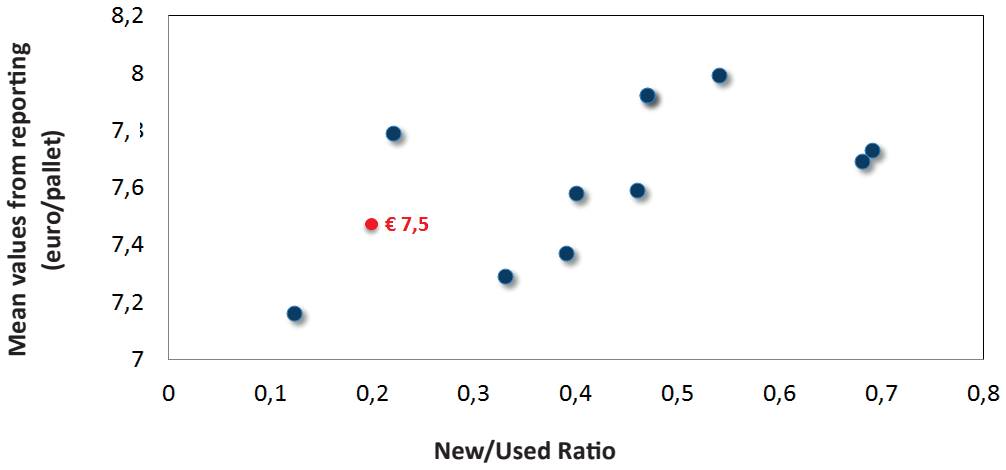


Figure 14 - Scatter plot of the average values from reporting on new-used ratio

Thanks to the many interviews with companies in the supply chain, ECR Italia's 2015 survey "Pallet management in the FMCG supply chain" made it possible to quantify the average management cost, as detailed below, for MMR companies.
First of all, the average estimated **distance** between **production plants and Distribution Centers** is 233 km, while the average estimated distance between a Distribution Center and its same brand stores is 111 km.

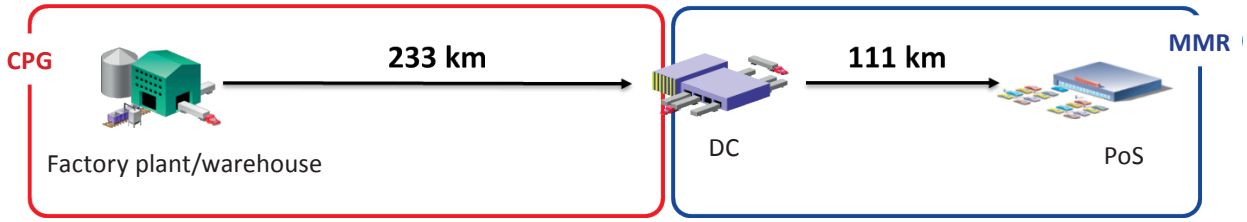


Figure 15 - Average distances between facilities of players in the FMCG supply chain.

Specifically, **the unit cost (€/pallet) leaving the plant, going to the Distribution Center**, broken down into the 6 cost items listed above, is as follows:

COST ITEMS	Best	Media	Worst	% mean cost
1. Financial charges	0,011	0,035	0,068	2,1%
2. Replacement and repair	0,320	0,650	0,966	39,4%
3. Return transport	0,398	0,565	0,756	34,3%
4. Physical management	0,050	0,189	0,364	11,5%
5. Storage space	0,016	0,041	0,086	2,5%
6. Administrative management	0,032	0,168	0,397	10,2%

Table 9 - Cost items comprising the management cost and their average incidence for CPGs

1,648 €/pallet

Instead, the unit **cost (€/pallet)** for MMRs, is calculated from the receipt of goods at the **Distribution Center** until they are unloaded at the **point of sale**.

COST ITEMS	Best	Media	Worst	% mean cost
1. Financial charges	0,013	0,016	0,019	2,5%
2. Replacement and repair	0,175	0,206	0,272	32,2%
3. Return transport	0,132	0,222	0,292	35%
4. Physical management	0,045	0,061	0,077	10%
5. Storage space	0,018	0,021	0,029	3,3%
6. Administrative management	0,068	0,113	0,216	17%

Table 10 - Cost items comprising the management cost and average incidence for MMRs.

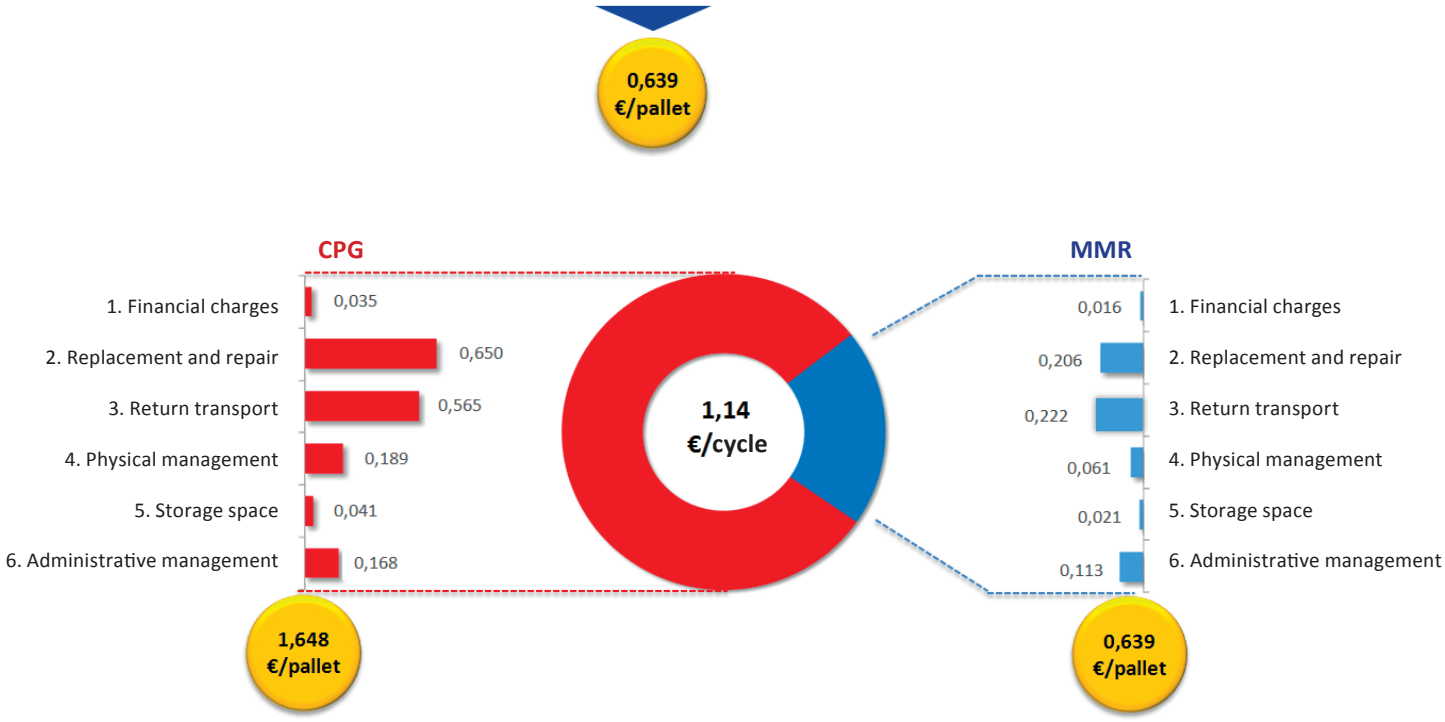


Figure 16 - Breakdown of a pallet's overall management cost

It follows that the average cost of a pallet exchange is around **€1.14 for each order-delivery cycle** completed (i.e., €2.28 for each round-trip CPG-MMR-POS-CPG order-delivery cycle completed).
As can be noted, the weight of the **financial charges** item has little significance as concerns the unit cost incurred by either Industry or Distribution. This cost is linked directly to the pallets' "downtime". Manufacturers calculate a turnaround time that varies between 10 and 50 days. This figure depends very much on the agreements made with logistics operators and the deductibles granted (the higher the deductible, the shorter the pallet turnaround time). Among the producers' financial charges, there are pallet vouchers. If for large-scale retailers these vouchers reduce the need for a "financial" buffer for exchange pallets, pallet vouchers often imply the need for investments in "real wood" for manufacturers. From the 2015 ECR Italy "Pallet management in the FMCG supply chain" study, it emerged

that the incidence of pallet vouchers over 12 months old could be as high as 40% for some manufacturers. Very often, deferred exchange can therefore generate pallet vouchers that risk becoming impaired receivables.

The **cost of replacement and repair** is the item that has the greatest impact on both manufacturers and MMRs, although for CPGs it is three times higher than for MMRs. An average loss rate of 12% is calculated as the sum of pallets purchased new and those repaired in a year as a percentage of the pallets used by companies and is generated by broken pallets that need to be replaced. Assuming the same natural rate of pallet breakage and the same repair unit cost (between €2.90 and €3.50 per pallet), the gap shown can be attributed to the replacement pallets discarded by MMRs. If, on the one hand, the MMR brands take care of paying a deposit on pallets bound for the points of sale, on the other hand, manufacturers register a scrap rate of between 3.4% and 8.6% on receipt at Distribution Centers. The cost of replacement and repair has been increasing in recent years due to an increase in the scrap rate (also because of increasing use of automated warehouse solutions) and the deterioration of the circulating pallet pool.

Also significantly preponderant is the **return transport** cost item, which is borne by the manufacturer for the first delivery cycle and by the MMR for the second. The average cost of return transport incurred by the Industry is greater than that incurred by the MMR. This cost is correlated to the average distance traveled, which is shorter between POS and Distribution Centers than it is between the DCs and the production plants. In cases where the distance between manufacturer and the MMR warehouse is considerable and the delivery drop is low, immediate pallet exchange is not always the preferred solution.

Figure 17 - Example of space dedicated to pallets to be scrapped and repaired

Figure 18 - Examples of pallet pickups at Distribution Centers

The "**physical management**" cost item includes the activities of handling, inspection and selection of exchange pallets, which includes pallet return from points of sale to the MMR warehouses, and return transport from the Distribution Centers to the manufacturers' factories. The cost of physical pallet management has an incidence of about 11% on the average unit cost incurred by the manufacturers (€0.189 /pallet) and by the MMRs (€0.061 / pallet). The difference is partly due to the manufacturers, who require high-quality pallets, paying more attention to inspecting incoming pallets. However, even at the Distribution Centers, there is significant selection activity for pallets returned by points of sale, aside from good pallet organization by color (white, red, blue, etc.) and wear status (good, poor, broken, etc.).

igure 19 - Examples of returned pallets being sorted and selected

The **costs of occupying space** cannot be overlooked when estimating the cost of exchanging an EPAL pallet. ECR Italia's 2015 field survey "Pallet management in the FMCG supply chain" found that pallets are generally stored in stacks of 15-35 units high. The findings showed higher space occupancy costs for the Manufacturers compared to the Distribution Centers (€0.041/pallet vs. €0.021/pallet respectively). Actually, many companies in the industry tend to accumulate empty pallets inside or outside their factory warehouses, very often under special sheds to keep them from getting wet or contaminated. This particular precaution can also be found in companies that do not produce foodstuffs. Pallet humidity and shrink wrapping the load unit could lead to the stacked cartons being damaged.

igure 20 - Examples of pallets stored outside and inside a Distribution Center

Last but not least, the cost of **administrative management**: today, pallets are a real asset for companies; therefore, they require management. This requires a near similar investment for manufacturers and MMR (€0.16 vs. €0.11/ pallet respectively). Every company should have a well-defined employee position, with administrative and management expertise who manages all pallet related activities, the "Pallet-man," who reports directly to Logistics Management. Among the activities carried out by the Pallet man, certainly, the most onerous is pallet voucher management (including data entry) and maintenance of "T-account ledgers" for the debit/credit balance with the different subjects. This cost item could certainly be reduced if there were a single system for issuing and tracing pallet vouchers and if direct exchange at the time of delivery could be increased (currently, 15% of all deliveries do not include direct pallet exchange).
Considering, therefore, an average management cost of €1.14/cycle for each pallet, total management costs linked to the FMCG sector can easily be calculated. For FMCG companies, **pallet management** generates **costs of about 182 million euros per year**. Obviously, in the "without pallets" scenario this cost item is zero.

Scenario	Management cost (€/order-delivery cycle)	Number of order-delivery cycles	Annual flow on EPAL pallets	Overall management cost of exchangeable pallets (€/year)
with pallets	1,14	2	80.000.000	**ca. 185.000.000**

Table 11 - Calculation of the annual pallet management cost in the FMCG sector.

2.5. SUMMARY OF SAVINGS SECURED BY USING PALLETS

Summing up the savings and costs detailed above for each cost item in both scenarios shows that overall, **companies that use wooden pallets save a total of over 1.8 billion euros each year**.

	Annual storage cost
Annual savings on vehicle loading/unloading	ca. 1.450.000.000 €
Annual savings on damaged goods	ca. 500.000.000 €
Annual storage savings	ca.120.000.000 €
Annual pallet management cost	ca. -185.000.000 €
Overall annual savings	**1.885.000.000 €**

Table 12 - Total savings generated by using pallets.

Considering the savings that each pallet can generate during its service life for the company that uses it, the result is even more significant. Statistics indicate that currently there are about 10 million pallets circulating in the FMCG supply chain (i.e., 60 million pallets with an average of 6 trips per year). Each pallet's average useful life, including one repair operation, is about 9 years. This means that **each pallet can generate about €1,250.00 in savings for the company** using it, which is **100 times more than the original "investment"** cost (€9.00 for purchase + an average of €3.50 for repair, for a total cost of €12.50 per pallet).

Moreover, that is not to mention that, over the last 70-80 years, **wooden pallets have provided greater workplace safety** benefits for companies and operators, demonstrated by the fact that there are notably fewer accidents and occupational diseases linked to handling loads.

The economic benefit generated by pallets in the FMCG sector makes it possible to assess the benefits for **the entire domestic economy**. Indeed, taking into account that about 75% of EPAL's annual pallet production is used by the FMCG sector, it would be correct to assume that the remaining 25% generates the same proportional benefits in whatever sector pallets are used. Therefore, when the impact on the Italian economy of the use of pallets for handling goods is quantified, the estimated annual savings come to **nearly 2.5 billion euros**.

Not only do these benefits concern companies and the welfare of warehouse workers, but they also offer consumers significant advantages. In fact, with **25 million families** in Italy, the overall **annual savings** resulting from the use of the "EPAL pallet exchange system" comes to **€100.00/year/family**.

3. A world without EPAL exchange

The second part of this paper examines and quantifies the economic benefits that come from the introduction of the **EPAL standard** and the **even exchange** management model being used by most industries, primarily the FMCG sector (see section 1.2). In this case, following the methodological approach used previously, the comparison will also use the calculation of the **differential costs associated** on the one hand with **EPAL pallets** and on the other, with certain types of **disposable pallets (T6, T8, T10)** on the market.

Only the management cost, described above (see paragraph 2.4), will be considered in the scenario of the exclusive use of EPAL pallets. This will include the cost items associated with EPAL-certified pallet management.
Instead, the **cost items** that will be examined for the 3 scenarios in which there is exclusive use of disposable pallets, include:

- For T6 pallets: the purchase cost of the pool of pallets considered disposable after the first order-delivery cycle and the disposal cost at the end-of-life;
- For T8 and T10 pallets: the purchase cost of the circulating pallet pool, determined on the basis of the number of reuse cycles, the cost of return transport and the disposal cost at the end-of-life.

3.1 COSTS OF EPAL PALLET MANAGEMENT

Starting in 1991, the practice of pallet pooling, i.e., the outsourcing of pallet management to third parties, became widespread in Italy, including supply, transport and collection. According to ECR research, the share of pallets handled and stored by the FMCG supply chain should be reduced by the wooden pallets in the different pallet pooling circuits. Therefore, the number of EPAL pallets handled annually in the supply chain should be reduced to 60 million. Considering that the FMCG supply chain overall has an average 2 months' coverage of pallet stock (Source: ECR- GS1 Italy), the estimated total number of **EPAL pallets currently used** in the sector in Italy is about **10 million**.

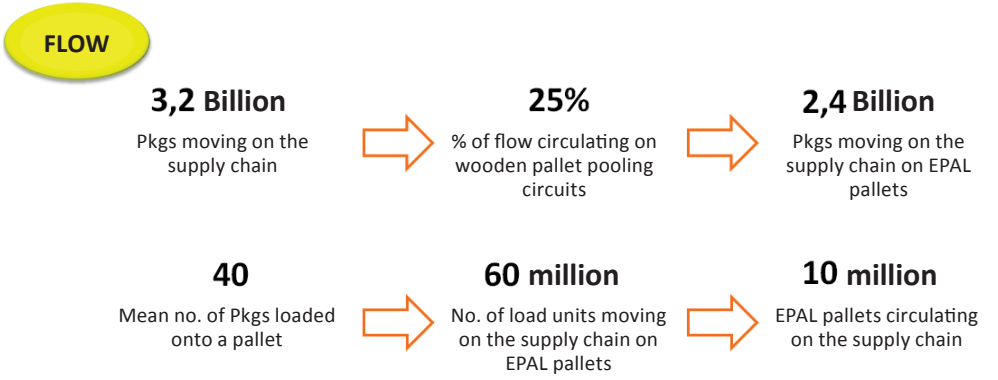


Figure 21 - Main values and parameters considered in the study

The **management cost** associated with the current use of **exchangeable EPAL pallets** has been calculated according to the same methodology used in the first part of this paper, starting however from the foregoing flow data.

Scenario	Management cost (€/cycle)	Number of order-delivery cycles	Annual flow of EPAL pallets in FMCG sector	Overall management cost of (€/year)
EPAL	1,14	2	60.000.000	**ca. 135.000.000**

Table 13 - Handling cost associated with EPAL pallets.

3.2 COSTS OF DISPOSABLE PALLET MANAGEMENT

There are many types of disposable pallets on the market. These differ in robustness and therefore in the number of times they can be used.
It was decided to consider **three types of disposable pallets in parallel** in this paper: **T6, T8 and T10**.

The main **difference** between these three types of pallet is the **height of the nine wooden blocks** on which the five boards rest: they measure 6 cm, 8 cm and 10 cm respectively. These blocks are considerably lower than the 14.5 cm high blocks used for EPAL pallets.
Another difference is the **width of the boards** that make up the support surface on which the goods rest. These boards are all 10 cm wide in the three types of disposable pallets considered. On the other hand, EPAL pallets have three 14.5 cm wide boards (attached to the top of the blocks) and two 10 cm wide boards (interspaced with the wider boards). These differences imply, first of all, that the pallets have different **robustness**: EPAL pallets guarantee a more stable support surface, capable of supporting loads up to 1500 kg. Instead, the maximum weight that can be handled and stored on disposable pallets is considerably lower. For example, the T10 pallet, the sturdiest of the disposable pallets examined is rated for a maximum load of 600-700 kg.

At the same time, there is a significant **difference in cost** for the quantity and durability of the wood used. The unit cost of the EPAL pallet is around €9.00, as seen in the previous chapter. Robust, quality certified pallets have a higher cost with respect to the "disposable" alternatives. Specifically, the unit cost of the T6, the most economical pallet is €3.50, then there is the T8, which costs €5.00, and finally the T10 at €6.50.

Figure 22 - Comparison between EPAL pallets and disposable pallets

The table below summarizes the main data from each scenario:

Scenario	Circulating pallets (millions)	Trips/year (or cycles/life)	Pallet pool in circulation (millions)	Single pallet cost (€)	Single pallet weight (kg)
EPAL	60	6 trips/year	10	9	22,5
T6	60	1 cycle/life	60	3,5	6
T8	60	2 cycle/life	30	5	8,5
T10	60	3 cycle/life	20	6,5	11,65

Table 14 - Main data from each scenario.

3.2.1 COSTS OF PURCHASING A PALLET POOL

In the year 2019, had there been no EPAL pallets and only disposable pallets were being used, the size of the circulating pool of pallets in Italy would certainly have been different. In fact, had the EPAL-certified pallets not existed, **disposable pallets would have, on average, completed** only **one** (T6), **two** (T8) or **three** (T10) order-delivery cycles between the manufacturers and MMRs before being scrapped.
Clearly, this value is an average, being the result of the research conducted by the LIUC Business School Center for Logistics and Supply Chain Management and their many field observations. In fact, once the above-mentioned number of deliveries has been completed not all pallets are no longer usable and therefore not all of them need to be scrapped. Some can be used for an additional order-delivery cycle, while others break beforehand or are not returned. Some are used internally by MMRs for storage or shipping to points of sale.

In the scenario where only T6 pallets are available, a pallet pool of 60 million units would be required to handle and store the same amount of packages in the "as is" scenario (2.4 billion packages per year). On the other hand, the estimated T8 pallet pool needed to perform an average of two order-delivery cycles would be around 30 million units. Similarly, around 20 million units would be the likely T10 pallet pool required.
The investment cost needed to purchase the pool of disposable pallets in the different scenarios can be calculated by multiplying the size of the pallet pool in their different alternatives by the unit prices of each type of pallet.

Scenario	Pallet pool (millions)	Single pallet cost (€/pallet)	Pallet pool cost (€)
T6	60	3,5	**210.000.000**
T8	30	5	**150.000.000**
T10	20	6,5	**130.000.000**

Table 15 - Calculation of pallet pool size in the different scenarios with disposable pallets.

3.2.2 COSTS OF RECOVERY AND REUSE OF DISPOSABLE PALLETS

According to GS1 Italy and Conlegno recommendations, the immediate exchange of the pallet with a pallet of the same quality upon delivery of the goods is the EPAL pallet's primary feature. This factor drastically reduces the number of trips required exclusively for pallet recovery, while at the same time it reduces the size of the pallet pool required to handle and store the flow of consumer goods. Obviously, in order for the exchange process to be efficient, each company participating in the exchange system must take full responsibility for the management of its own pallet pool. Therefore companies must do everything necessary to ensure that the minimum quality parameters are sufficiently maintained to ensure the exchangeability of its pallets as well as their availability at the "exchange points".

In scenarios with disposable pallets, manufacturers must incur **costs associated with their return transport** to regain possession of their own pallets. The only scenario not affected by this requirement is where only T6 pallets are used. These "disposable" pallets, by definition, complete only one order-delivery cycle and are not returned to the manufacturers' plants or warehouses. Conservatively considering the average cost of €1.00/disposable pallet for return transport and physical-administrative management (i.e., less than one half the management cost of an EPAL pallet), it is easy to estimate the cost that companies would incur to replace their pallet pools with 30 million units for the T8 scenario and 20 million units for the T10 scenario, respectively.
Therefore, return transport costs can be estimated at **€15 million for the T8 scenario and €20 million for the T10 scenario**.

Scenario	Return transport	Unit cost for transport and management (€/pallet)	Cost for transport and management (€)
T8	1	1	**30.000.000**
T10	2	1	**40.000.000**

Table 16 - Calculation of T8 and T10 scenario transport costs.

3.2.3 ENVIRONMENTAL IMPACT OF DISPOSAL

CONAI (Consorzio Nazionale Imballaggi [National Packaging Consortium]) is the consortium that manages the recovery and recycling of packaging waste. From an operational standpoint, the CONAI system is based on the activities of different Consortia that operate according to the type of material used for the packaging, e.g., steel, aluminum, paper and cardboard, wood, plastic and glass. There are currently six associated Consortia: CIAL, RICREA, COMIECO, RILEGNO, COREPLA, COREVE.
The higher costs incurred for waste sorting and the costs for primary packaging waste recycling and recovery or in any case, consignment to the public waste disposal service, are shared between the manufacturers and users of these packaging materials. Manufacturers and users are required to pay CONAI an **Environmental Contribution (CAC)**, determined on the basis of the type and quantity of packaging materials introduced onto the national market. The environmental contribution linked to disposal and recovery of wood (the packaging material under examination here) is **€7.00 /ton**.
As noted above, the CAC Environmental Contribution for EPAL pallets is already included in the €1.14/order-delivery cycle management cost incurred by companies in the MMR supply chain.

Figure 23 – Example of disposable pallets abandoned at the roadside

Then, by considering the weight of each type of disposable pallet and the different pallet sizes needed to handle and store total supply chain package flows, estimating the annual environmental contribution linked to each of the three scenarios is easy.

Scenario	Pallet pool	Weight of one pallet (Kg)	Environmental Contribution (€/t)	Total environmental contribution (€)
T6	60.000.000	6	7	2.252.000
T8	30.000.000	8,5	7	1.785.000
T10	20.000.000	11,65	7	1.631.000

Table 17 – Calculation of C.A.C. in the three scenarios with disposable pallets.

3.3 SUMMARY OF SAVINGS SECURED BY INTRODUCING THE EPAL EXCHANGE SYSTEM

After estimating each cost item, it is interesting to evaluate the overall **management cost** associated with each of the scenarios considered for disposable pallets.

Scenario	Pallet pool purchase cost (€/year)	Return transport cost (€/year)	Environmental Contribution (€/year)	Total environmental contribution (€)
T6	210.000.000	-	2.200.000	**ca. 211.000.000**
T8	150.000.000	30.000.000	1.800.000	**ca. 180.000.000**
T10	130.000.000	40.000.000	1.600.000	**ca. 170.000.000**

Table 18 - Calculation of the overall management cost associated with each of the three disposable pallet scenarios.

The cost item with the greatest impact on overall management costs turns out to be, for all three scenarios, the purchase cost of the pallet stock. This is not surprising: these pallets' limited robustness and hence their reduced useful life implies the need to frequently replenish the pallet stock.
If compared with the EPAL pallet management cost (€136.8 million), the savings generated by using the latter compared to using disposable pallets is easy to highlight.

Scenario	Management cost (€/cycle)	Number of order-delivery cycles	Annual flow of EPAL pallets in the FMCG sector	Overall management cost of (€/year)
EPAL	1,14	2	60.000.000	**ca. 135.000.000**

Table 19 – Calculation of overall management costs in the EPAL scenario.

For the FMCG supply chain alone, using only T6 disposable pallets would entail an extra annual expenditure of about €76 million. Using only T8 pallets would encumber the supply chain economy with an extra outlay of over €45 million when compared to using only EPAL pallets. Finally, a cost increase of €35 million would be incurred by the FMCG sector if it were to use only disposable T10 pallets.

Scenario	Overall cost (€)	Extra cost vs. EPAL pallet (€)
EPAL	135.000.000	-
T6	211.000.000	**76.000.000**
T8	180.000.000	**45.000.000**
T10	170.000.000	**35.000.000**

Table 20 - Calculation of the extra costs generated by the use of disposable pallets vs. the use of exchangeable EPAL pallets.

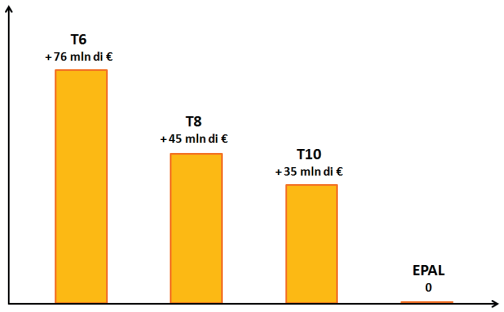


Figure 24 - The extra cost generated by the use of disposable pallets vs. the use of exchangeable EPAL pallets

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A world without pallets...
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