IMPROVING CAR PORT TERMINALS EFFICIENCY THROUGH MODELLING AND SIMULATION

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ABSTRACT

Palermo Euro Terminal (PET) s.r.l. is an Extended Enterprise of the Italian shipping company "Grimaldi Group" and specialises in multimodal port logistics of cars, and vehicles in general, carried to the port of Palermo through the Grimaldi Group car carrier ships and Sicilian road transporters trucks. On behalf of the Grimaldi company, PET performs physical operations (receiving, unloading, stocking, delivering and loading, cars onto ships or trucks) and the related informatics tasks (cars data collecting, updating, warehousing), including mandatory reports about order and conditions of managed cars. This paper aims to show how the Object-Process Methodology (OPM) modeling and simulation approach supported the analysis and overall improvement of PET efficiency highlighting a lack of effectiveness of the informative system, and of a number of internal processes, mainly leading the implementation of a new, significantly more effective and less expensive infrastructure for the management of cars data.

Keywords: port terminal efficiency improvement, multimodal port logistics of cars, modeling and simulations, object-process methodology

1. INTRODUCTION

Palermo Euro Terminal (PET) has been established in 1997 by the Italian shipping owner Grimaldi (http://www.grimaldi.napoli.it/it/index.html) and a private local partner with the purpose of provisioning an effective port logistics to the car manufacturers and the road transporters operating in the European Automotive market area and specifically in Sicily.

The well known Global Market Crisis, began in the end of 2008, led the companies of all the world to a huge loss of turnover, including the world wide Automotive market which estimated loss in sells of cars has been estimated approximately around 40%, compared to the previous year. This in turn led all cars manufacturers and related supply chain companies, like road, railway, airway and maritime transporters directly or indirectly involved, to the same, but not always equal, dramatic and unexpected situation. In those circumstances, the PET management decided to implement a strong costs reduction policy in order to avoid dangerous waste of resources.

With respect to the Informative System used at that time, the management of PET company asked its Data Centre system engineers for a wide and well detailed analysis of the infrastructure and the related enabled operations.

This paper aims to describe methodologies and techniques used by PET Data Centre managers to identify a set of more affordable and more usable options available on the market through those used at that time by the other port terminals of the Grimaldi Group, including hardware devices and software interfaces, with the specific purpose of improving the overall efficiency of the PET company through a reduction in costs and, simultaneously, an elevation of the quality of services provided.

2. MISSION

In 2008 PET performed 100.000 car transits. From the beginning of 2009 to the end of 2010, the global automotive market lost about 40% of sales. In the same period, PET lost about 30% of its turnover. This, coupled with the increasing amount of information about location and conditions of cars required by the clients, led the PET management to perform a detailed spending review. A mandatory reduction in personnel, about 20% less, was highlighted and operated. This, coupled with an increasing request of information by the clients, led the company management to ask its Data Centre for testing the performances and investigating the effectiveness of the Informative System, and evaluating affordable alternatives in order to maintain the same level of quality of services provided and reduce the high costs required by the system management and maintenance.

3. METHODOLOGY

In order to perform an efficient and effective logistics, it is mandatory that all the involved operators (Car Port Terminals, Shipping Companies and Road Transporters) are able to perform simultaneously the highest number of activities in order to complete the highest number of both Physical and Informatics operations in the smallest amount of time. This in turn

requires effective and updated facilities (i.e. Informative Systems), and well trained personnel.

With respect to the Port Terminals Logistics, incoming cars must be first checked on board the carrier means of transport by the stocking yard "Surveyors" who are responsible for filling the specific reports about the order and condition of received cars before the "Drivers" unload them.

After stoking the arrived cars inside the port terminal compound, the "Tallymen" scan the barcodes of the cars with specific mobile scanners and provide the "Office Personnel" for collected cars data in order to update the PET database and integrate the data uploaded with last informations.

Next, office personnel generates many different kinds of files, depending on the specific transporter or manufacturer database to update.

Cars data must be uploaded onto clients databases in time, usually within 24 hours from the physical arrival, and with the maximum level of accuracy in order to keep clients well informed about locations of cars and their conditions.

After this, the transporters send a list of required cars that must be arranged in charging lines in order to be quickly loaded onto the specific means of transport when the transporter arrives at the port terminal.

Finally, outgoing cars are checked again by the PET Surveyors together with the transporter drivers and loaded onto trucks or ships.

3.1. Models and Simulations

According to the Object-Process Methodology, OPM, (Dori 2002) and the Divide and Conquer Strategy (Knuth 1998), a Decompositional Approach has been adopted by the PET system engineers in order to perform an early analysis of the structure and the behavior of the company and build an OPM System Model providing a consistent overview of the whole set of involved facilities (represented as object together with their related states) and processes, with respect to both the related Physical and Informatics tasks. A list of building blocks has been created and validated together with both PET personnel and Grimaldi Group supply chain to check the correspondence between the model and the real company. Next, using the OPCAT modeling tool (free academic version available at http://www.opcat.com), the behavior of system model of the PET company has been simulated, as shown in Figure 1-4, above.

The structural view of the PET supported, and it's still doing that, the management of the company with an effective tool to keep under control the whole set of costs centers and their related effectiveness and efficacy level.

The behavioral view highlighted the fundamental role here played by the Informative System with respect to the time required to complete all the tasks belonging to the management of the cars data, which is closely dependent on their complexity.

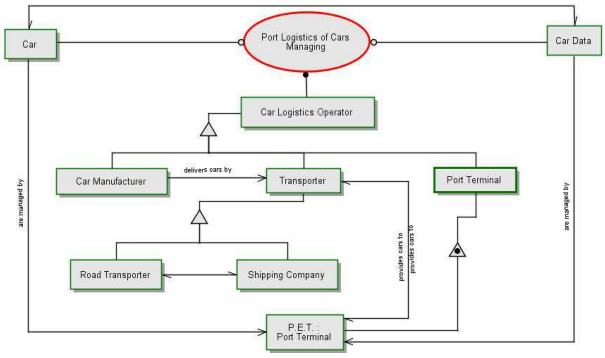

Figure 1: PET OPM System Diagram representing the main process of Port Logistics of Cars Managing

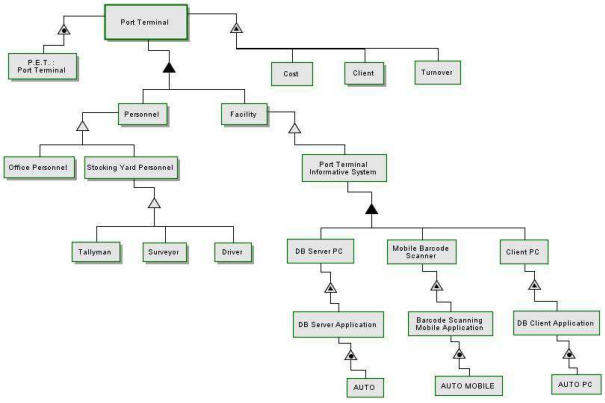

Figure 2: PET OPM System Diagram representing the Port Terminal Unfolding

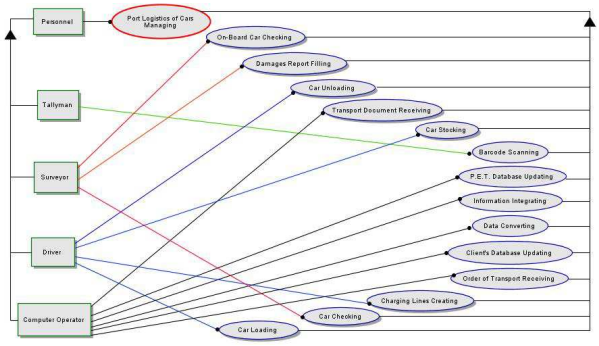

Figure 3: PET OPM System Diagram representing the Port Logistics of Car Managing Unfolding

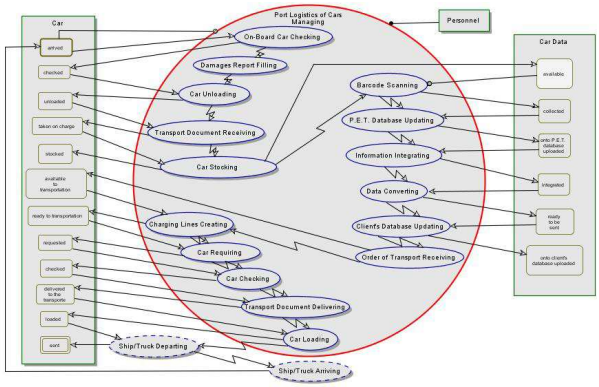

Figure 4: PET OPM System Diagram representing the Port Logistics of Cars Managing Inzooming

Next, system engineers performed a wide range analysis of the informative systems used by the most representative European Grimaldi Group port terminals in order to collect information about the widest set of available options and related costs and performances.

Finally, the informative system to be implemented has been identified and the expected company efficiency improvement has been obtained, leading in addition some unexpected but positive result with respect to the personnel way of working which in turn led an overall improvement of the quality of services provided by the PET company to its clients.

In the Conclusions are presented the results and the main outcomes of the activities mentioned above.

3.2. Initial Findings

Simulations highlighted a lack of effectiveness related to those processes enabled by the informative system. Figure 4 shows how the simultaneity of physical and informatics processes ends very early and is not recovered until all the informatics processes are executed and related tasks are performed. Because this is widely considered the main efficiency and effectiveness factor bearing down on the time a car requires before it is physically available on the market (Time to Market).

In other terms, given a fixed amount of time, the more a port terminal is able to manage simultaneous processes, the more cars are delivered to clients or, given a fixed amount of cars, more processes a port terminal is able to perform simultaneously bigger is the saving of Time to Market.

This early finding led the PET system engineers to further analysis into the internal processes and alternative informative systems available on the market.

3.3. Port Terminals Informative Systems Analysis

Supported by Supply Chain and Data Centres' managers of the Grimaldi Group, PET system engineers have visited some of the most representative European port terminals of the Grimaldi Group and a couple of Italian Grimaldi partner logistics company stocking yards. Very huge number of data about architectures, performances and costs of many different informative systems were collected paying attention to the number and complexity of tasks performed by every single port terminal.

The survey that was carried out confirmed the necessity of PET company to implement more effective informative systems in collaboration with the various logistics operators PET met during these visits.

The list below contains Grimaldi Group port terminals and partners involved

- AET (Antwerp Euro Terminal), Antwerp, Belgium
- VTE (Valencia Terminal Europa), Valencia, Spain
- Setram Port Terminal, Barcellona, Spain
- Terminal San Giorgio, Genova, Italy
- LTM (Livorno Terminal Marittimo), Livorno, Italy
- CTE (Civitavecchia Terminal Europa), Civitavecchia, Ialy
- SAT (Salerno Auto Terminal), Salerno, Italy
- Agenzia Marittima Marangolo, Catania, IT

All of those analysed informative systems required the use of barcode scanners and custom software interfaces that allow the conversion and upload of cars data onto the clients databases. Those architectures provided for automated data upload software modules shown the best performances in terms of user cognitive workload, error or delay avoiding and overall time saving.

Some port terminal was testing the effectiveness of RFID into the domain of the port logistics of cars. At that time some trouble due to the Tag positioning onto the cars affected the experiments and the solution was rejected, even those it was very interesting with respect to the time saving during the Cars Data collecting activity.

Some of the informative systems that have been evaluated shown very high costs, with respect to the devices implementation, management and maintenance costs whilst others required very expensive servers and/or a very time consuming personnel training, to name just a few key issues, but all the systems analysed shown a remarkable level of effectiveness and notable performances.

The right balance between system complexity, usability, performance, cost efficiency and training duration has been found in the informative system AUTO, developed by the Italian software house SOFTNET which is a trusted supplier of the Grimaldi Group after the remarkable performances shown in many circumstances by the AUTO system.

Because the AUTO informative systems is actually used by a huge number of Italian Grimaldi Group port terminals (Palermo, Genoa, Livorno, Catania, Savona, Ravenna) and the files they need to share are fully interchangeable and compatible, the improvement of efficiency of the entire Grimaldi port logistics is rapidly increasing and widely appreciated by its managers and Data Centre's operators.

3.4. PET Efficiency Improvement Evaluation

The final stage after implementation has been focused on the evaluation of usability and of both mobile Barcode Scanners (Pirhonen, Brewster and Holguin 2002) and databases User Interface (UI) to assess the real final PET efficiency improvement obtained through the implementation of the AUTO informative system. For this purpose specific Tasks Analysis (Benyon, Turner and Turner 2005) have been performed on both the old one and the new one informative systems.

Evaluations have been performed in collaboration with the PET personnel according to the principles of the Participatory Heuristic Evaluation (Hix and Hartson

1993; Shneiderman 1998; Nielsen 1993; Nielsen and Mack 1994; Muller, Matheson,Page and Gallup 1998).

Collected data confirmed initial findings about the level of effectiveness of the old informative PET system due to the following outcomes.

3.4.1. Barcode Scanner Effectiveness Assessment

The outdated barcode scanner mobile application mainly did not fulfil the PET needs with respect to the clients requests of informations and did not allow the decode of the most part of informations contained in the barcodes of the cars, with the exception of the chassis number, as shown in Figure 5, below. In other terms, PET operators was required to input manually all the basic cars informations during the scanning activity or, after that , the office personnel had to often recover missing data, like the origin, the destination, the brand and the model of the cars, the carrier name and type (ship or truck), through the Grimaldi shipping company database or asking for informations directly to the related manufacturer Data Centre.

This unnecessary waste of time coupled with the high risk of wrong data collection were due basically to a lack of compliance to the basic principles of the User Centred design of software interfaces, this in turn led the most common problem the related literature has investigated within last thirty years.

A different set of problems, strongly contributing to the mentioned lack of effectiveness of the early informative system, were caused by a low functional file transfer software interface responsible for a not unusual total loss of the data collected during the upload process onto the PET database. This in turn often led unpleasant delays in delivering cars to and share data with the clients together with a huge and unnecessary waste of time.

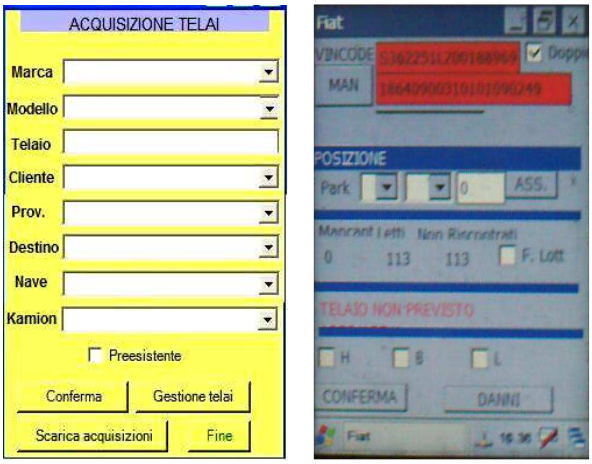

Figure 5: The Old and the AUTO Barcode Scanner Mobile Application Graphic User Interface (GUI)

Conversely, the AUTO barcode scanner together with the mobile application provided, as shown in Figure 7 above, requires the operator simply scan the barcode to retrieve and display the informations contained inside the scanned barcode. The manual mode is always available in order to enable the operator to insert the cars data even those the barcode is not readable. In addition, a strong reduction in time with respect to the scanning activity (the time saving has been estimated about 50% less) has been obtained thanks to the implementation by the SOFTNET of the Sequential Barcode Scanning option very useful in case of a temporary unavailability of all operators required or if a group of cars for some reason must be quickly scanned and delivered to the road transporters or loaded on a ship close to its departure. In addition, since the early implementation of the AUTO informative system, it never happened that some information has gone lost because the new scanner, provided for an external SD card, saves the data of the scanned barcodes one by one after each single scanning operation. Then, to execute the file transfer onto the PET database, the office personnel must simply open the folder where the mobile application stored the barcode data and copy and paste onto the PC desktop folder the files generated during the last scanning session. This in turn definitely avoided the loss of data, because of the duplication of the file made by the office personnel before uploading it onto the PET database server, and strongly reduced the uploading time required to update the PET database.

In addition, SOFTNET offers a cheap widely appreciated service consisting of the remote maintenance and update of the entire AUTO infrastructure, including hardware components, software modules and interface depending on the company needs and on the shipping company Data Centre requests. In case of unavailability of connections, the PET logistics operations can be performed because both the barcode mobile application and the file transfer interface installers have been released to the Data Centre system engineers in order to restore them in case of failure or communications breakdowns avoiding costly and time consuming interruptions of informatics and related physical operations.

3.4.2. Database User Interface Effectiveness Assessment

As shown in the Figure 6 and Figure 7, below, the old P.E.T. informative system was provided for a Textual User Interface (UI) which made very difficult the execution of tasks in parallel like recalling informations related to a specific chassis number and integrating the data related to a new group of cars at the same time. In other words, also the simultaneity of informative operations was not allowed by the old informative system UI. This in turn unnecessary increased the Office Personnel workload together with the risk of data loss and/or data errors.

In addition, while the AUTO system automatically moves the cars delivered to the transporters from the available car stock onto the sent car group, the old system did not do that requiring the Office Personnel every end of the day a very hard work to calculate, the exact amount of cars sent and physically available

inside the compound. This, because of both the manufacturer databases and the transporters databases must match in every moment. Also this activity was often affected by some error leading the company management to unpleasant consequences.

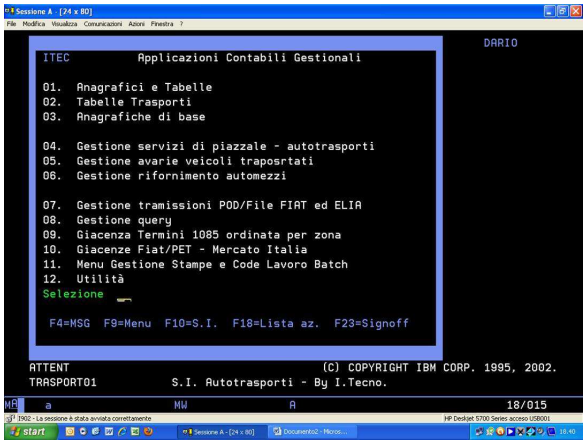

Figure 8: Old Client Server Application Interface

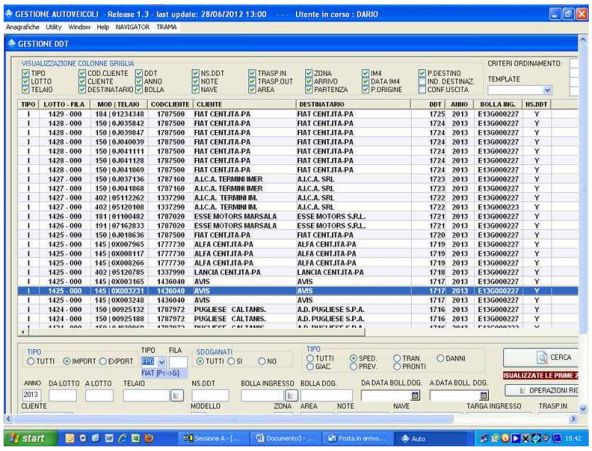
Figure 9: AUTO Client Server Application Interface

4. CONCLUSIONS AND FUTURE WORKS

Usability tests results confirmed the initial findings came out from the OPM Modeling and Simulation early stage that underlined the Palermo Euro Terminal (PET) company was affected by an excess of resources consuming mainly due to a lack of both the simultaneity in executing internal Physical and Informatics processes and the effectiveness of the Informative System in use at that time.

Latest measurements confirmed that the system AUTO drastically reduced the time (up to 50% compared to the PET old informative system) to complete most of the tasks related to the cars data collection, warehousing and sharing through the implementation of more usable hardware and software interfaces that pushed down their overall complexity.

Simultaneously, the implementation of the AUTO Informative System helped the management of the company to enable the mandatory costs reduction policy because of the lower number of personnel units required by the management of the cars data together with very low management and maintenance costs.

In addition, all the mentioned improvements contributed to elevate the overall Quality of Service provided to the clients because of the very low amount of errors in cars data shared with them now completely compatible.

Further positive effects have been obtained with respect to the lower workload requested to the employees and their higher awareness of the extended logistics chain they are part of.

All the mentioned results strongly contributed to the requested improvement of the PET company overall efficiency and led the management to ask the Data Centre for further analysis focused on assessing the availability of some additional software module to integrate in the AUTO system in order to manage the port logistics of Lorries, since it is becoming the new company core business because of the strategic position of the Port of Palermo inside the Mediterranean Market Area with respect to the countries of the North Africa.

ACKNOWLEDGMENTS

The author with P.E.T. Management would like to thank the shipping company Grimaldi Group and all the involved Data Centre operators for their help and support. The Author wish to thank also the Prof. Edward Crawley and the Engineering Systems Division from the Massachusets Institue of Technology (MIT) and the Prof. Dov Dori together with the Enterprise System Modeling Laboratory (ESML) from Technion - Israel Institute of Technology for their highly helpful and valuable contribution to this work and for their kind hospitality and availability.

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