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A micro-simulation model for performance evaluation of a logistics platform

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Abstract

The paper focuses on the receiving area of a logistics platform operating in the agri-food sector. The main aim of this work is to propose a "what to" approach for the resolution of problems related to the vehicles and goods receiving. The approach is based on a dynamic, stochastic, discrete-event micro-simulation model, which was properly specified and calibrated.

The work proposes the formulation of the mathematical model defining the receiving activities in the logistics platform. The aim of the objective function is to minimize the average trucks turnaround in accordance with constraints allowing to establish the optimal entry sequence of the inbound trucks. The problem formulation considers the introduction of ITS to support the receiving activities management.

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Keywords: logistics platform; receiving area; micro-simulation model; ITS; mathematical model

1. Introduction

A logistics platform, like a warehouse, "is a facility, which provides the services about material storage and management to a manufacturing firm or customer". Its efficiency depends on many factors and is important because costs affect the production or distribution accounts and ultimately fall on the consumer.

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The implementation of new management philosophies and the generalized application of new technologies and ITS give new opportunities to improve warehouse operations. Real-time process monitoring, communication with other supply chain components and automation of some features may help to improve the warehouse performance, especially in terms of efficiency (time and monetary costs).

The proposed work is part of an extensive search, in which a discrete event, stochastic, dynamic micro-simulation model has been appropriately specified, calibrated and validated to analyze the operation of a logistics platform in order to determine ITS performance in different system configurations by using appropriate efficiency indicators (Gattuso and Cassone, 2012).

The paper introduces the mathematical formulation of a trucks scheduling problem for a logistics platforms, with particular attention to the specification and calibration of the objective function.

The problem formulation considers the introduction of ITS to support the management of the receiving system through appropriate representative variables and, as a result, to increase the efficiency and effectiveness of the services provided for the goods receiving.

The model allows the performance evaluation of the receiving area of logistics platforms, already existing or to be built, by offering a support for the decisions about the planning activities at different levels.

The proposed model is a useful decision support tool for the operators of logistics platforms. As a matter of fact, based on its results, it is possible to make evaluations on the operational level that may direct the planning of tactical and strategic actions for the existing platforms. As regards the analysis of the platforms to build, the simulation allows to test the scenarios offering to the operators the opportunity to make updated choices about the provision of space and resources as well as the management approach to be taken in the planning phase.

After the characterization of the micro-simulation model, the proposed procedure can be transferred to other contexts and applied for the capacity analysis of the warehouses dealing with different types of goods.

2. Literature Review

A logistics platform, like a warehouse or a cross-docking, is a very dynamic environment, where resources are used and allocated in real time in order to meet the client's requirements.

In the literature, several studies deal with operational problems such as the trucks scheduling problem. Tsui and Chang (1992) address the problem without considering temporary storage of the incoming goods, the objective is to minimize the distance traveled by the handling means. They use a traditional formulation for the problem and a branch-and-bound algorithm for the resolution. The model is a reference point in the literature sector, in fact many authors propose an integration or an adaptation of it (Bermudez et al., 2001; Rong Zhu et al., 2009; Cohen and Karen, 2009; Guignard et al. 2012). Chen and Lee (2009) develop a polynomial approximation algorithm and a branch-and-bound algorithm to minimize the makespan for the products going through a cross-docking facility without temporary storage. In particular, the authors propose to sequence the unload/upload and degroupage/groupage operations for the inbound/outbound goods to minimize the makespan. Boysen (2008) uses a dynamic approach and heuristic methods to minimize the total time spent at node by the inbound/outbound trucks. Yu and Egbelu (2008) study the scheduling issue of the inbound and outbound trucks in cross-docking systems with temporary storage. They try to find the scheduling sequence for both inbound and outbound trucks to minimize total operation time when a storage buffer to hold items temporarily is located at the shipping stock. Bolori Arabani et al. (2011) deal with the same problem and propose an implementation of a genetic algorithm for the resolution.

Other researches concern the study of the trucks scheduling through simulation. Rohrer (1995) discusses about the modeling methods and the issues as they are applied to the cross docking systems. He describes how the simulation helps to ensure success in the logistics platform system design by determining the optimal hardware configuration and software control. A simulation model of a generic cross docking facility (Magableh et al., 2005) to examine the operational risks associates with individual cross docking facilities within a company's distribution network under a dynamic environment. McWilliams et al. (2008) cover a specific truck scheduling problem at a parcel hub. A simulation-based scheduling approach with an embedded genetic algorithm is proposed.

Only very few research papers focus on the trucks and goods management in the receiving area of the logistics platform by using the ITS (Radio Frequency Identification - RFID; Electronic Data Interchange - EDI; Enterprise Resource Planning - ERP), for instance, Ching-Long and Wu-Chen (2007) propose a hybrid multiobjective training

scheduling genetic algorithms to help enterprises proceed with training schedule of ERP system. Coulson et al. (2003) propose a training model based on the whole ERP concepts. They emphasize the operators have to understand the entire “Blue Print” of the system continuously so that it can make the quality of entire ERP usage and efficiency reach to the optimization. Wu and Cheng (2007) show the differences between the current operations and likely impact on a distribution center operations and costs once the RFID technology is introduced. They study the problem using a simulation approach and their results show that the adoption of RFID does have a positive impact on overall operating efficiency of the node under study.

Other studies discuss about the reduced receiving time, the loading/unloading time and the waiting time before the unloading operation by using ITS (Bear, Stearns Co. Inc., 2003; Radko and Schumacher, 2004; Rutner et al., 2004).

3. Model description

The aim of the proposed model is to optimize the inbound truck receiving activities by minimizing the total time trucks spent at the node, from their arrival to their departure.

The receiving area of a logistics platform is composed by a gatehouse; by one or several docks equipped with some doors for the unloading operations and the reloading of the rejected goods; by a receiving area where the inbound goods is subject to the qualitative and quantitative checking and, then, is sorted into the storage area. Generally, the docks of a logistics platform correspond to specific warehouse zones and they are used to receive only certain types of goods so that the following operations of inbound goods handling and storage can be facilitated.

The receiving process concerns the activities carried out to handle inbound trucks and involves the receiving zone and the corresponding operational areas. In detail, once the conformity of the amount and type of goods transported by a truck is checked following their order of arrival, the gatehouse assigns the inbound vehicle a dock and a serial number. Generally, the dock is assigned according to the type of load, in order to optimize the following unloading and storage operations, while the serial number is assigned on the basis of the arrival time and registration at the gatehouse. Thus, the truck remains waiting for the service and, when one of the doors of the assigned dock becomes available, it is let in. Then, unloading operations start and, finally, they are followed by check operations (Transport Document: TD). It is important to notice that the qualitative and quantitative check is carried out by priority, i.e. if the inbound goods are not immediately required in the warehouse, the check is postponed. When check operations end, if goods are deemed suitable, they are stored, otherwise they are reloaded on the truck, which leaves the door at the end of all operations.

The flow chart in figure 1 describes the receiving process.

In relation to the operational and functional characteristics of the receiving area of a logistics platform an optimization problem is formulated. The objective of the problem is to minimize the time between the arrival and the departure of the inbound trucks, the so-called *receiving makespan*.

The model formulation is based on the following assumptions:

- the unloading sequence of the inbound trucks is known;
- the inbound trucks transport only goods of a specific type k ;
- the interchange time of the trucks served at the same door is known and it the same for all served trucks;
- the time of the trucks positioning at the assigned door is known and it the same for all served trucks;
- the undocking time is known and it the same for all served trucks;
- the checking time for each pallets unloaded from a generic truck i is known.

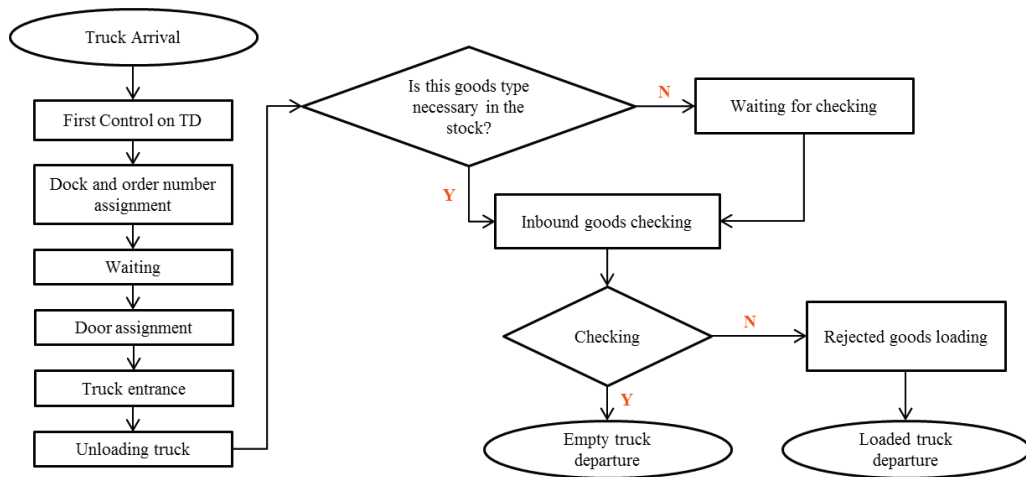


Fig. 1. Flow chart of receiving area activities

4. Mathematical model formulation

The problem is formulated following the approach adopted by Yu and Egbelu (2008), which includes a scheduling problem of the inbound/outbound trucks in a cross docking terminal through the minimization of the total operating time.

In particular, the following variables is used.

- T_I receiving makespan, time between the arrival and the departure of the inbound trucks in the receiving area;
- T^* time at which the last truck comes out of the receiving area;
- S_{dk} number of available slots at door d_k , which is used to receive goods k ;
- q_{dk}^i quantity of goods unloaded from truck i , served at door d_k , which is used to receive goods k ;
- $x_{jk}^{j^{th}}$ available slot to store goods k ;
- N_k number of available slots to store goods k ;
- Q big number;
- T_{out}^i time at which inbound truck i comes out of the receiving dock;
- T_W^i service waiting time for truck i ;
- T_{in}^i time at which inbound truck i comes in the receiving dock;
- T_{unload}^i unloading time of truck i ;
- T_c^i time to check the goods unloaded from truck i ;
- T_{rej}^i delays for truck i and time for reloading the rejected goods on truck i ;
- B interchange time between two trucks;

the following are the decision variables of the problem:

- s_{ik} binary variable, equal to 1 if goods k transported by truck i is necessary in the warehouse, 0 otherwise;
- y_{ih} binary variable, equal to 1 if truck i comes before truck h in the sequence of inbound trucks, 0 otherwise.

thus, the problem can be formulated as follows:

$$\text{Min} (T_I) \tag{1}$$

Subject to:

$$T_I \geq T^* \quad (2)$$

$$q_{dk}^i \leq S_{dk} \quad \forall i, d, k \quad (3)$$

$$q_{dk}^i \leq \sum_{j=1}^N x_{jk} \quad \forall i, j, d, k \quad (4)$$

$$0 \leq q_{dk}^i \leq Q \cdot s_{ik} \quad \forall i, d, k \quad (5)$$

$$T_{out}^i \geq T_W^i + T_{in}^i + T_{unload}^i + T_c^i + T_{rej}^i \quad \forall i \quad (6)$$

$$T_{in}^h \geq T_{out}^i + B - Q(1 - y_{ih}) \quad \forall i, h \text{ with } i \neq h \quad (7)$$

$$y_{ii} = 0 \quad \forall i \quad (8)$$

$$s_{ik} \in \{1, 0\} \quad \forall i, k \quad (9)$$

$$y_{ik} \in \{1, 0\} \quad \forall i, k \quad (10)$$

Constraint (2) sets the receiving makespan greater than or equal to the time at which the last scheduled inbound truck leaves the receiving area. Relations (3) and (4) express capacity constraints. Constraint (3) ensures that the number of goods pallets unloaded from truck i at door d_k , which is dedicated to handle goods k , do not exceed the number of slots available. Constraint (4) ensures that the amount of goods pallets k , unloaded from truck i , can be stored, in other words, that it is lower than or equal to the total number of slots available for goods k .

Constraint (5) ensures that the quantity of goods k , unloaded from truck i at the receiving dock, takes a finite positive value if needed in stock.

Expression (6) sets the leaving time of a truck i from the receiving dock is greater than or equal to the sum of the arrival time of the same truck and the unloading time.

The last three constraints make a valid sequence for the arrival and leaving times of the inbound trucks. If truck i comes before truck h , the arriving time of truck h must be greater than or equal to the sum of the leaving time of truck i and an interchange time (7). Also, no inbound truck i can precede itself in the inbound truck sequence at the receiving dock (8). Constraints (9) and (10) ensure that the decision variables of the problem are binary.

5. Specification and calibration of objective function

The specification and the calibration of the objective function is based on the statistical analysis of the data collected through some direct surveys in an Italian logistics platform.

The probability distributions of the time variables, composing the receiving makespan T_I , are identified and the evaluation of the corresponding characteristic parameters is made through a statistical procedure: the real frequency distribution is obtained for each variable, then according to such distribution, a theoretical probability distribution, fitting the real trend, is defined.

The receiving makespan can be defined through the following function:

$$T_I = T_W + T_{Service}$$

where:

- T_W waiting time of the trucks at the collect point;
- $T_{Service}$ service time.

The waiting time of a truck depends on the logistics platform organization. An inbound truck will not be served immediately, but it will be assigned to an appropriate dock depending on moved goods k , and it will be served according to the arrival time only when a door becomes free. Ultimately, this time will be a function of the truck arrival time (H); the receiving area efficiency (O_d), measurable in relation to the service time; the number of available doors for the handling of goods k ; the number of the operators engaged in the unloading activities, etc. Hence:

$$T_W = f(H, O_d, k)$$

Statistical analysis show that T_W is a Beta variable, whose characteristic parameters α and β are shown in Table 1.

Since T_W is characterized by extreme variability, depending on exogenous and endogenous variables to the system, it can be evaluated through a simulation approach.

Table 1. Characteristic parameters of the Beta distribution for T_W

Beta distribution	Goods type				
	<i>Cross</i>	k_B	k_C	k_D	k_E
α	1,00	1,80	0,95	1,26	1,20
β	3,00	7,50	3,50	6,60	3,90

k_B : detergents; paper products; hygiene and personal care products. k_C : beers, wines and liqueurs, plastic/glass drinks; high value perfumes. k_D : oil and vinegar; conserves; pasta, rice and similar products. k_E : water, milk, biscuits, bread and similar products; early childhood products; controlled temperatures and flammable goods.

The service time is the sum of three elements: the time necessary for the unloading operations (T_{unload}), the time spent to perform the first qualitative and quantitative checking on the incoming goods (T_c), the time spent in the docking/undocking operations at the door and the waiting time for the go-ahead by the logistics platform management (T_{extra}):

$$T_{Service} = T_{unload} + T_c + T_{extra}$$

In particular, the unloading time depends on many factors:

- the load condition of the inbound truck (Q - goods quantity to unload);
- the door efficiency, i.e. the methods used to unload the goods (m_{up} - manual unloading or unloading with suitable handling vehicles, Add_{up} - number of operators and vehicles employed for the unloading operations);
- goods k to unload: the fragile loads require more care in the handling operations, therefore more time.

Hence, the unloading time can be expressed as:

$$T_{unload} = f(Q, m_{up}, Add_{up}, k)$$

The analysis of the available data allow the specification and calibration of a cost function useful to the evaluation of the unloading time.

The truck unloading time can be expressed through either a linear or a logarithmic functional form:

$$T_{unload} = \beta_1 \cdot N_{stack} + \beta_2 \cdot Add_{up} + \beta_3 \cdot M_{up} + \beta_4 \cdot K$$

$$T_{unload} = \beta_1^{N_{stack}} + \beta_2^{Add_{up}} + \beta_3^{M_{up}} + \beta_4^K$$

N_{stack} is the number of pallets piles necessary to unload the truck (which is not necessarily equal to the number of unloaded pallets, as, during unloading, the pallets can be stacked); M_{up} and K are shadow variables; M_{up} is 1 if the goods is unloaded manually, 0 otherwise; K is 1 if the goods to unload is fragile, 0 otherwise.

Table 2 shows the results of the parameter calibration referring to the two functions. The calibration is performed on a statistical basis using the Ordinary Least Squares.

Table 2. Results of β parameters calibration for T_{unload}

		β_1	β_2	β_3	β_4
Linear	Value	0,69	0,57	5,03	-1,31
	SE	0,023	0,456	1,591	0,723
	R ²				0,896
Logarithmic	Value	1,08	2,19	2,01	0,86
	SE	0,003	0,053	0,186	0,085
	R ²				0,938

SE: standard error; R²:coefficient of determination

Both functions give high values of R², but a careful observation of the results shows that the logarithmic function is the most suitable cost function for the calculation of T_{unload} . This choice is justified by the negative value of β_4 in the first function, which implies that the unloading time decreases if the handled goods are fragile. Actually, the unloading times for fragile goods increase owing to the greater attention needed during the unloading activities.

The checking time is related to the qualitative and quantitative checking methods (m_c); the number of operators employed to check the goods (Add_c) and the number of pallets to be checked (N_p).

$$T_c = f(N_p, m_c, Add_c)$$

Statistical analysis show that T_c is a variable Weibull type with the characteristic parameters varying according to goods type k (Table 3).

Table 3. Weibull distribution parameters for T_c

Goods type	Parameter	Value
C_{cross}	α	1,1
	β	10,52
k_B	α	1,8
	β	36,85
k_C	α	1,6
	β	37,9
k_D	α	1,7
	β	37,64
k_E	α	1,6
	β	50,96

α : shape parameter; β : scale parameter

The accessorial time is the sum of three time values: the truck positioning time at the assigned door (T_{in}); the waiting time for the checking and for the loading of the rejected pallets (T_{rej}); the time for the undocking operations (T_{out}):

$$T_{extra} = T_{in} + T_{rej} + T_{out}$$

The most determinant element is T_{rej} . In fact, the qualitative and quantitative checking on the incoming goods is carried out by priority, i.e. if goods k is not immediately necessary in the warehouse, the checking is postponed. This often means that even if the unloading operations occur quickly, the truck leaves the door after a long time because there are some delays in the checking and in the inspection of the goods for any possible damage during the transit.

T_{in} and T_{out} are negligible and depend on the structure of the logistics platform and the paths followed by the trucks in order to reach and leave the receiving door.

Ultimately, T_{extra} is characterized by extreme variability due to T_{rej} and it is a function of goods k ; the door efficiency (O_d) and the adopted management approach (G):

$$T_{extra} = f(k, O_d, G)$$

The data statistical analysis show that the T_{rej} time is distributed according to an exponential law with the characteristic parameter varying according to the treated goods type (Table 4).

Table 4. Weibull distribution parameters for T_c

Goods type	θ (min)
<i>Cross</i>	0,029
k_B	0,025
k_C	0,026
k_D	0,025
k_E	0,017

6. Scenario analysis

In order to optimize and improve the performance of a logistics platform operating in the agri-food sector, the use of Intelligent Transportation Systems (ITS) can be considered.

An Enterprise Resource Planning (ERP) system can be useful since it determines the inbound trucks scheduling by time slot and according to the needs of the storage area.

The system allows organizing the truck arrival on the basis of the daily platform plan. If the demand for goods k in the warehouse and the truck arrival during the day are known, it is possible to schedule truck arrivals optimally by reducing not only the waiting time at the gatehouse, but also the service time. In fact, this organization would cut down the waiting time resulting from the delays in the qualitative and quantitative checking on the incoming goods. In addition, the truck arrivals would occur by time slots and would be evenly distributed in the reference period, thus reducing the complexity of the formulated problem of trucks scheduling optimization.

The platform could be equipped with an Electronic Data Interchange System (EDI), which manages the exchange of the electronic documents (orders or invoices) in a structured and standardized format without any human intermediation. This leads to processes automation and performance improvement through the elimination of manual tasks as well as the increase in speed and accuracy in data transmission. Thanks to the possibility to digitize all data, the use of EDI implies a time reduction in reading and checking the transport documents of the vehicles, in processing goods delivery documents and in filling in the form for the rejection of faulty or unsuitable goods.

The information system composed by ERP and EDI bring down the waiting time at the gatehouse and the accessorial time. Therefore, the hypothesis to choose such systems for the management of the trucks arrival (Scenario 1) produces changes in the problem proposed formulation. As regards the objective function, the T_W has a zero value and the T_{extra} becomes equal to the time necessary to the trucks docking/undocking. Moreover the capacity constraints of the problem (constraints (3) and (4)) can be dissolved because the trucks arrival at the node in an organized way in respect of the operating conditions and the space available in the logistics platform.

As regards the qualitative or quantitative checks of the inbound pallets, RFID (Radio Frequency Identification) technology may be introduced. The presence of RFID tags on incoming goods automatically checks the amount and type of products received by comparing the RFID read codes and the information contained in the transport document and in the delivery note.

The RFID reader can be mobile or fixed. In the former case, a screener uses a portable unit to obtain information from each goods TAG, with a reduction of some 10-15% in the estimated check time.

In the case of a fixed reader, there are gates equipped with antennas and devices for RFID tags reading that allow the simultaneous reading of multiple tags. Goods can be checked without screeners during unloading operations, thus eliminating the time necessary for checks.

In the case of RFID use for the performance of control activities, the objective function changes and in particular the time T_c has zero value if platform is equipped with reading gates (Scenario 3), instead T_c has a different distribution if the control is done by manual scanning of the RFID tag (Scenario 2).

The described scenarios are tested by simulation. Specifically, a dynamic, stochastic, discrete-event, micro-simulation model, proposed by Gattuso and Cassone (2012), implemented by the WITNESS software-

For each scenario, a simulation run has been made providing the results showed in Table 5. The ITS allows the reduction of the receiving makespan compared to the present state (Scenario 0). Specifically, the use of ERP and EDI (Scenario 1) cut the time spent at the node by inbound trucks by 286% on average, thanks to an optimal organization of the platform, arrivals scheduling in accordance with the processed orders, the available resources and the platform efficiency.

The RFID use to speed up the control activity cuts the receiving makespan by 12% if the control is done by manual scan (Scenario 2). If the platform is equipped with special RFID gates (Scenario 3) the receiving makespan is cut by 290%.

Table 5. Simulation results

Goods Type	T_i (min)				
	Scenario 0	Scenario 1	Scenario 2	Scenario 3	Scenario (1+3)
<i>Cross</i>	213,29	26,94	174,26	141,42	23,94
k_B	254,25	47,70	238,01	154,86	22,57
k_C	84,35	73,03	96,75	23,73	26,16
k_D	166,65	58,78	170,28	72,43	23,85
k_E	158,06	63,67	109,58	47,32	24,38

7. Conclusions

The logistics platform is a fundamental component of the supply chain; it is the link between producers and consumers and, in general, it forms 15-20% of the logistic costs. It plays a double role in the logistics network: they are both “containers” of goods in stock and “transformers” of inbound flows into outbound flows.

Therefore, there is the tendency to improve productivity and to reduce the total supply chain cost through the introduction of advanced technologies, i.e. by creating an “intelligent logistics system”.

The implementation of new management philosophies and the generalized application of new technologies give new opportunities to improve warehouse operations. In particular, real-time process monitoring, communication with other supply chain parts and automation of some features may help to improve the logistics platform performance especially in terms of efficiency (time and monetary costs).

The paper proposed a formulation of mathematic model to optimize the receiving activities of a logistics platform. In particular, objective function aims to minimize the makespan of the receiving area.

The optimization of a logistic system can be achieved also through the ITS introduction that plan, organize and automate the processes at the node.

Future developments of research will integrate the proposed model in order to carry out the efficiency analysis of the whole platform.

References

- Bear, Stearns & Co. Inc. (2003). Supply-chain technology: track(ing) to the future. Equity Research Report. (www.bearstearns.com/bscportal/pdfs/research/supplychain/technology_rfid.pdf).
- Bermúdez, R., Cole, M.H., (2001). A Genetic Algorithm Approach to Door Assignments in Breakbulk Terminals. University of Arkansas, Mack-Blackwell National Rural Transportation Study Center.
- Boloori Arabani, A.R., Fatemi Ghomi, A.M.T., & Zandieh, M., (2011). Meta-heuristic implementation for scheduling of trucks in a cross docking system with temporary storage. *Expert Systems with applications* 38 (2011), 1964-1979.
- Boysen, N., Fliedner, M., & Scholl, A., (2008). Scheduling inbound and outbound trucks at cross-docking terminals. *OR Spectrum* 2008.
- Chen, F., & Lee, C.Y., (2009). Minimizing the makespan in a Two-Machine Cross-Docking Flow Shop Problem. *Europe Journal of Operational Research*, Vol. 193, No. 1, 59-72.
- Ching-Long, S., Wu-Chen, S., (2007). A Hybrid Genetic Algorithm Approach to Multi-objective ERP Training Scheduling Problems. *Proceedings of the 13th Asia Pacific Management Conference, Melbourne, Australia*, 1159-1165.
- Cohen, Y., & Keren, B., (2009). Trailer to door assignment in a synchronous cross-dock operation. *International Journal of Logistics Systems and Management*, 5(5), 574-590.
- Coulson, T., Shayo, C., Olfman, L., Tapie-Rohm, C.E., (2003). ERP Training Strategies: Conceptual Training And The Formation Of Accurate Mental Models. *Proceedings of the 2003 SIGMIS conference on Computer personnel research*, 87-97.
- Gattuso, D., Cassone, G.C., (2012). Micro-simulation model supporting the management of an interregional logistic platform. *Procedia – Social and Behavioral Sciences, Elsevier*. n° 54 (2012), 557-566.
- Guignard, M., Hahn, P.M., Pessoa A.A., da Silva, D.C., (2012). Algorithms for the Cross-dock Door Assignment Problem. *Matheuristics 2012*.
- Magableh, G.M., Rossetti, M.D., Mason, S., (2005). Modeling and analysis of a generic cross-docking facility. *Proceedings of the 37th Winter Simulation Conference, Orlando*, 1613-1620.
- McWilliams, D.J., Stanfield, P.M., Geiger, C.D., (2008). Minimizing the Completion Time of the Transfer Operations in a Central Parcel Consolidation Terminal with Unequal Batch-Size Inbound Trailers. *Computers & Industrial Engineering*, Vol. 54, No. 4, 709-720.
- Radko, J., Schumacher, A., (2004). Electronic product code: RFID drives the next revolution in adaptive retail supply chain execution. *Global Exchange Services White Paper*. (uk.builder.com/whitepapers/0,39026691,39066441c,00.htm).
- Rohrer, M., (1995). Simulation and crossdocking. *Proceedings of the 1995 Winter Simulation Conference, Arlington*, 3-6 December 1995, 846-849.
- Rong Zhu, Y., Hahn, P., Liu, Y., Guignard-Spielberg, M., (2009). New Approach for the Cross-Dock Door Assignment Problem. *XLI SBPO 2009 - Pesquisa Operacional na Gestão do Conhecimento*.
- Rutner, S., Waller, M.A., Mentzer, J.T., (2004). A practical look at RFID. *Supply Chain Management Review*, January/February. (www.manufacturing.net/scm/index.asp?layout=siteInfoWebzineandview=Detailanddoc_id=42385).
- Tsui, L.Y., Chang, C.H., (1992). An optimal solution to dock door assignment problem. *Computers & Industrial Engineering*, N. 23, 283–286.
- Wu, Y.C.J., Chen, J.X., (2007). RFID application in a CVS distribution center in Taiwan: a simulation study. *International Journal of Manufacturing Technology and Management*, 10 (1), 121–135.
- Yu, W., Egbelu, J.P. (2008). Scheduling of inbound and outbound trucks in cross docking systems with temporary storage. *European Journal of Operational Research* 184, 377-396.