Management of check-in at the Naples port terminal by DES logic

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Abstract: The goal of this study is to produce a simulation decision support model for check-in desks in the port. In particular, this study develops a simulation model can be used to build a structure that helps predict delay and to produce a logical and rational management of check-in and security checkpoint inside the terminal port.
The model was tested in the medium size Italian port (Naples).

Key-Words: - passenger flow system, simulation, decision support system, discrete event simulation.

1 Introduction

The main objective of this work is to show and to offer a valid suggestion, for management cruise industry, preferably quantitative and market-oriented in service companies [1].
The focus of this paper is to propose a new vision for management of tourist port, placing the company in view of port and then considering the same as real producers of experience to manage not just as simple carried out services or activities, based on tacit knowledge and on experience of managers, but according to well-defined management models [8].
In this regard through this research, we deal with related issues management of passengers' flow [11] for the cruise industry, trying to take a step forward by working on logistics and management mechanisms that govern the activities that consider the passenger/customer only beneficiary, to make them highly efficient and therefore able to achieve high levels of Customer Satisfaction.

2 Problem formulation

In the introduction to the guide of the *Maritime Industry Museum at Fort Schulyler* (State University of New York Maritime College Campus), to define the maritime industry, it uses a rhetorical form: the maritime industry is "Much More Than The deep-sea merchant fleet " and it makes a long list of all production activities and services that it can be included, such as services for access to ports, those related to cargo handling, passenger services, excursions inland waterways, the construction and repair of ships, marine education and training insurance business, communication and much more. What activities, thus defining the 'maritime industry'? It's obvious membership maritime industry:

- the activity of shipping - (considering both the ship owners whose business is to invest in vessels and not necessarily to deal provision of transport and carriers that can carry with chartered vessels);
- the port services, given the nature of close complementarily with the transport service, since ports play a crucial role in the transfer of goods from shipping to the terrestrial transport;
- the shipbuilding, whose product is exclusively used in shipping goods and passengers.

With a more empirical approach and look more at the shipping in its generality and the submarkets that characterize it, the figures 1 and 2 depicts what was said, referring to the shipping market.

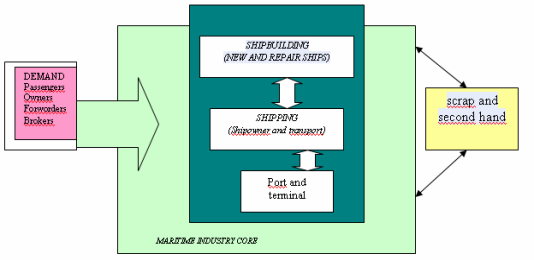

Fig. 1 – Maritime Industry model

3 Shipping Industry

The two main activities of the maritime transport are related goods and passengers.

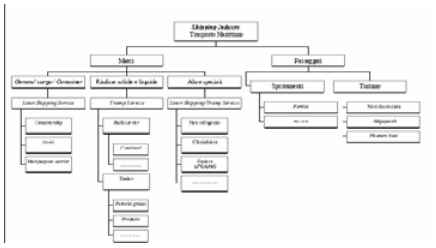

Fig. 2 – Transportation typologies

As for the passenger, the identified type demand is:
- workers, part of a journey land - sea, multimodal trip;
- leisure.

In the first case the voyage is part of a more comprehensive travel for business or tourism in the second case is the stay at sea for himself the subject of tourism. The vessels are mainly considered for moving the ferries and in the second instance the *ro-ro*. Vessels considered for tourism are mainly cruise ships.

3.1 Management ship board

What is really a cruise?

It's absolutely impossible to give a definition of what is really a cruise, because, whatever, would be too simplistic. Essentially it could say that a ship is a complete travel destination, like any other, but with a difference: it is a holiday destination that goes to other destinations.

The tonnage is a measure of internal volume of a cruise ship and is expressed in tons. For example, a ship of 78,000 tons, with 9 bridges is equivalent to building 10 to 12 floors. Spaces on board are well distributed, regardless of vessel size. Everything has been adapted to the number of passengers and everyone can find their space. Yachts, sailboats, freighters, each ship has a capacity different. Set capacity means choosing a style of vacation. To calculate the space available on a cruise ship, the tonnage must divide by the number of passengers:

- 50 and over: a fantastic place;
- 30 to 50: very spacious;
- 20 to 30: reasonable distance;
- 10 to 20: moderate little room or space;
- 10 less than 10: small space.

The ratio crew/passengers lets you know if the service will be normal or luxury. Obviously, the fewer passengers against each crew member, then the service will be furnished. Usually, that passengers are 500, 2000 or 3000, most companies apply the famous ratio 1/3 (a crew member for 3 passengers).

4 Naples Port Terminal

The Port of Naples has always been the logistical hub of millions of passengers and tourists who annually use the port infrastructures. Passenger traffic is divided into direct passengers to the islands and the gulf of Naples sites, Salerno and the Pontine Islands. Cruise traffic in the last year exceeded one million passengers. The Harbor Station welcomes cruise ships. The company operates the Cruise Terminal Seaport Spa. The company consists of the major cruise lines: *Costa Cruises, MSC, Royal Caribbean*.

4.1 Technical data on the terminal

- 10 berths;
- 7 moving walkways;
- 12 computerized check-in desks;
- arrivals and departures hall;
- tape Storage;
- shops bars and other services that are being planned.

The company manages the entire structure of the cruise terminal and its support activities to ships and passengers. The terminal extends for 1 km and includes all of the piers near the Maritime Station. It is equipped and organized to accommodate a considerable number of passengers per day, and for the loading/unloading to transit. To excursions, passengers can either loading on hydrofoil/ferry from the same pier, access to buses in the large parking. The cruise terminal has 7 piers for berthing for 1,100 meters long and 11 meters deep and 7 mobile walkways.

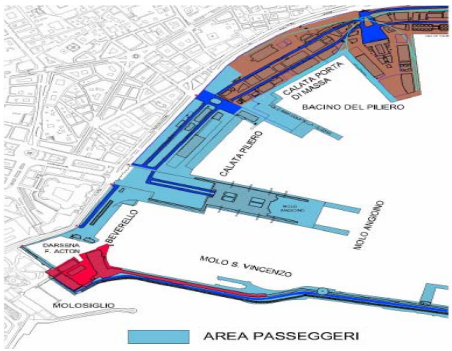

Fig. 3 – Naples port terminal

Cruise Terminal Services include:
- check-in desks;
- arrivals and departures area;
- assistance/information desks;
- parking;
- bus stop;
- security area.

Here are the boarding stages on cruise ships:
- achieve the Cruise Terminal or shuttle bus transfers;
- deposit their suitcases at luggage acceptance (on the ground floor at dock landing ship) already equipped with a label of recognition received by the agency.

If the bags were not equipped with these labels, the hostess taking the luggage check-in desk must put a new label, where the colour identifies the type of ship (if there are more than a vessel of the same company) that is designed luggage. The same is done for luggage for suites (the passengers of those cabins will undertake a different

procedure from other boarding). After this step the guest is separated from his luggage and then meet once on board the cabin. Then follow different procedures:

- make the check-in going to locations inside the cruise terminal: this phase differs, sometimes even substantially, depending on the cruise company. In our case, we monitored the company boarding lists that provides a first step check-in baggage only to perform the first tests of *Security*, through an x-ray can control the security specifications. During this phase, the passenger must show to hostess the booking number of his cabin, which will be compared with the affixed label to the baggage to verify the consistency. While the hold baggage will undergo the checks, the passenger will move to the first floor in waiting room pertaining to its cruise line, after receiving a number that can identify the group to which he belongs and according to which will be called for the phase control customs before boarding;
- wait boarding instructions that will be communicated by the staff of his own travel company;
- make checks boarding pass: at this time the guest will present all the documents to be identified before boarding.

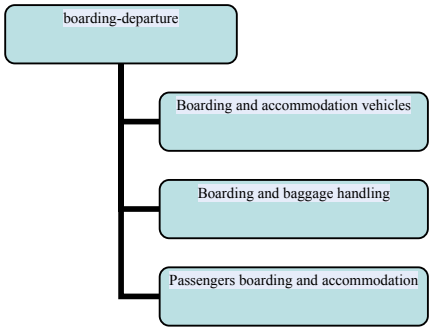

Fig. 4 – Boarding procedures

The rapid evolution of the cruise industry, as highlighted by the chart, led us to conduct this study to be aimed at optimizing the queues at check-in terminal of Naples.

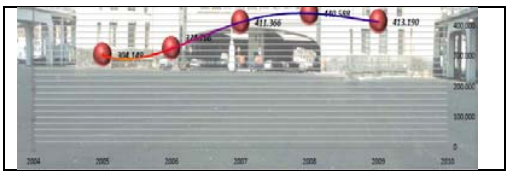

Fig. 5 – Cruise industry trend

5 The model design

As previously mentioned, our study is aimed at developing a simulation model to optimize, in a more rational way, the management of check-in desks in the terminal port [7].
The importance of this model lies in its ability to identify, at any time of year and depending on the traffic volume into account, the number of check-in desks at the same time necessary and sufficient to perform the operations of acceptance in full regularity and respect for the expected travel time, ensuring a satisfactory level of services for departing travelers. The model is equivalent to virtually retrace the path taken by departing passengers, studying the issues and highlighting all the possible alternatives. This development is essential to an inspection at the terminal, both useful to understand the approach of passengers, both to get all the necessary information for the work evolution. To clarify the issue at the beginning it must know the number of available check-in counters, which are in number 12, with only two security desk. The frequency with which the passengers have to check-in desks is a key variable of our study process. Generally, given the randomness of the phenomenon, it is assumed that the distribution of the number of passengers is symmetrical around the average interval of time for registration. This feature is reflected graphically by a curve called “presentation curve”, which shows on the x-axis the time of opening of desks and on the y-axis the passengers share.

5.1 Survey and data analysis

The most problematic phase of all the work was the data acquisition completed with a sample in place. Sampling took place in the passenger terminal at the port of Naples. After a careful examination of the port traffic results that a peak passenger traffic during the whole week is on Mondays and Fridays, so the data collection phase has been focused on these two days of the week. The survey was repeated for several weeks by two people with different detection tasks: the first detector monitored near the check-in desks the arrival of passengers to determinate the so-called 'curves of presentation' and service time of the acceptance procedure, the second one has carefully examined the queues near the desks by defining queue length and waiting time. Obviously, the actual detection is only the final act of a previously careful study, carried out to try to understand which data to analyze; this study has led to 2 type tables determination. Both worksheets show some basic information such as header information on the type of vessel and then cruise ship's departure, opening and closing check – in desks.

Worksheet 1

In this table the first column shows the passengers number at the desk, namely whether individually or in groups. This news might seem trivial but in reality in cases where the worker to check - in to explain details such as delay or otherwise, loses much less time to inform a group of four people rather than repeat the same four times, although slowing slightly the total service time. This does not mean, however, try to ensure that passengers remain in a group to save time, but simply write down everything that is due to

our task of the detector. The second field concerns the timing which travelers are presented, putting in the queue at check-in counter. Analyzing these times we can find the curve with which passengers arrive at the terminal, called curve presentation. The table is entered for each passenger or group of passengers on any number of luggage to be loaded, because for each additional time is required due to the operations of weighing and labeling. The table follows with a variable number of columns representing the counters available for a specific tour operators or for a specific company in the case of common check-in where we are going to write down the desks contemporary operating. Finally we list the start and end times of check-in procedure for each passenger or group allowed them to obtain the average value of the service times by type of journey.

PASSEGGERI	Tempo in coda	BAGAGLI	BANCO n.	BANCO n.	BANCO n.	BANCO n.	TEMPOin	TEMPOfi

Table 1 – Worksheet n. 1 sample

Worksheet 2

In this second table, the task of the detector was to count the last passenger in queue for a particular journey and write the time relieved in cell named LAST.

When this passenger began to be served we write new time, thus obtaining the total waiting time in queue of the same, and the number of desks active and operating in the same time. From this information we determine average queue length and time of queue disposal and we can also extract the average service time. As for the Security desks (on the first floor of the terminal), we used both historical data in our possession that new data collected. Recognition in each case was simpler than that performed the check – in area. The next step for a proper analysis of data collected, has seen the development of proper investigation of data stratification to highlight fundamental aspects. This was a crucial step to get to the theoretical distributions that can approximate the experimental measurements, to be included in the simulation model to validate the same.

TEMPOin	Num. CODA	UTILIMO(riferimenti)	Tattasa ultima	BANCO n.	BANCO n.	BANCO n.	BANCO n.

Table 1 – Worksheet n. 2 sample

5.2 The development of logic model

The simulation model is only implemented in a simulation software (Arena in our case) of a logical model previously developed. In this section we will define the described system through a logical model, with a sufficient level of detail to make significant subsequent simulation. It's thinking in terms of the modular system, developing the model through several submodels which make clearer the understanding and allow for easier management of the whole. The procedure at departing passengers from check-in until boarding process can be separated into the following two blocks: passenger generation and process system [9, 10].

In Process block are incorporated two submodels: the acceptance of passengers, baggage and security check. So the three representative sub-model for the whole system are: generation passenger, check-in, safeguards [3, 4, 5, 6].

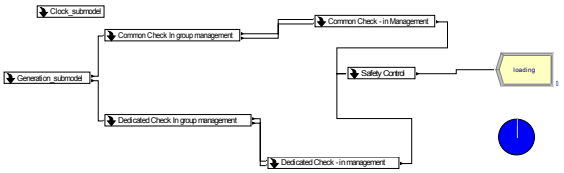

Fig. 5 – Model representation in Arena environment

5.3 Check-in

The acceptance process under consideration is modeled assuming the presence of both dedicated desks that promiscuous. The main difference is that the dedicated desk can be used particular types of passengers, such as members of special travel programs and/or emoluments; the second type belong the desks that have no discrimination in the use. In modeling the system terminal at the port of Naples was used schematization of the "common" check – in. However, in described modular view and assuming it can make, with the model built, future scenario analysis, there is a section of the model which analyzes the possibility of including desks feature dedicated programs. In particular, we choose to model the use main operations in the terminal, following a logic based on the use of binary variables: the user queue

(generated entities in the model) is waiting in the queue a signal indicating that there is at least a free resource to serve. For this reason we have chosen the value 1 to indicate the status of free counter and value 0 to busy. The simulation process queries at every time step, the system state: the presence of at least one resource (desk acceptance) freedom ensures the possibility of one or more service users.

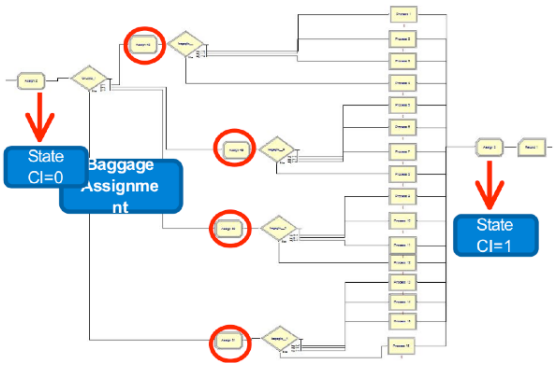

Fig. 6 – Check-in logic

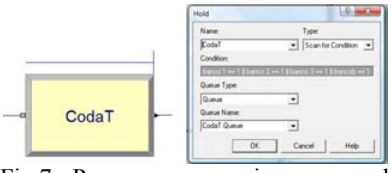

Fig 7 - Passengers queue in common check-in

For these design choices queues of passengers were handled with the type of hold block in the Arena software with scan for condition rule, in which the block is inserted into an expression that allows users to leave the queue and continue the journey.

Following the queue, just before being sent to the desks, people (entities) are grouped with the batch modules: these blocks are needed to model the possibility that passengers may be in the group and/or with large numbers of baggage. At initial state all desks are of course free and therefore for each attribute assumes label equal to 1. Each check-in counter, whenever activated by the presence of one or more entities (passengers), works, or seize entities for a period of time equal to the service time. Each check - in desk will be occupied for a time variable and dependent on several factors: type of cruise types of remuneration; number of passengers and baggage. The status of the respective resource, in this case goes from free to occupied (from 1 to 0). Elapsed service time the resource takes the value 1 again, so that the first user in the queue may finally be served. Finally, in theory, it can also arise where the queues have the same length, therefore this possibility must be considered a further application that distributes to the *n queues* equally likely.

5.4 Security desks

Unlike during the acceptance procedure, the security checks are carried out individually on each passenger. Depending on the available time, before departure, not all passengers choose to, directly, cross the security zones (or can do it according to their group identification number) [11]: some choose to use the remaining time visiting commercial galleries, working at the computer, reading a book, etc.. For this reason we define the possibility that the *security check* (SC) is delayed. The queue at the security zones is handled as in the case of common check-in, i.e. single row for multiple desks available. This procedure is much simpler to model because treating passengers individually and being free of luggage (as they were previously deposited at the reception desk), there is no need to differentiate between service times. Proposing the same logical solution already adopted, and then attach a value 1 to the desks with free state and 0 for others.

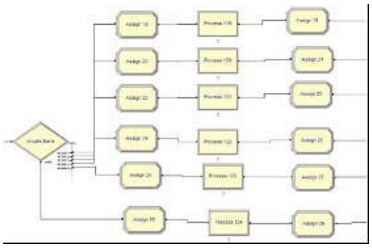

Fig. 8 – Security control logic

6 Simulation analysis

To use the simulation as decision support is necessary to make preliminary check. For this purpose, we use the first launch of model to verify the correct operation, closing all the desks, i.e.: resources state are 0 [2].

Output	Average	Half Width	Minimum Average	Maximum Average
Coda_A_Tempo_att_medio	0.00	0.00	0.00	0.00
Coda_Bd_Tempo_att_medio	0.00	0.00	0.00	0.00
Coda_Bus_Tempo_att_medio	0.00	0.00	0.00	0.00
Coda_T_Tempo_att_medio	0.00	0.00	0.00	0.00

Fig. 9 - Simulated scenario with all closed resources

As can be seen in the previous table, simulation, in output does not provide any entity, since passengers, finding all closed desks, will accumulate in the queue. Functioning correctly, we proceed with the first real simulation, initially leaving open 7 the check-in desks and all the included Security desks (2) in the model and we'll proceed with fewer than 10 times.

Number Waiting	Average	Half Width	Minimum Average	Maximum Average	Minimum Value	Maximum Value
Coda A.Queue	21.7389	3,53	15.9816	32.5216	0.00	199.00
coda Bd.Queue	0.02260145	0,01	0.00132335	0.06232497	0.00	3.0000
coda4.Queue	0.6582	0,22	0.2151	1.0447	0.00	14.0000
coda5.Queue	0.6593	0,22	0.1933	1.0351	0.00	15.0000
coda6.Queue	0.6678	0,21	0.2856	1.1128	0.00	15.0000
Codabus.Queue	0.04970299	0,02	0.02615481	0.08802838	0.00	5.0000
CodaT.Queue	1.6089	0,48	1.0276	3.2907	0.00	48.0000

Fig. 10 - Users Number in the queue with 7 resources available

As shown in fig. 10, we have in this scenario (7 check – in

desk available) a higher number of user in the queue, that implies there is a lower number of available desks. The values of the queue are not considered satisfactory for this scenario for the customer.
Then we define a new theoretical scenario. We open 2 more Check - in Desks in the model, we initialize with value 1 (Free State) and we restart the simulation.

Waiting Time	Average	Half Width	Minimum Average	Maximum Average	Minimum Value	Maximum Value
Coda A.Queue	0.1442	0,03	0.08273419	0.1898	0.00001713	0.4012
coda Bd.Queue	0.02710774	0,01	0.00849423	0.07885684	0.00482387	0.1219
coda4.Queue	0.1394	0,03	0.08541390	0.1838	0.00013671	0.4811
coda5.Queue	0.1325	0,02	0.0948	0.1881	0.00001231	0.5248
coda6.Queue	0.1316	0,02	0.08474739	0.1666	0.00018533	0.4373
Codabus.Queue	0.01880890	0,00	0.01524115	0.02770415	0.00014332	0.0915
CodaT.Queue	0.04046939	0,01	0.02104750	0.05911443	0.00000303	0.1521

Fig. 11 - Time of waiting in line at 9 check – in available

In this new context we note that waiting times in line were reduced significantly.

7 Future developments

The results provide the average values of the Arena queues and waiting times as well as their points of minimum and maximum on the number of resources left open in the model.
In the following will need to run the optimization to know what combination of check-in desks and security desks minimizes costs.
To achieve this aim will be to define an objective function that takes into account operating costs and opening of individual desks and individual security desks, and the cost representative of the inconvenience suffered by the user when the number of users in the queue ahead of him (or the same way the waiting time) exceeds the tolerable limit.

References:

[1] Evans, W.A., 1994. “Approaches to intelligent information retrieval”. *Information Processing and Management*, 7 (2), 147–168.
[2] Sargent R., 2003 “Verification and validation of simulations models”, *Proceedings of the 2003 Winter Simulation Conference (WSC 2003)*.
[3] Joustra, P., and Van Dijk, N., 2001. “Simulation of Check-in at Airports”. *Proceedings of the 2001 Winter Simulation Conference*, 1023.
[4] Verbraeck, A., and Valentin, E., 2002 “Simulation Building Blocks for Airport Terminal Modeling” *Proceedings of the 2002 Winter Simulation Conference*, 1199-1200.
[5] Appelt S., Batta R., Lin Li, Drury C., 2007. “Simulation of passenger check-in at a medium sized airport”. *Proceedings of the 2007 Winter Simulation Conference*, 1252-1260.
[6] Chun Wai Hon, Wai Tak Mak R., “Intelligent Resource Simulation for an Airport Check-In Counter Allocation System”. IEEE Transaction on Systems, Man, adnd Cybernetics – part C: applications and reviews, vol. 29, no.3, august 1999.
[7] Guizzi G., Murino T., Romano E., 2009 “A Discrete Event Simulation to Model Passenger Flow in the Airport Terminal”. Proceedings of APPLIED COMPUTING CONFERENCE 2009 (ACC '09). ISNN: 1790-2769.
[8] Michael Johnstone, Vu Le, Saeid Nahavandi, Doug Creighton, 2009 “A dynamic architecture for increased passenger queue model fidelity”. Proceedings of the 2009 Winter Simulation Conference. 978-1-4244-5771-7/09 ©2009 IEEE.
[9] Baldwin, R. O., Davis, N. J., Midkiff, S. F. and Kobza, J. E. 2002. “Queueing network analysis: concepts, terminology, and methods”. The Journal of Systems and Software 66: 99–117.
[10] Bitran, G. R. and Morabito, R. 1996. “Open Queueing Networks: Optimization And Performance Evaluation Models For Discrete Manufacturing Systems”. Production And Operations Management 5(2): 163-194.
[11] Hanisch, A., Tolujew, J., Richter, K. and Schulze, T. 2003. “Online simulation of pedestrian flow in public buildings”. Proceedings of the 2003 Winter Simulation Conference, ed. D. Ferrin, D. J. Morrice, P. J. Sanchez, and S. Chick, 1635-1641 vol.2. New Orleans, LA: Institute of Electrical and Electronics Engineers, Inc.