AGILE SOLUTIONS & DATA ANALITICS FOR LOGISTICS PROVIDERS BASED ON SIMULATION

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ABSTRACT

The current advances are enabling the development of new solutions in data analytics and decision making in many fields; it is quite interesting to analyze the impact of this approach on logistics providers; this paper proposes examples of these challenges in this context as well as an example of a *simulation based solution* able to interconnect the different information sources and to fuse the data in order to analyze the logistics processes and support decisions. The proposed solution is based on web services and web application that are adopting the MSaaS concept (Modeling & Simulation as a Service) by using stochastic models.

Keywords: Logistics, Smart Planning, MSaaS, Stochastic Simulation, Web Application

1 INTRODUCTION

Logistics is a quite challenging framework having to deal with multiple requests operating in different frameworks in contact with real world and being subjected to very quick changing boundary conditions; sometime it is said that logistics is a function in industry that is quartered by other major company functions.

In facts logistics providers are usually acting on a very competitive market for supporting industries and business sectors (e.g. Retail) in order to guarantee supply chain operations and quality (Blackwell 1997; Chopra et al. 2001; Bolstorff et al. 2003; Bruzzone et al. 2004; Wenjing et al. 2010). The companies take care of external and/or internal services such as truck transportation services and warehouse operations and they need to adapt to the expectations and requests of different customers (Bang-Ning Hwang et al. 2013) also taking into account reverse logistics (Longo, 2014). So, as happen for all service providers, the logistics operators need to quickly adapt processes, procedures and rates to market evolution taking also into account technological and demand changes. From this point of view the evolutions in ICT sector and infrastructures is a very important enabler in this sector, providing great opportunities to improve the service and react dynamically to change requests (Perakovic et al. 2017).

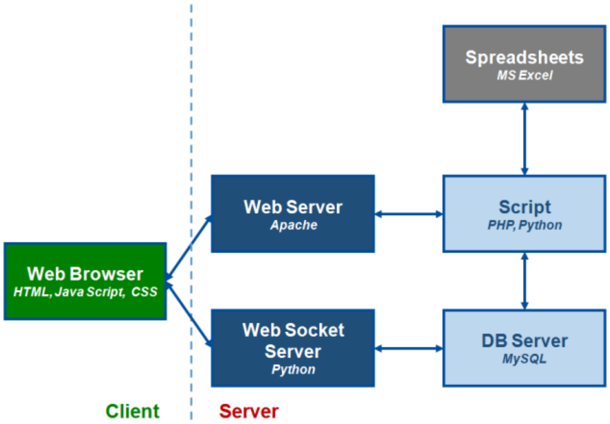

Fig.1- MSaaS Architecture and ALLONS Components

For sure data analytics is a very popular subject, therefore to success in this area it is necessary not only to collect and analyze data, but also to make them consistent and usable to represent correctly the different components of the logistics processes. In addition today there is a big issue in letting the users and decision makers evolving in adopting innovative models and solutions in data analytics, so support in terms of education and training in this area is very fundamental.

In facts, the evolution of logistics processes along recent years has been strongly influenced by enabling technologies including mobile solutions, IoT and cloud techniques; from other point of view the market situation required logistics providers to adapt increasing responsiveness, flexibility and efficiency as well as to cover new markets (Voss et al.2017).

So, this paper proposes an approach based on Modeling and Simulation (M&S) that use stochastic simulation and web application to provide easy and immediate access to models able to correlate the available data and to improve the analysis capabilities devoted to support logistics decisions. The use of mobile solutions and web applications allows to extend the opportunities for education and training (Massei et al. 2010; Lukosch et al. 2016); so the first proposed use is intended for Education and Training adopting multiple platforms such as smart phones and interactive virtual exercise classes.

In general this approach is applying to the MSaaS concept that allows to provide simulation to users as a web service directly integrated with the different Systems) and databases (Siegfried et al. 2014).

2 DATA ANALYTICS IN LOGISTICS

Today "data analytics" is a very popular subject and, in some occasion, it turns also into a buzz word quite fashionable respect traditional "data analysis" (Bryman & Hardy 2009; Kadel 2010); therefore it could be improper to simplify just accepting this point of view considering that the reality is much more articulated and complex: the modern ICT (Information and Communication Technology) & IoT (Internet of Things) systems, the networks and web services structure have been evolved enormously regarding a decade ago (Press 2016). This means that many new opportunities emerge in data processing: for instance, even if the information on the basic cartography has been already available way since decades (e.g. GIS), today the Database is much richer and extended, at very low cost, with many additional data sets, kept "fresh" and immediately accessible (e.g. traffic jams, access regulation, public transportation connections, other level of details); these considerations are worth practically for all various sources of data (e.g. traffic monitoring, vehicle tracking, consumptions, company costs, etc.) and services (Bruzzone et al. 2004; Davenport et al. 2012; Kitchin 2014; Amini et al. 2017,). The direct and economic accesses to this enormous amount of data represent an very big potential to develop an effective understanding of company reality including capability to evaluate dynamically the process efficiency, the values over chain, the customer behaviors, the real operational costs and times, etc. (Zhao et al. 2017). From this point of view, these data are very valuable, therefore they often result pretty hard to be computed and analyzed due to the high level of details and the size of the dataset. For instance, in the analysis of a truck company as in the case we are investigating, it could be very interesting to correlated the consumptions and operational costs with the waiting times at customer pick and drop off sites to identify most profitable services; therefore this analysis requires to be able to define each single truck mission exploded in its subcomponents considering that often it includes multi customers combining and overlapping the relative services (Johansson et al. 2014). This simple example points out the necessity to process a large amount of data (many missions), to fuse different detailed data source (e.g. travelling time, invoice records, site locations, shipping documents), to develop models to create new records (e.g. algorithms to distribute refueling costs over multiple missions, criteria to attribute mission delay among served customers, etc.). The conceptual complexity as well as data dimension require to develop and/or access multiple algorithms, methodologies as well as software solutions. Therefore, considering that often the data are incomplete, inconsistent and require to correlated database characterized by different granularities, it results evident the necessity to develop articulated models able to identify and process the raw data and to fuse them for being usable in the analysis (Castanedo 2013).

Today, it is possible to address these challenges thanks to solutions that allow to access and interoperate with different databases, web sources and services, physical devices, for instance mobile, in a way that was mostly inconceivable just few years ago (Liew et al. 2015).

So it turns evident that the "Data Analytics" is much more than a buzz word, representing a pretty new computational capability enabled by modern technologies and data sources (Cooper 2012); indeed this research is focused on this aspect in relation to logistics providers. In facts the main objectives include the development of models, algorithms and procedures devoted to be able to practically support decision making and planning in complex scenarios dealing with logistics companies. Indeed the modern MIS (Management of Information Systems) and web services guarantee a quite effective and efficient access and extraction to databases, supporting quick elaboration of the information for finalizing analysis devoted to support operational management and strategic decisions (Longo 2013; Hu & Sheng 2014). In this research, these concepts are addressed pragmatically using a real case study to validate and verify the proposed approach; in facts the problem addressed is related to a company that expanded largely within one year: from just 60 trucks addressing a single service on a single district to a fleet tree times large operating over different logistics sectors in a much more wide area.

3 LOGISTICS VS. TRANSPORTATION

It is not rare in several context to register a quite high degree of confusion between the logistics and transportation concepts respect expert's definitions (Kasilingam 1998); sometime this is due to historical reasons related to Institutional approach; for instance in some Countries the Institution in charge to define Strategies in Logistics is a National Department dealing with new infrastructure constructions so it address the problem without a common picture combining the different element of supply chains and combining cargo and passage flows (Maggi & Mariotti 2012). In any case, it is evident that transportation is usually a main component of logistics, therefore it is also clear that the supply chain operations are not limited to these activities. Logistics require not only to move something from Point A to Point B, but also to determine: When it have to be moved, How to move it, How to Load and Unload on vectors, the Synchronization of potentially different vectors to plan a set of multi modal transportations (e.g. heavy haul, railways, ships, barges, air transportation), etc. (Christopher 2016)

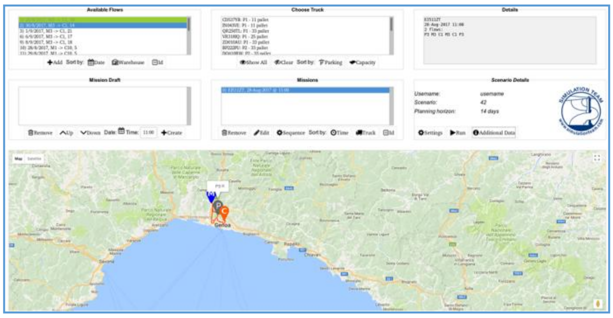

Fig.2- ALLONS Simulator Interface

In facts, the confusion between Logistics and Transportation concepts is a potential sources of problems, especially at High Level (e.g. National Departments), considering that strategic investments going to renew and expand transportation infrastructures could miss the real logistics needs.
For instance, in Italy there is a case where a new large port was constructed from *tabula rasa* in South Italy on a place almost disconnected from other networks interconnecting the Country and Europe (e.g. no effective connection both on railways and highways) just to serve an hypothetical new steel production facility planned for this site and expected to be the largest in Europe (Gironda 2011).
This new port was totally isolated in terms of logistics and even the steel production plant was planned without a view about the global supply chain for steel, resulting in canceling the plant project and dismissing the new port. After several years a very convenient bid allowed to resume the ghost port, assigning almost for free it to private operators that used it for creating a new Container and Ro-Ro Terminal devoted to serve as transshipment facility; obviously the new use was quite successful for the private operator due to the free availability of the basic infrastructure and considering that the transshipment was emerging in logistics context; vice versa, considering the huge initial investments, the low margins and fall-out of this kind of logistics operations, it is evident that the public investment strategy resulted completely wrong and ineffective in terms of overall country development as well as return of investments. The error was due to many aspects, but for sure improper models and data analysis have been in used in such case; in facts, the analyses show that for an European port, it is almost impossible to be profitable without a strong interconnection with global logistics (Adolf & Liu 2014); if the port is not well connected, it could survive by turning into a mere exchange point providing transshipment services (Notteboom 2004).
Therefore these solutions that could be able to attract large logistics flows, have to face very harsh competition with strategic facilities, often more convenient for basic geographical reasons.
For instance considering that the European imports are around 37% and over fifty percent over Sea almost all arriving from East Suez Channel (7.5% of world ocean traffic) excluding Cape route usually dealing with very large bulk cargo (WSC 2007; Eurostat 2016 & 2017; Schuler 2016). So under this global conditions, the Port Said and Tangier ports, corresponding to the two forced gateways (Suez and Gibraltar) to access Europe from this route have a very challenging advantage respect almost any other port for transshipment operations, reducing further marginality of potential competitors in this sector (Yetkili et al. 2015; Benhayoun 2017).
To succeed in this context it is necessary to have a view related to the whole supply chain and logistics networks and not to get lost in single node or specific transportation service (Bruzzone 2002). Obviously these main considerations are true also for logistics companies dealing with inland transportations, considering the necessity to serve logistics nodes in the network interconnected with other elements (e.g. ports, rail terminals etc.) even if from the single company point of view the business is limited just to trucks.
In the proposed case related to North Italy Region, within South Europe, the main issue is not to determine the most convenient path between two towns such as Genoa to La Spezia (in this case there is only one in practice) or between Savona to Milan (in this case may be just two are suitable); vice versa the real question is to define the frequency of the service (e.g. daily, each other day, two times per week, etc.), to define when to carry the transportation (e.g. Monday & Wednesday vs. Tuesday and Thursday), to choose the vector solution (e.g. a big tractor-trailer once per week or two medium size lorries two times), to decide to cross a Distribution Center or to use direct service. These are the real issues to be addressed in terms of logistics and it is important to outline that this does not diminish the importance of Operational Management techniques and simulation, but it is evident that the problems where to apply these methods are quite different from classical shortest path or TSP (Travelling Salesman Problem) and pretty challenging adding usually time to space in terms of investigation range for finding the "optimal solution" (Ayers 2001; Donati et al. 2008). The dimension of the problem as well as the nature of the constraints and resources usually make it very hard to finalize an optimization by simplified approaches introducing the necessity to develop heuristics and to use simulation for "optimization" (Monks 1996; Gousty 1997; Bruzzone 2002). Therefore another very important aspect in this sense is related to the nature of logistics processes that are dealing with external environment (e.g. delays at source and destination, general traffic, weather conditions, equipment failures and problems, etc.). Indeed it could be also considered the impact of safety regulations and issues, especially when fresh good or hazardous material transportation is concerned (Fabiano et al. 2005; Bruzzone et al.2014b). In this context stochastic factors are very important, so it could happen that there is not a "optimal solution", but several alternatives characterized by different statistical KPI (key performance indexes) with specific risks and opportunities levels. So the optimization concept in these problems is very specific and it requires to move

away from traditional linear programming or theoretical analysis that does not consider these confidence bands and related risks. In addition to the above issues to be addressed, obviously there are many other ones dealing with the logistics demand (Pendyala et al. 2000); for instance a very crucial point is to identify the customers to be included into a mission, the sequence to adopt in serving multi-pick and/or multi-drop locations, the way to use personnel in loading/unloading, the equipment selection and use mode (Livernash & Heuer 2003).

Based on these consideration it is evident that dealing with logistics means to address a much more complex problem respect the basic transportation A to B. In this sector there are many constraints to be considered including technical aspects (e.g. vector capability to maintain temperature for refeer cargo considering number and duration of drop-offs), infrastructures (e.g. truck accessibility respect road network), temporal windows (e.g. urban access timeframe, customer timetable for accessing facilities), traffic (e.g. crossing urban areas out of rush time), costs (e.g. fees and costs of the service), legal regulations (e.g. maximum active work time for drivers, number and duration of rest stops, HACCP constraints), quality (e.g. service level, timely, responsiveness, reliability). Indeed the goal of this research is to develop solutions able to support management and process control as well as strategic decision making within logistics companies operating truck fleets based on the dynamic data and information.

4 SIMULATION AS A SERVICE

The MSaaS (Modeling & Simulation as a Service) foundations are quite consolidated despite the recent fortune of this acronym deriving from evolution of Cloud business, therefore it is evident that the adoption on innovative architecture and environments is usually required for properly addressing Service Oriented Architecture (Tsai et al. 2007). In facts MSaaS concept turned popular with the diffusion of Cloud approach as a way to provide these services in effective, flexible, efficient and maintainable (Cayirci 2013). In this sense the adoption of MSaaS is supported by adoption of standards and guidelines supporting reusability and interoperability as well as by creating an effective VV&A support for the models and simulators (Balci et al. 2009; NMSG 2016); in facts by this approach it becomes possible to develop M&S Services for specific applications and domain and to carry out the simulation within distributed environments and it could be interesting to combine it with MS2G Paradigm (Bruzzone et al.2014a).

5 AGILE SIMULATION SOLUTION

As anticipated, delivery of goods is one of main parts of economy and delivery planning is one of its key aspects. In the past, the planning was performed mostly manually, therefore today the planning software is pretty diffused to improve the logistics process control, reduce costs and offer to customers better quality of service. In facts the motivation of this R&D (Research and Development) activities is originated by the need to create a new platform independent simulator supporting multiple purposes from Education and Training of logistics planners into data analytics and to directly provide logistics planning services and operation supervision; obviously this application serves as first step in developing useful decision support systems for logistics providers. ALLONS have a big potential as decisions support serving for completing a priori analysis on new logistics solutions and could provide Reference Baselines to be used during setup, ramp up and production times to verify if the expected results are achieved as well as best corrective actions and improvement opportunities (Fawcett & Cooper 1998)

The simulator proposed hereafter, titled ALLONS (Agile Lean Logistics Network Simulator) and its architecture have been developed specifically to get benefits from advances in web services and new ICT solutions in order to be able to address the current needs of logistics providers that are looking for reliable, intuitive, economic and flexible solutions. In this sense the simulation is by itself the fundamental enabler to develop agility within logistics acting on multiple streams. For instance in many Countries as in Italy there is a great need to diffuse a scientific approach to management and logistics based on techniques and methodologies that are just partially mastered (or even known) by many managers and operators in this area (Bruzzone et al. 2007). The opportunity to provide a framework to support Education & Training of concepts, criteria, methodologies by experiencing them directly into a synthetic environment is very interesting for these companies. ALLONS simulator is in use with students from engineering classes and professional courses for experimenting and evaluating his potential for Educations and Training (E&T). In addition, the proposed simulator could be easily integrated with open data coming from multiple sources in order to turn easily into a decision support systems for planners and executives in logistics companies; this capabilities could enhance the competitiveness especially for small and medium size companies and the authors are testing and validating this approach in enterprises that operates from few dozens of trucks to hundreds. As anticipated, ALLONS is based on web technologies and allows to provide simulation as a service; in facts, ALLONS is enabled to operate on LAMP server (Linux, Apache, MySQL, PHP) and server-side Python modules to execute simulation, indeed it contains Apache Web Server, DB MySQL, PHP scripts and simulator written in Python. The database includes multiple data, such as customers (e.g. id, company name, address, coordinates, delivery contract type, cluster, delivery hours, accessibility constraints, statistical data on the demand etc.), fleet (e.g. truck register plate, capacity, speed on highway and normal road, consumption, reference parking, maintenance, assurance & depreciation costs, etc.), logistics nodes and warehouses (e.g. id, address, coordinates, etc.), parking locations (e.g. id, address, coordinates, etc.) and routes (e.g. total distance and route steps obtained from Google Directions API), etc.. PHP is used for server-side scripting and it supports main activities such as database connections. Currently an Apache Web Server guarantees communication between client and server through HTTP (Hypertext Transfer Protocol), being designed to operate also on secure networks. ALLONS Client include planning capabilities and it is implemented in JavaScript with additional libraries such as jQuery which is executed in web browsers, while the GUI (Graphic User Interface) is designed in HTML: (Hypertext Markup Language) and CSS (Cascading Style Sheets) to guarantee immediate and extensive reusability over multiple platforms and Operating Systems. Hence, ALLONS is platform independent and is supposed to be capable to run in all modern web browsers, furthermore CSS performs resize and change of position of interface elements based on screen resolution of user's device allowing ALLONS to run on any platform and devices. This is very important to make the simulator able to be used with different screen size, from smart phones, tablet as well as on regular personal computer with big screen. Connection between clients and server is managed by Apache web server, while data exchange between client and PHP scripts, which are required for data acquisition from central database and some auxiliary calculations, is performed using AJAX (Asynchronous JavaScript and XML). This architecture allows ALLONS to carry out operation supervision and planning operating remotely just using the network. Therefore to improve reliability in distributed use, several information about terrain, costs, routing are downloaded on the client at the scenario creation in order to be able to continue to conduct planning and simulation even in case web network failure, obviously without the capability to upload on the server the solutions until the connection is back on. To complete the planning, the users are enabled to select the logistics flows to be processed as well as the vector (e.g. truck), timetable (e.g. time and date of departure from initial parking) and the AIM (Artificial Intelligence Module) of ALLONS performs a preliminary check on the logistics constraints (e.g. delivery time, time windows, access constraints, etc.). These data are necessary to create the different missions that compose the whole planning; each mission include the path of the truck from original parking to each logistics node required to complete the pickups and each customer for dropoff as well as to return back. As anticipated, during the mission creation, ALLONS verifies mission consistency by checking several aspects such as:

- Truck capacity to carry the quantities corresponding to the selected flows
- ETA (Estimated Time Arrival) to logistics platform and customers is consistent with their time table
- Preliminary estimation on delivery costs.

After all preliminary checks and computations, ALLONS carries out the simulation on the whole planning or on a subset including stochastic factors and replicating the experiments to measure the confidence band on the Key Performance Indexes (KPIs). ALLONS includes among the different KPIs: mission duration, mission costs, delays, vector saturation, service level, respect of the different constraints, etc.

$$SLa(t,s) = \frac{\sum_{i=1}^{n} |Fpa_{de}(t,i) - Fpa_{dr}(t,i)| \cdot Ap(i,s)}{Dt'^{(t,s)}}$$

$$SLc(t,c) = \frac{\sum_{i=1}^{n} |Fpc_{de}(t,i,c) - Fpc_{dr}(t,i,c)|}{Dt'(t,c)}$$

$$Fpa_{de}(t,i) = \int_{t_{low}(t)}^{t} de_i(x)dx$$

$$Fpa_{dr}(t,i) = \sum_{k=1}^{Nm} \sum_{j=1}^{m_k} do(i,k,j) \int_{t_{low}(t)}^{t} do_{k,j}(x)dx$$

$$Fpc_{de}(t,i,c) = Cpe(i,c) \int_{t_{low}(t)}^{t} de_i(x)dx$$

$$Fpc_{dr}(t,i,c) = \sum_{k=1}^{Nm} \sum_{j=1}^{m_k} Cpd(j,k,c) do(i,k,j) \int_{t_{low}(t)}^{t} do_{k,j}(x)dx$$

$$t_{low}(t) = \begin{cases} t \le t_0 & t_0 \\ t > t_0 & t \end{cases}$$

$$Ap(i,s) = \begin{cases} l_i \in s & +1 \\ l_i \notin s & 0 \end{cases}$$

$$do(i,k,j) = \begin{cases} l_i = des(k,j) & +1 \\ l_i \ne des(k,j) & 0 \end{cases}$$

$$Dt(t,s) = \sum_{i=1}^{n} Ap(i,s) \int_{t_{low}(t)}^{t} de_i(x)dx$$

$$Dt'(t,s) = \begin{cases} Dt(t,s) = 0 & +1 \\ Dt(t,s) \ne 0 & Dt(t,s) \end{cases}$$

SL(t,s)	Service Level at t time over s area
t	time
t_0	time at simulation start
t_{low}	low value of time window used to computer SL
Δt	time window amplitude (usually set equal to t)
n	number of the demand elements
m_k	number of drop offs of the k-th mission
Nm	Number of missions
$de_i(x)$	i-th demand at x time
$do_{k,j}(x)$	j-th dropoff of k-th mission at x time
des(k,j)	location nof the j-th dropoff of the k-th mission
Cpe(i,c)	check [0,1] if the i-th demand belongs to c-th customer
Cpd(j,k,c)	check [0,1] if the j-th dropoff of the k-th mission is addressing the c-th customer
do(i,k,j)	check about the fact the j-th dropoff of k-th mission addresses i-th demand

s	Subset of the overall region
l_i	Location of i-th demand
Fp(t,i)	Demand Satisfaction at t time over i-th demand
Ap(i,s)	Presence of i-th demand within s area
Dt(x,s)	Overall Demand over s area at x time
Dt'(x,s)	Corrected Overall Demand on s area at x time

To perform open tests of interface's usability and planner's functionality the authors created a public available database inspired to real cases.

For E&T applications the logistics flows are generated based on the statistical data related to customer demands by using Park-Miller PRNG (pseudo-random number generator) at the start of the session; indeed the scenario generator uses the customer data available in central database and creates the flow by considering the statistical momentum of the statistical distribution used for representing the logistics demand in terms of pallets ordered; in addition the generator could change service model (e.g. same day logistics service vs. 2 day lead time) and other parameters (e.g. peaks on weeks, average quantities).

ALLONS provides all data to conduct design of experiments and other analysis techniques (Montgomery 2008). This approach guarantees also the possibility to reproduce the same scenario multiple time keeping active the stochastic elements for crowdsourcing purposes based on collaborative and competition within a large community of people involved in using the simulation to find an “optimal solutions” (Mascagni 2016); in this way it is possible to generate a sequence of value that allows to reproduce the scenarios and validate potential choices from the users and customers in comparative mode. It's important to mention that all complex procedures like generation of flows are server-side, leaving for a browser only parts required to provide communication with server and implement user interface; this approach guarantees confidentiality of the inner models and parameter tuning in case of business applications.

The core of ALLONS is the simulation engine which allows to simulate the partial and complete planning considering the stochastic nature of flows, transportation and logistics operations; the simulation engine estimate the results of the execution on planned missions and evaluate KPIs and related risks. In facts to make the scenario even more realistic, the simulator creates stochastic events, for example driver could 'decide' to make a long break otherwise several short because his fatigue is increasing during work time. Another important aspect of functionality is intelligent correction of missions, for example if during loading at a warehouse the amount of pallets to be elaborated in current mission is higher than truck's capacity, mission is reprogrammed. It means that quantity of pallets which must be delivered is reduced reprogramming flows beginning from the last one in sequence, otherwise entire flow could be excluded from the mission. Mission planning horizon could be very long, for example several weeks, so to reduce calculation time and load of server discreet-event simulation is used. However results must be visualized in scaled real-time, so additional module for visualization is required.

So the ALLONS proposes the results of simulation in log window as text and on map updating them using timer.

Hence one hour or delivery is visualized always in the same amount of time, for example in 10 seconds.

To execute simulation in server and visualize results in browser real-time full-duplex data exchange must be provided; however due to limitations of HTTP(s) this task could not be performed using web-server only and additional communication protocol must be introduced. In presented case, this problem has been solved by using web-socket server.

This choice is due by the fact that modern browsers have native support of this technology and mainstream high-level programming languages could use web-socket modules and libraries to support it. Due the fact that simulator is developed in Python, most documented and supported technologies, such as Autobahn implementation of the protocol and Twisted networking engine, have been adopted. However the protocol itself allows to integrate into project additional modules in Python, Java, C++ and most of popular high-level programming languages.

As mentioned this communication protocol allows to operate in real-time; so by this approach users are enabled to interact with simulation during the execution and receive and visualize dynamically its results as soon as they are available, further improving ALLONS responsiveness.

6 CONCLUSIONS

As mentioned, ALLONS could be used not only for commercial delivery planning, but also for educational purposes; in facts by activating the auxiliary module it's possible to produce self assessment and evaluation of the planning as well as additional result of simulation. The planner provides a comprehensive analysis of the performance evaluating, among the others: percentage of flows successfully satisfied, fuel consumption and costs, early arrivals, delays in deliveries, truck overloads and other factors which affect customer satisfactory.

After simulation results these results are in databases, allowing the instructor, as well as the trainee, to compare efficiency of planning before and after training course.

The same stochastic scenario generation features permits to create exercises for large classes required to compete in finding best solution on a specific automatically generated case studies as well as to learn to collaborate to find a global solution by applying crowdsourcing (Brabham 2009).

In business use, the simulation results represent the crucial element to reconstruct partial data and obtain reference values for KPIs about future planning to be used to control the logistics processes and to obtain a competitive advantage.

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