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A PLUG AND PLAY WEB-ENABLED SOLUTION FOR SUPPORTING SMALL HAULIERS COLLABORATION

Small hauliers enterprises are ever more requested to work with very fragmented freighis that have to be delivered in a continuously decreasing time. Besides, their monitoring capabilities are not compliant with the market requests, that asks for continuous freight updates. Small hauliers are still not able to efficiently monitor their trucks and to organise their freights so that it is possible to optimise the load composition, reducing costs and increasing quality. Thus, it seems to be necessary a certain degree of collaboration with other small hauliers in order to gain the necessary business competitiveness.

We here describe a "Virtual Fleet" WEB based service where small and independent hauliers share some resources (trucks) in order to reduce time wastes and costs. They can asks for goods delivery or declare their free resources to the Virtual Fleet. A WWW site collects the requests/declaration and computes the optimal plan to be proposed *to the Virtual Fleet and* negotiated *among hauliers.*

Introduction

Small haulier appeal Vs. business feature

In the global transport market, enterprises survival is strictly linked to their capacity of reacting quickly to the demand of new services with three fundamental features: quality, low costs and monitoring capabilities. Moreover, it is becoming necessary to manage ever more complex and quickly changing services. Planning, control and management of freights, logistics, resources and performances are just the major tasks to ensure the desired appeal level of the company.

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On the other hand, new technologies are for the first time available to every company at low prices. For the first time, it is now possible, for SMEs to really exploit the WWW, now able to support the increased necessity to exchange information with the working partners. For the first time it is possible to join all the actors belonging to the logistic process at low prices with easy to use tools. This already happens (or begins to) for big logistic companies, but it also exists a transport world consisting of very small haulier companies (even single-truck owner) that act into this changing environment with increasing problems.

For such companies, it is difficult to accept the market changes. They do not perceive the extremely high risk to renounce to their independence due to their reduced business competitiveness. Anyway, they are expected to survive still for a long period due to their incredible working capability. They can usually rely on a strong friendship with their customer or partners. In Europe there are many industrial cases where such kind of haulier are very diffused.

This old working style is not business attractive, to be a small haulier with a few trucks forces the company to have high costs. Anyway, it has some interesting features that should be maintained. In many cases, it happens that it is necessary to have a friendship with haulier customers. Especially when also the customers (typically small resellers) are of small dimension, the loading-unloading procedures usually need very skilled personnel. In those cases, drivers are expected to be able to do unusual activity. For example, they are asked to be able to use elevators. It is not so rare the case where they even have the keys of the warehouse.

All of these skills and competencies (as well as reliability) cannot be easily founded in big fleets. Their employees respect fixed working rules and are not available for extra-driving activities.

This is the power of small hauliers. They are available and able to give a high added value to their service. This gave to them the possibility to survive till now. It could be not sufficient for the future. This is the starting point for what we will say in this paper: we aim at giving to small hauliers the necessary competitiveness as it is required by new economy, without losing their working peculiarity and without introducing excessive and traumatic changes in their working style.

The small haulier needs

Considering the transport Enterprises acting in the previous scenario, it is possible to understand the growing number and variety of jobs that are in charge of their internal and limited resources. In order to get a better control of their network and simplify the daily activities of managers and employees, the market

of the Information Technology is providing many and different solutions. Nevertheless, in majority of such IT solutions have been mainly conceived for big enterprises, which may afford the IT tools employment by means of dedicated laboratories or divisions. A bigger effort is required to the developers in order to provide the desired technological support to the SMEs, and this requires solutions particularly customised to the low investment capability of the target companies, that means reduced costs for the support system and easiness of use for the end users. Moreover, such hauliers rarely have access to complex monitoring devices and fleet management system GPS based. This reverberates on their quality standards.

The support of the Information Technology to a network of hauliers

During last years different models and tools have been developed to allow the management of big fleets. Nevertheless, they base on the assumption that the company that uses such models and tools is the same. The use of such systems for fleet management implies new working procedures that are tuned on particular needs. This approach discourages the small hauliers, they do not usually trust in too heavy working style revolutions.

Thus, our main purpose is the definition of a model that allows to obtain the best results without force anything. During TROP project (IST-1999-20277), we introduced the concept of Virtual Fleet. This paradigm has been inspired by Virtual Factory concepts [1]. We base the model on the assumption that many independent hauliers have the possibility to optimise their freights if sharing some resources (i.e. trucks). If so, we are able to set up a WEB site that allows to manage the resources that they decide to share. The idea is that each haulier that joins the Virtual Fleet is not forced to work with the Virtual Fleet, it continues to work as usual but, if needed or if convenient, it can ask for services or offer services to the Virtual Fleet. The success key is the easiness of the service use.

In order to be accessible and useful to each haulier of the virtual fleet, it is necessary the usability and the adaptability of the model and of the tools to be adopted when joining the network. In fact, the smaller is the effort for joining the network, the higher will be the probability that a node decide to share its resources, increasing the competitiveness of both the Virtual Fleet and of the single haulier. This will start a positive feedback process that is the key fort Virtual Fleet success. If this does not happen, if the effort to join the network is too high, each haulier will be discouraged and the Virtual Fleet will not become a matter of fact.

The Sassuolo case

During TROP project (IST-1999-20277) we test Virtual Fleet paradigms and tools on a real case. This experiment bases on a significant industrial district in the North of Italy. The Sassuolo ceramics district represents the 18 % of the world-wide production of tiles. In the same district (a limited area similar to a rectangle 10 × 20 Km), there is a huge presence of tiles factories (ceramics) and of small hauliers. Particularly, as regards hauliers size, they typically manage from 5 to 10 trucks. This small size reverberates on optimisation problems. They are usually forced to go into a tile industry warehouse to load a few pallets, even if the average load time is very long. This is certainly a problem that would be dramatically reduced if belonging to a Virtual Fleet. It would be possible to send a single truck to warehouses and share its load space among various carriers.

In the following, it is showed the Sassuolo case working phases.

- Customer Order. The customer orders the tiles to the ceramic company. They agree on delivery due date. The first time that a customer makes an order to a company, it usually specifies the haulier to be called.
- Haulier Advise. The ceramic company advises the specified haulier, telling: the quantity, the due date and the customer. This is the usual procedure. But, sometimes, the customer calls the haulier himself, after he called the ceramic company. Anyway, from this moment, the customer usually calls the haulier specifying the freight due date (for each specific order).
- Driver Dispatch. According to all the incoming customer orders, the haulier management dispatches to driver the various locations.
- Pallets pick up. The trucks go into the ceramics warehouses.
- Freight Definition. Usually, before starting the delivery phase, the trucks have to pass to the haulier warehouse because some pallets need to be transferred among trucks according to freight definition.
- Once the freight has been defined, the trucks start the delivery phase. Note that they can deliver to the customer warehouse or directly to the yard (if already existing).

Where does the Virtual Fleet paradigm can work? In the Sassuolo case, the hauliers limit the collaborations to the loading phase. They complete the freight on their own, but they can ask (or offer) for resources (trucks) during the loading phase. In other words, they ask to other hauliers to bring pallets into their own warehouses and then they manage pallets for the following freights. Anyway,

this optimising collaboration could go on further. They can freely decide to share also delivering phases (6), the system would allow this without any changes.

System architecture

The TROP architecture has been designed in order to enable high customisability degree.

First of all it has to be specified that the network of carriers is completely horizontal. Thus, who physically hosts the servers? How the Virtual Fleet works? The Virtual Fleet has to be considered as service. In the Sassuolo case, it is supplied by LAPAM, a category association that already supplies many services to Sassuolo hauliers.

In the picture, the main modules of the system. Each haulier accesses the service via the site. Each carrier manages its own fleet on its own. The trucks are connected to the system so that it is possible to monitor mission status and trucks positions. The system intelligence, its planning and management capabilities are represented by the Planner and by the Work Flow Manager. Note that this TROP system acts as a Virtual Control Room, it does not require human intervention (except for configuration and maintenance). This forces to adopt clear and simple rules for belonging to the Virtual Fleet. The system behaviour has to be defined according to haulier needs, in order to clearly define what we have called *a Virtual Fleet policy*.

In general, the system can be tuned according to many environmental parameters that

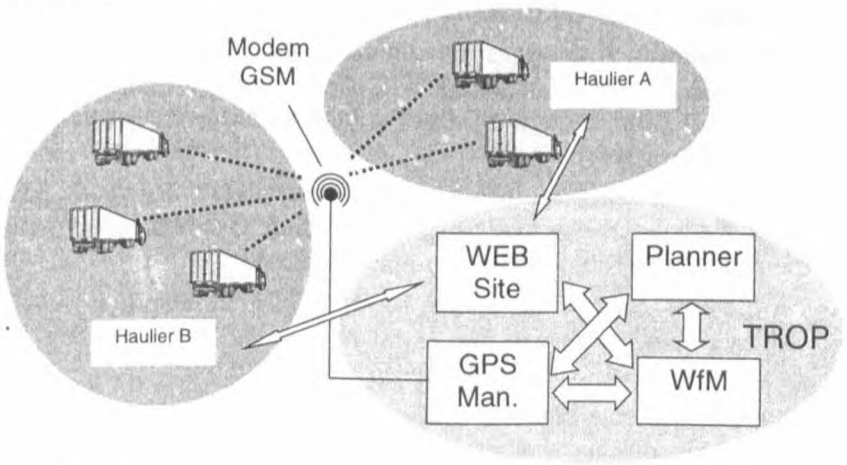

Figure 1

suggest to the Planner the best possible (expectable) working plan. Anyway, this plan cannot force haulier decision. They can freely decide if to follow or not the Virtual Fleet suggestion. Only when an agreement is reached, the system begins to monitor the so called missions. The Work Flow Manager keeps track of all the running missions, of the trucks positions and signals, when needed, events to hauliers. The nature of these interactions depends both on Virtual Fleet policy and on technical equipment. The TROP system is configurable. For example, if the truck has on board a GPS equipment, it will be possible to continuously display its position to the haulier via the WEB site. Besides, each haulier can also use the site to send SMS messages to their drivers. The nature of these messages is absolutely free.

As for the technical point of view, the TROP system is composed of a set of independent HW and SW modules. The whole TROP platform (Planner, Workflow Manager and GPS manager) runs over a Windows (NT, 2000) platform whereas the WEB server can run over the same server or over any other platform (for example a LINUX one) since the site and the TROP platform communicate each other via the TROP Database. This Database can be accessed via a ODBC connection that enables to chose it according to the expected workload and to place it on the most convenient server. For small applications it could be sufficient a Microsoft Access Database, for complex one, we suggest Microsoft SQL server. As for the single SW modules of the TROP platform:

1. The Planner. It is a C++ module that reads the needs and the availability from the TROP Database. It proposes the working plan to the Virtual Fleet.
2. The Workflow Manager (WfM). Basically, it is a Visual Basic module that manages negotiation, workflow and that keeps track of the running mission.
3. The GPS Manager. It manages the communication with the GPS world. It dialogues with the SMS modem and with the Cartography Manager (Mappa Server) allowing the WfM to monitor the running missions and to the WEB server to display maps.
4. Mappa Server. It generates the GIF images that shows the trucks position and allows to determine the geographic coordinates that correspond to a certain address. It bases on a cartography Database.

As for the HW devices, the system needs a GSM Modem that makes the system able to communicate with the on-board devices. These devices can be chosen according to specific needs. We propose two solutions:

1. Magneti Marelli Route Planner. This is a complete route planner GPS based with a graphic display that allows drivers to monitor the routes to be followed, according to assigned mission.

2. E-where. This is a custom module that has an alphanumeric display that makes the driver able to read mission details and to communicate with its company.

The Virtual Fleet effects

How does the Virtual Fleet paradigm impact on single haulier business? First of all, we have to focus on the fact that each carrier can act in two different ways, it can offer services or ask for. This depends on what we called the *haulier attitude*.

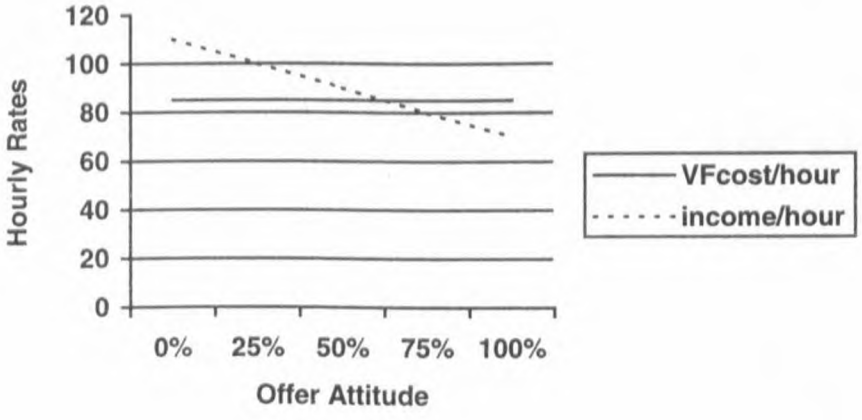

Figure 2

The «Offer attitude» (i.e. the convenience that each carrier has for offering its services to the network) is certainly a function of the costs and of the incomes (hourly) of each haulier. For example, assume that the Virtual Fleet costs 85,000,000 ITL each hour (for a single truck), and assume that the dashed line represents the incoming of a particular haulier (for a single truck working). It is evident that the more a haulier has low incomes, the more it has 'convenience' to offer Virtual Fleet services. When the dashed line goes under the solid one, to offer services to the VF becomes more convenient, for who offers the service, than to work for other customers. The solid line represents what a haulier that asks for Virtual Fleet services has to pay to the Virtual Fleet (i.e. to the haulier that offers the service). It is obviously flat. The offer attitude increases when the incomes of the carrier that offers become low.

It is evident that the income due to Virtual Fleet services is the difference between the Virtual Fleet costs (that have to be considered as earnings for who offers VF services) and the incomes that the haulier would have had if it had worked for other customer rather than for the Virtual Fleet.

In case of hauliers that ask for Virtual Fleet services, this choice becomes as more convenient as the carriers have high incomes when working for other customers. If they can ask for Virtual Fleet services, they can redirect their trucks to other works (more convenient). Thus, if we mix together these two attitudes (offering Vs. asking for services), we have that a haulier has only to choose in which side of the graph in figure 3 would be placed. Its position depends on its working style and on particular needs. Figure 3 shows that the Virtual Fleet incoming could be always over zero. In fact, choosing the right attitude, means to understand if it is convenient to offer or to asks for services, i.e. to stay always on the positive area of the graph, according to Virtual Fleet cost and own earnings. The graph refers to a Virtual Fleet tariff of 85.000 ITL (hourly). Both the lines cross the abscissa when their hourly incoming is equal to Virtual Fleet cost. In that case, to offer or to ask for services does make no difference.

Figure 3 does not take into account that the Virtual Fleet has own costs. To provide

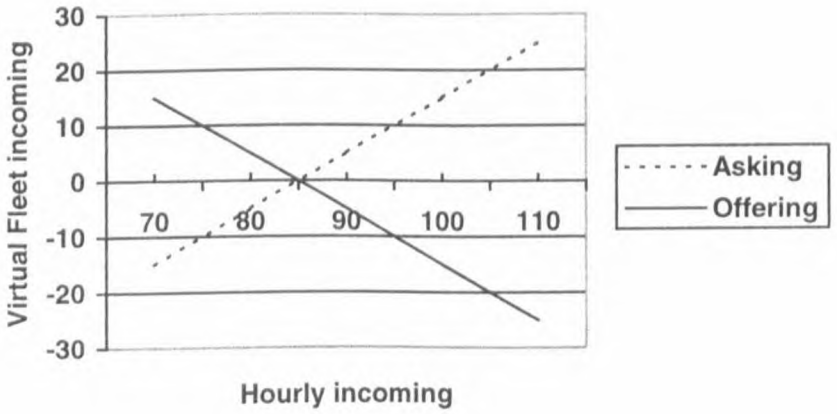

Figure 3

TROP services, necessarily introduces costs. The WEB servers have to be maintained, the communication means (SMS mainly) have costs. Thus, the

organisation that provides the services needs to be paid. If we take into account also this additional cost, a "non-convenience interval" should be introduced into picture 3. As for service costs, we have to distinguish among una tantum and yearly (monthly) ones:

1. On board devices (una tantum). The trucks to be monitored need devices that cost from 800 € to 2000 €, according to offered facilities. These costs are in charge of the single hauliers.
2. Site maintenance (yearly). If the site and the TROP platform run on a server of an Internet provider, it is expected to pay from 5000 to 7000 €. If the Virtual Fleet service provider already has a public IP address (site address) and can autonomously publish the site, it would have only fixed costs (PC and SW licenses).
3. SMS traffic (monthly). Each time a user asks for a localisation of a truck or the system communicates a new mission to a driver, the GSM modem sends an SMS. It is possible to stipulate contract with the phones company so that to reduce the cost of each SMS.

The above costs do not take into account the installation of the TROP system and of the system itself. All of these costs are expected to be recovered by the Virtual Fleet service provider through fees to be paid by hauliers whenever they successfully use the Virtual Fleet services. The entity of these fees has to be computed according to the particular implementation of Virtual Fleet and to the kind of the organisation that provides the Virtual Fleet service.

Conclusions

As for the theoretic point of view it is evident that the Virtual Fleet paradigm is able to improve business performances of each participant to the Virtual Fleet. The technical solution is not the main issue. This is certainly feasible, at low cost. The real problem is the critical mass of the fleet. Only when a sufficient number of collaborations happens, the Virtual Fleet becomes a convenience. Thus, we proposed this *progressive* system that leaves independence without introducing excessive costs.

What could happen if the Virtual Fleet really starts and support these collaborations? If the service supports a high number of hauliers, it could be convenient to set up a new and independent company (for example, participated by the hauliers) that represents the Virtual Fleet that as an autonomous entity.

This new company could act various roles in the transport world. For example, it can represent the Virtual Fleet enabling the small hauliers to have a

louder voice when speaking with big partners. In fact, the Virtual Fleet is able to warrant a service that a small haulier cannot provide.

Going further, this new company could even become more active. It could extend its role to logistic, managing the Virtual Fleet common warehouse. This would even improve Virtual Fleet performances due to additional optimisation.

Summarising, also for this small haulier world, it is possible to greatly improve business by means of IT solution, but the real challenge is not to propose the solution, but to make it applicable (i.e. to obtain hauliers confidence).

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