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TECNOLOGIE DI LOCALIZZAZIONE INTELLIGENTE NELLA PIANIFICAZIONE SPAZIALE E DEI TRASPORTI

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SOMMARIO

In questo contributo, si riflette sulle possibilità e i limiti indotti dall'adozione di soluzioni tecnologiche abilitanti per il riconoscimento ed il controllo dei flussi delle merci all'interno delle infrastrutture e dei nodi di trasporto. In particolare, si discutono le frontiere aperte per la pianificazione spaziale e dei trasporti, nello specifico delle aree portuali, dal connubio tra tecnologie per l'identificazione a radiofrequenze – RFID, che consentono un aumento della conoscenza sui flussi delle merci, e l'utilizzo di sistemi GPS, che consentono una più rapida ed efficiente localizzazione delle stesse all'interno delle reti. Soluzioni basate su tale tipo di integrazione tecnologica risultano utili ai fini della definizione di architetture multi-agente per sistemi di intelligenza localizzativa per la gestione delle aree portuali. L'implementazione di tali sistemi risulta strategicamente valida ai fini dell'aumento dell'efficienza nei sistemi portuali ed intermodali, in linea con i piani di potenziamento dei traffici marittimi, oggetto dell'interesse per lo sviluppo delle Autostrade del Mare e dei Corridoi di Trasporto Trans- e Pan-Europei, nonché ai fini del soddisfacimento dei requisiti di sicurezza, oggigiorno sempre più pressanti, in relazione al controllo dei flussi delle merci in transito.

1 INTRODUCTION

Today, the problem of controlling moving items raises the interests of scholars, in manifold fields ranging form robotics to merchandise. In particular, concerning goods and substances, increasing attention is put on hygienic and large environmental problems. The logistics of the optimisation of item flows along moving and manipulation chains and graphs is a particular approach to such issues in terms of managerial engineering and economics.

Our interest is addressed at the potentials of an intelligent multi-agent approach to optimal logistics of chains, in particular when moving and manipulation operations in such chains are complex and involve environmental risks. Our methodological horizon is hybrid multi-agent modelling, based both on cellular-automata-like propagation phenomena and on phenomena of cognitive interaction of even remote agents.

In our approach, moved and/or manipulated items, in a complex chain managed in artificial-intelligence environments, are activated by agents (passive activation) but meanwhile they are agents in the agent chain (active activation). With such approach, we try to show how it is possible (i) reproduce efficiently and effectively the managerial behaviour of intelligent human agents assigned to chain logistics and (ii) increase the informational and cognitive level of transactions in the chain and through such increase reduce the environmental risks of the chain.

Our study is addressed to parts of manipulation-moving chains of goods, such as the ones characterising intermodal nodes of transportation networks -namely maritime ports- in which it is necessary to perform analyses, decisions and actions. We assume that goods –altogether or in single items- are acknowledged by identification tools like active RFIDs and localised through GPS linkages connected to tags working in the future as intelligent or highly informed agents.

2 FREIGHT TRANSPORT IN MODERN SOCIETY

Freight transport and good distribution have been a fundamental component in the modern changes of contemporary economies. They supported the economic development of industrial countries, allowing their products to reach the final costumers in the tight time required by the market law. The technological improvements related to the availability of modern solutions and ICT have contributed to increase the performances of these systems, conferring transport activities more refined features with reference to efficiency, reliability and security.

Nowadays, the optimisation of the logistic tasks carried out in transport nodes represents a crucial point for the implementation of the distribution systems. The increased competition between manufacturers as well as the opening of the markets at global, regional and local

levels urges operators to increase the efficiency of these systems, in terms of time and money saving for the distribution phases of their products.

The importance of a well running distribution machines is currently seen as not less important as a well organised production organisation. Thus, the attention is gradually focused, instead of the physical attributes of transport activities, in terms of origins and destinations, on how the transport activities are organised. Current trends set transport and distribution chains directly inside the logistical organisations, being the transport activities directly considered as a component of an integrated demand (Hesse and Rodrigue, 2004).

Integrated supply chains require complex control systems, which are able to manage operations of the internal and external supply chains, co-ordinating material management, manufacturing activities and distribution flows. At the same time, the flexibility required for competing in the global market implies the necessary availability of structures for good distribution, which can follow the customers' need and that are, in other terms, directly dependent on the demand. The application of ICT solutions to freight distribution permits indeed conferring higher dynamism to these systems, contributing in conferring the above mentioned flexibility, particularly important to capture the market demand (Hesse, 2004).

Transport flows in modern contexts express the results of multi-agent processes that many times grow over very huge areas, crossing national borders and being set in a day-by-day more unified and trans-national environment. In such contexts, the interoperability between operators assumes a crucial importance, in order to upgrade the system performances, since it eases good and data flows between the agents involved in the supply chains.

The coexistence of many agents in transport and good distribution opens additional concerns on the traceability of products. This is related to the need of manufacturers of a better organisation in the production tasks inside the production plants, for instance, co-ordinating the arrival of different pieces and components which are to be assembled in the production of a more complex item. On the other hand, the traceability of good is nowadays perceived as important to certify the origin and the conditions in which goods were made. Thus, the certified origin of products plays an increasing role in the creation of the added value of the final items sold on the market.

Concerns arising from the existence and the widespread of counterfeited goods create strong opinion movements among customers, who aim to more certified origins of products. At the same time, institutions are increasingly worried about the effects of the widespread of such "grey" products, whose origins and attributes are not well known, or sometimes completely mysterious.

The definition of new international regulations in this field is aimed to give an answer also to these concerns. New rules have been encouraged to protect commercial rights and trademarks against counterfeiting. Besides, they aim at increasing the traceability of goods, especially for foods and agricultural goods, which can be referred to as potential risky for human health, by

certifying their origin and ingredients, as well as proving the treatments these kinds of goods have received during the production cycle (EU Regulations no. 1829/2003, no. 1830/2003). The common awareness of potential risks related to hazardous processes in manufacturing, as of the use of chemical products in agriculture in excessive rates have pursue for a better regulations, which aim tracking the production and distribution of goods, especially for food and beverage (EU Regulation No. 178/2002). People attention on this topic has been much more alerted after the introduction of genetic modified organisms, whose positive effects on the agricultural production are to be judged in comparison with the still unclear effects on human being and on the environment (EU Regulations no. 1829/2003, no. 1830/2003).

Moreover, in recent years the need of more detailed information on good flows is looked as crucial in the definition of measures to adopt to protect national security against terrorism and organised crime. An increased control on supply chain, in conjunction with the modern tools for the identification and for data exchanging, is seen to be necessary to improve the measures for assuring higher levels of security in the distribution supply chain and in freight transport (Lee, 2005). Besides, the adoption of more reliable unified standards for security is desirable (European Commission, 2003).

3 THE EVOLUTION OF TRANSPORT AND SUPPLY CHAINS

The structure and the interrelations within the transport chain of goods has rapidly changed in recent years since the introduction of new Information and Communication Technologies. The challenges that companies have to face in order to cope with efficiency, reliability and stakeholders' needs, did increase hugely due to the globalisation of economy and the increasing rate of competition from some developing countries, especially in the Far East (e.g. China and India). Logistics' cost has always been a huge fraction of the overall cost of a product, and therefore minimising it has been an important goal of supply chain management.

We can define logistics as "the set of activities whose objective is to move items between origins and destinations in a timely fashion" (Daganzo, 1999) and, on the other hand, supply chain management as a process responsible for development and management of the total supply system (Burt, 1996). These wide definitions allow many perspectives through which we can analyse logistics' concepts.

Due to the aim of this paper, it is useful to focus our attention to the highest level of the supply chain, which is the transport chain from production to consumption, analysing the main nodes and flows involved.

A simplified and overall representation could be as follows:

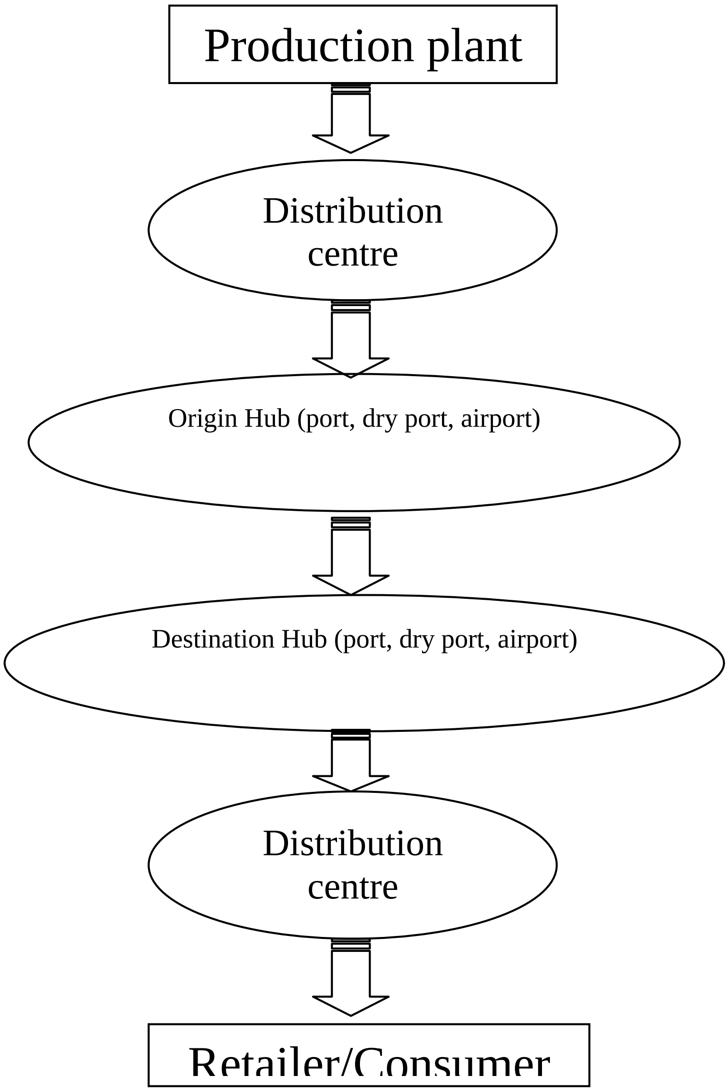


Figure 1 Main nodes in a transport chain

Even in a simplified vision like this, there are many different agents playing a role in the chain. If we start considering the peculiarities of each of the nodes of a supply chain, looking at the different functions and at the different actors involved, we will easily see the complexity of such nodes.

We are now going to consider a particularly complex and crucial node in the transport chain, like a port.

It is possible to group the agents in four main categories (customer, organiser, executor and authority) among which many interrelations occur.

All these agents act on different levels, from the operational one to the strategic one, needing different degrees of responsibility and, therefore, knowledge. In particular it is possible to divide these agents in two clusters, depending on their role, whether it is functional or decisional.

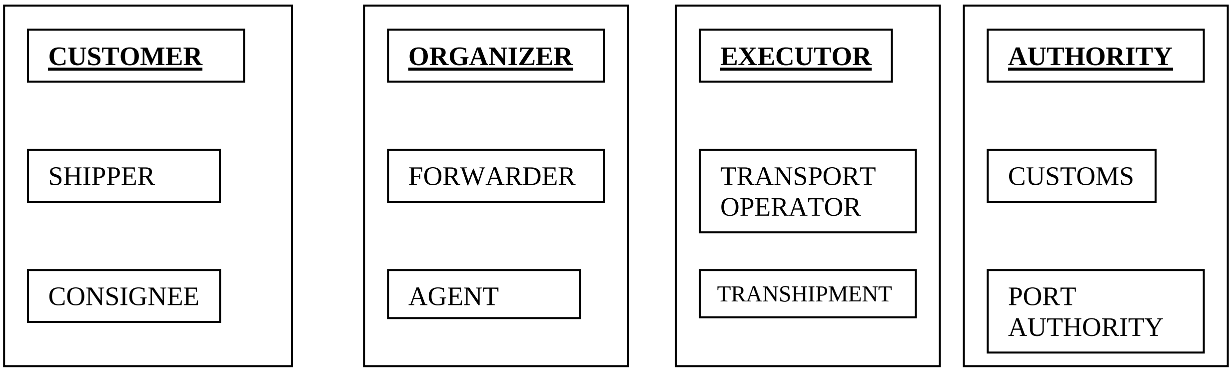


Figure 2 Main categories and agents

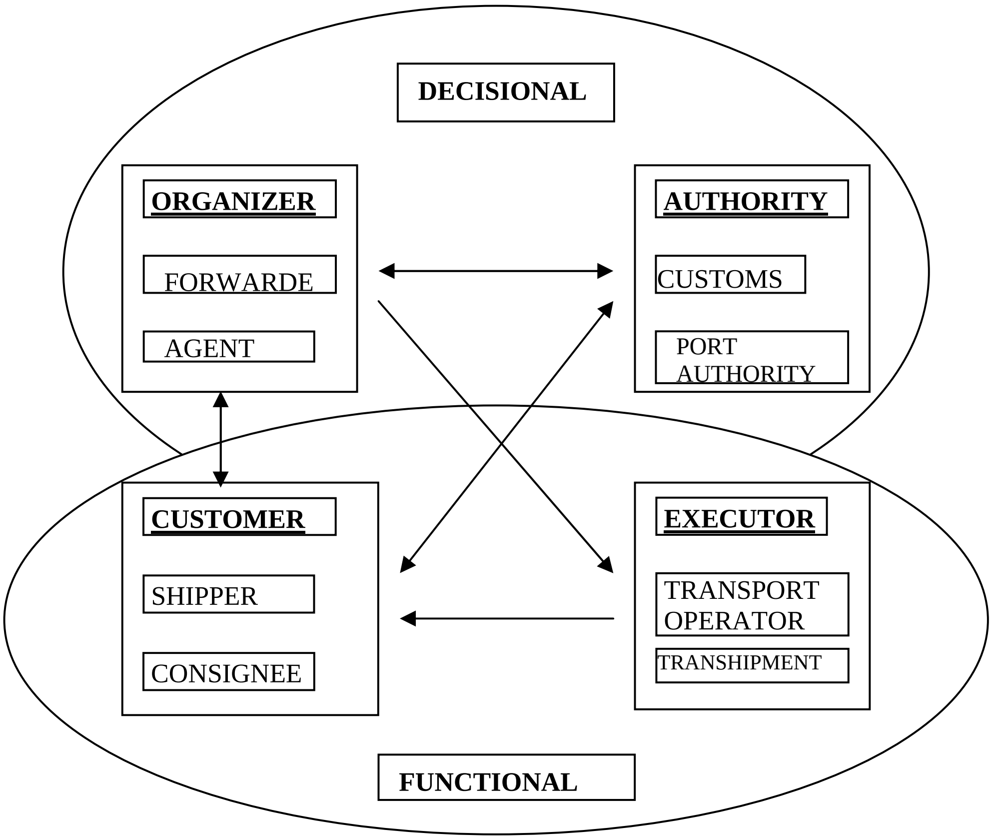


Figure 3 Interrelations and clustering of agents

The scheme above shows, in a simplified way, the main interrelations that occur among the two main clusters of agents, functional and decisional. We did decide to consider "customer" with a functional role, because we are assuming their decisional role already took place (i.e. where and when to receive the cargo) so that it is possible to focus on what happens in a port (typically a port of arrival).

As shown above, many of the relations are on both directions and just a few of them are mono-directional. The main interrelation occurs, on both directions, between "organiser" and "authority". This kind of relation is mainly due to security operations, i.e. not only the

security and integrity of the cargo but as well custom operations. In fact compliance to security regulations requires that the shipping company has to provide evidence of the security measures adopted in order to be allowed to enter in a port, and on the other hand ports, together with customs, are in charge of the inspections of cargoes (IMO, 2003).

Ports are concerned with customs operations, information management, warehousing, transhipment, security, handling and are particularly important in the supply chain because of the increasing containerisation of goods (currently around 80% of all the cargoes) (Steenken, 2004), which mainly passes through ports. Given the complexity of a port system, with multiple participants, there is ample opportunity to increase efficiency and reduce costs by means of ICT, which enables integration of the links in the supply chain.

When a containership arrives in a port, both the ship and the port have to comply with severe security regulations (ISPS, C-TPAT, SST) (Gooley, 2005). Compliance with these regulations implies a huge amount of information about origin and destination of the cargo, its contents and its status (e.g. number of handlings). Management of this kind of information has been improved by means of ICT. Nowadays every major port has a port management system, which is in charge of managing in real time this information.

Typical services provided to goods by a port are security, checking and marking, insurance, customs clearance, documentation, administrative and commercial clearance. All these activities involve to different extents some form of information management. The players who are mainly involved are shipping agents, liner agents, port agents, forwarder agents and customs inspectors.

They all have to manage sensible information, inspecting the cargoes, their integrity and their contents. What can possibly happen if personal intervention moves to some automatic device?

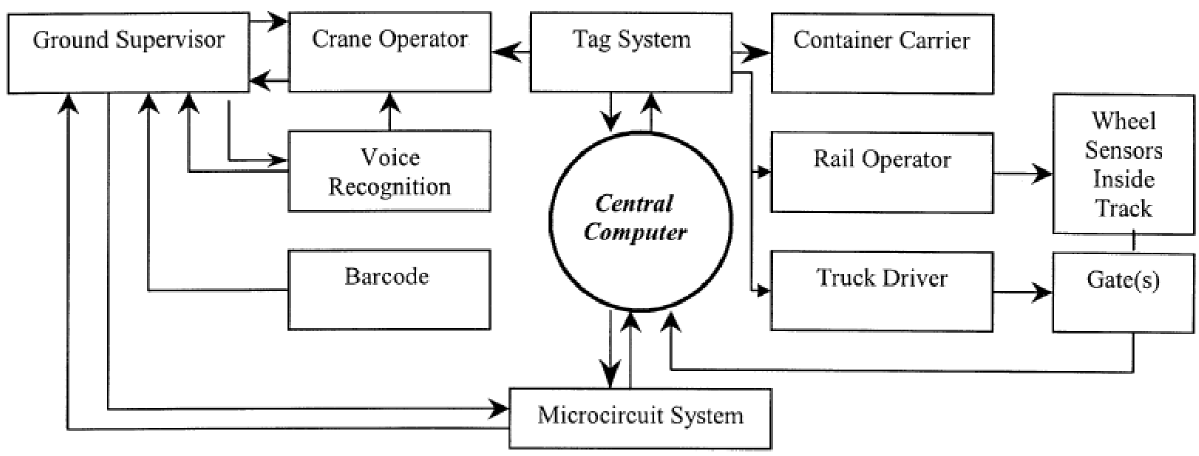


Figure 4 Management System Architecture

The efforts in last years have been aiming to this target (Kia, 2000). Many different technologies are nowadays available to meet the needs of a faster, cheaper and maybe more secure information management. Tracking and tracing devices like Global Positioning

System, RFID and many more, are now available on the shelf, as well as sensors and more complex devices (like the Container Smart Box) are quite common to meet security requirements. An effort in modelling the influence of IT processes in ports has been made (Kia, 2000), highlighting the main electronic devices available and their links with the port community.

A comparison between straddle carrier services time with or without electronic devices shows a reduction in waiting time percentage between five and fifteen percent (Kia, 2000). The number and the relevance of the information shared in such a system allows to ask ourselves whether these devices give as much "knowledge" about the cargo as an agent do. Is there a loss, a gain or a "change" in the information?

This paper will try to give an answer to this question.

4 A GENERAL MODEL OF INTELLIGENT MULTI-AGENCY AIMED AT MANIPULATING AND/OR MOVING ITEMS IN A LOGISTIC CHAIN

We assume a chain of items manipulating and/or moving as being in the meantime a far more simplified and complex version of a classical supply chain. It is far more simplified in that our chain is seen not as integrating part of a production process, but as an abstract system of items and item interactions per se, for an easier intelligent optimisation. It is far more complex because in our chain all items are seen also as agents able to express information and interact with other agents in an active way, rather than being merely manipulated and/or moved in a production process (since chain items-agents –then mainly active rather than passive- are encumbered with phenomena of risk and intentionality).

The logistics of our proposed chain is similar to the management of an intelligent and partially autopoietic control of a natural-artificial system characterised by emerging properties. In it, the items of manipulation-moving can become active agents in the chain when needed (in particularly complex or risky situations).

We can sketch our chain out as a N whole of n agents (A) that can interact with a M whole of m goods in order to manipulate and/or move goods (in our model, manipulation is identified as a substantial-normative analysis aimed at verifying the nature of goods and their conformity to normative standards of acceptability).

The result of such interaction is a new I whole of i interacting agents, where i is a number defined on a function of the intersection probability of the two wholes:

$$I = f\,P\,(N, M)$$

Just to complicate things, agents can interact with other agents, both internal and external to the N whole. Goods can either be divided for purposes of analysis and/or optimisation of the chain logistics, with a divisibility limit defined by a normative constraint (for example, any

legal constraint linking the goods manipulating and/or moving agent to the goods referential agents), or can interact with own referential agents for cognitive needs in the logistic chain.
It is possible to superimpose a G graph to the wholes described above, where arcs represent interactions and transformations and nodes represent agents. Each arc can be represented by a function of interaction and transformation, and each node can be represented by a function of 'environmental' organisation of interaction and transformation (control agent plus controlled agent). Both function can be optimised through typical optimum functions.
Each item is characterised by a whole of attributes that are recognised by the control agent either in indirect and passive way (acceptance of information attached to items) or in direct and active way (substantial analysis of items).

5 DISTRIBUTED AGENTS IN TRANSPORTATION NETWORKS

A worldwide scale transportation network is a complex system, at both organisational and technological levels, being composed by various agents and different processes. Agents work in the production, transportation, distribution and management sides of socio-economic chains: however, their roles and actions are often very similar even in different contexts. In general, we can see them as categorizable according to their capability to give an active command to system evolving (active agents), or to be simple implementers of actions decided elsewhere in the system (passive agents). For example, port authority control lines (active agents) scan tags of container (passive agents) that are discharged on port areas. If items are toxic wastes, there may be intelligent tags on the ship (active agents) who automatically deal with port authority control lines before discharging, and possibly decide to change destination.
Yet, grouping articulation may strongly depend on the types of role and action carried out, and the extension and number of groups may vary accordingly. In the particular case of nodes of transportation networks, namely intermodal structures or port authorities, agents can be categorizable according to their role during the necessary control actions developed. In exchange nodes, agents may perform static actions, such as normative verification of items, that can involve very elementary prerogatives of analysis, comparison and deliberation (passed/not-passed) (static agents). However, items may need to be investigated more deeply and moved, so requiring ad-hoc manipulations that represent a more complex activity and a more intelligent ability for involved agents – perhaps obvious for human agents but not for automated agents so needing to be provided with intelligent technologies (dynamic agents). For example, the pointing, grabbing, moving actions of port-based human agents in controlling shape and consistence of discharged items are often an essential security operation, whose replication by automated agents is connected with deep investigation on operational planning (Blum, Merrick, 1997).

Generally, such agents as above are likely to act within well agreed contexts of action, at times superimposed by strict laws and norms, especially when operating in the fields of control and verification. As a matter of facts, safety and security prerogatives are increasingly characterising transportation processes, and international rules and directions do mirror such trends (Petitt, 2001). However, transportation chains are deeply rooted in the microeconomic mechanics of globalisation, too, where time plays a major and increasingly critical role (see the just-in-time transport issue: Wang, Sarker, 2006). Delayed, anticipated or timely decisions are very likely to impact the performance of transport chains and -therefore- of economic/financial conveniences. In a control and verification framework in which rule-based agents may risk to slow down the process, the need of higher-rank agents shows up. Such discretionary agents may be located in sensible nodes of the chain and take critical decisions that can integrate or even replace standard agents' actions and speed up the process itself. In this context, they may act being integrated horizontally in the agent network, in a par-inter-pares fashion. This is the case of an agent that can change its role in the chain, when occasionally burdened with pieces of information that need to be immediately shared with the entire network so as to recalibrate the chain [e.g., the RFID network: Ranasinghe, Leong, Engels, Cole, 2005). The discretionary agent may also act while being in a hierarchically higher level, as a process manager. This case may occur in customs agencies, for example, when routinary directions of a controlling expert system (rule-based agent) may be overcome by the command of a supervisor (discretionary agent), for security reasons.

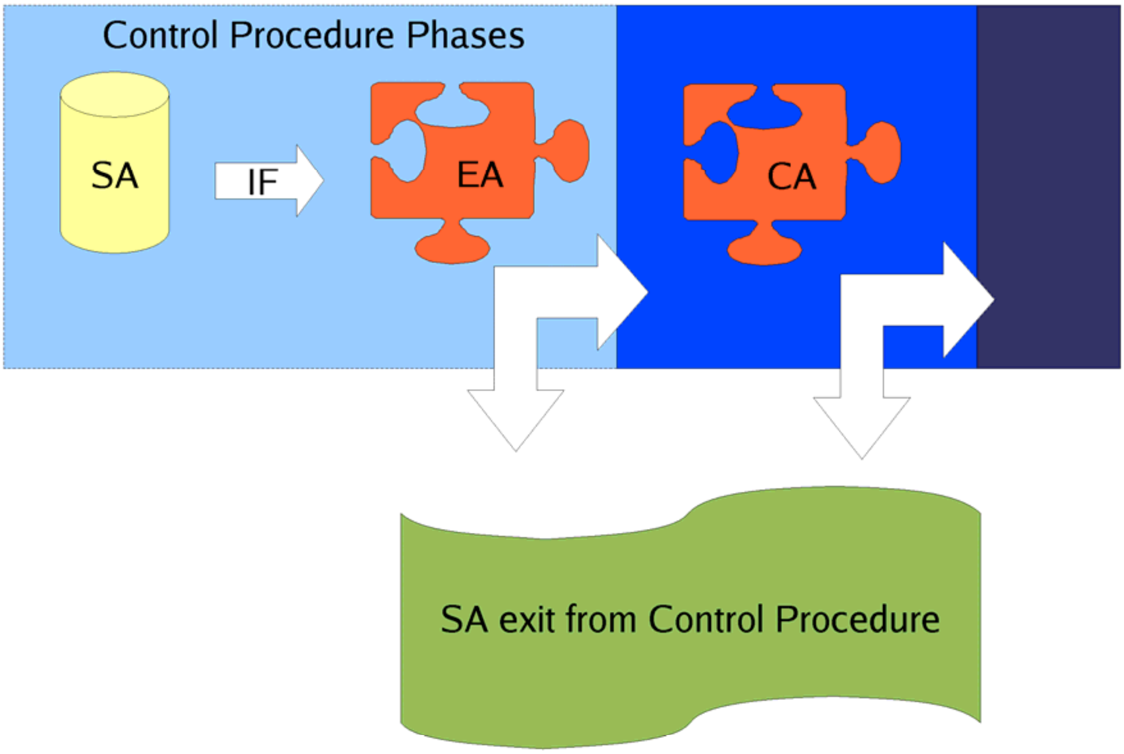
Normative and discretionary agents represent a critical key of our logistic chain research, that needs to further investigated because of the manifold issues and potentials raised. Among the two agent type options, the second one may be more effective and legitimate in terms of process manageability than the first one, whereas being more expensive especially when rule-based agents may suffice, so leaving discretionary agents inactive.

6 HIERARCHY AND HYBRIDISATION OF CONTROLS AND AGENTS

Items potentially dangerous for the environment which move through an intermodal transport chain in a port need to be controlled according to a routine and non-routine procedure, that is a hierarchically layered procedure: a routine control procedure is substantially normative, lives in a well-structured space of rules, a non-routine control procedure is substantially explorative, lives in an ill-structured space of conjectures; there is a hierarchy within the agents charged of these different procedures, in the sense that routine controls can be performed by executive agents, non routine controls must be performed by creative agents (for a classification of agents in a supply chain see Tang and Wong, 2005).

Creative agents resort to metarules (rules about rules) in their work or – better – they combine existing internal and/or external knowledge and memories in original ways (Borri, 2002).

Integrated intelligent control of executive agents and creative agents is both efficient and effective: in fact, by emulating conventional human organisations, it implies a multitude of agents committed to ordinary controls and a few agents committed to extraordinary controls; executive agents are numerous and distributed in the control space, creative agents are rare and concentrated and their activation is driven by specific situations which go out from normality.
But how to understand if the control of an item moving through an intermodal transport chain in a port has or has not to be shifted from an executive agent to a creative agent?



Control Procedure Schema:SA = story-agent, IF = information flow, EA = executive agent, CA = creative agent (note that creative-agent could be an agent different from EA of first phase or the same agent in a new role)

Figure 5 Control Procedure Schema

In our work, we postulate the existence for this task of a hierarchical society of distributed control agents (Minsky, 1987; Ferber, 1998) in which items per se, conceived as story-agents, concur to good control performance by providing useful information on due control procedures to the external control agents: for doing this, the items to be controlled, at both individual and package level, include a RFID-based piece of information which de facto constitutes an essential story of their manipulation and movement and can be explored at different hierarchical levels by control agents (backward and forward navigation through and abstraction in the space of this story is allowed by its architectural organisation) (figure 5).

Executive agents perform story reading and scanning of story space searching for risk markers (built as metarules and/or peculiar configurations of events and processes in the story that belong to a class of stories or sub-stories that call for creative control) and eventually shift the control to higher level control agents (creative agents). The RFID architecture of this story is the following figure 6.

Hierarchical hybrid intelligent control (HHIC) with concurrence of controller-agents and controlled agents is a particular high level control procedure in which a society of co-operative active (controller-) agents and passive (controlled) agents manage the complex task of RFID detection of compliance of goods to safety international rules in intermodal transport (port) chains. The basic idea in HHIC is to have, for acceptability control of goods potentially dangerous for the environment in intermodal transport nodes, both intelligent activation of a hierarchy of controller-agents and participation of controlled agents (goods items) in the control procedure through story control (story-agents).

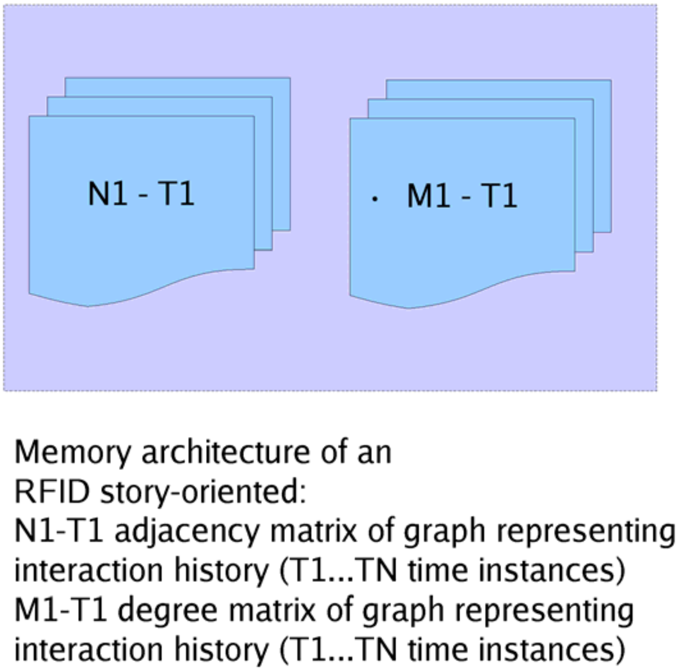


Figure 6 Architecture of a story-oriented RFID

6.1 Instable Hierarchies in Nets of Control Agents

Another important issue is the way in which it is possible to avoid problems which relate to the rarity of high level controller-agents (creative agents) in the control space and to the possible time delays in their activation (and also to other inefficiencies of the dual – executive and creative – control model), in a world characterised by increasing amount of commercial transactions, intermodal transport nodes, non-interoperable and incomplete information, etc. To cope with this problem in our research we postulate a multi-agent and multi-role control

environment in which controller-agents are not rigidly located in the hierarchy of control competencies and capacities but can incorporate this hierarchy into themselves in the sense that they can decide to perform both routine (executive) and non-routine (creative) operations, in goods control, according to situation-based, case-based reasoning: should they decide to perform a non-routine control, the high level (creative) knowledge-ability which is needed by the non-routine procedure comes from better (creative) exploitation of their individual knowledge base and/or from knowledge networking with other remote or close agents, variously located in the accessible nets of knowledge with their hierarchies.

7 Some perspectives on process modelling

More formal modelling and verification techniques like those related to conventional computer science could be used for the analysis of hybrid systems such as the haven node at stake. The rationale underlying such consideration lies in the inherent similarity of the hierarchical and decentralised control strategies of hybrid systems and the communication and operation protocols used for distributed systems in conventional computer science.

We have focused our attention on an individual complex node in the setting of the supply chain, indeed. A port can be viewed both as a single multi-agent system and a group of several multi-agent systems, each characterised according to the aims of the system itself. Under this viewpoint, each multi-agent subsystem can be considered as a distributed agent, therefore it can be described according to the well established BDI (Beliefs, Desires, and Intentions) model.

A simple standard subsystem characterisation could be as follows:

1. Service management subsystem:

B: knowledge of spatial characteristics of the haven, infrastructures, transportation, etc.

D: providing optimal backing to the supply chain.

I: context-sensitive decision state of the agent.

2. Carrier subsystem:

B: nature of load carried, timing, routes, etc.

D: maximum cost reduction, timing optimisation.

I: context-sensitive decision state of the agent.

3. Authority subsystem:

B: laws, rules and regulations.

D: abiding by the law.

I: context-sensitive decision state of the agent.

Possible interactions among distributed agents or multi-agent subsystems are manifold and, likely, can not all be envisioned *a priori*. Such interactions can be represented by the intersections among sets with ill-defined borders.

The above interactions can also be viewed as a probability function (fp) defined by subsets of the agents making up each multi-agent subsystem:

$$i = fp(NS,NC,NA)$$

where:

NS is any possible subset of the agents making up the service management multi-agent subsystem;

NC is any possible subset of the agents making up the carrier multi-agent subsystem;

NN is any possible subset of the agents making up the authority multi-agent subsystem.

It should be pointed out that some agents can well belong to more than one subsystem at the same time.

Interactions are markedly affected by the nature of the load carried, therefore the above probability function should be further enriched by specifying the nature of load:

$$i = fp(NS,NC,NA,L)$$

where L is the nature of the load carried.

The probability function should also take into account the physical (spatial, temporal, etc.) and procedural (laws, rules and regulations) constraints of each subsystem:

$$i = fp(NS,NC,NA,L,CS,CC,CA)$$

where:

CS is any possible subset of the constraints attached to the service management multi-agent subsystem;

CC is any possible subset of the constraints attached to the carrier multi-agent subsystem;

CN is any possible subset of the constraints attached to the authority multi-agent subsystem.

This way of reasoning is strongly related to that of Feasibility Analysis of packet switching algorithms; the latter, as is well known, widely employs probability functions. Contrary to Feasibility Analysis, in our model determining the expression of probability function and the specific values acquired by its components is hard to determine.

As a consequence, knowing the cognitive model underlying each multi-agent subsystem is of the utmost importance.

The interactions among multi-agent subsystems depend on the “states of mind” stemming from perceptions, representations, beliefs, and desires of each of them. These “states of mind” can be depicted through graphs describing the algorithmic and architectural aspects, respectively.

Our use of graph theory is close to that adopted by the analysis of the topological structure of networks and the algorithmic properties associated with network routing schemes.

In this context, a set of graphs has the dual function of (a) describing, and (b) memorising the corresponding “state of mind”:

(a) Graphs describe different blocks of a multilayer cognitive process and, particularly, within- and between-subsystem intralayer and interlayer communications.

(b) A dual nature of memory, short-term and long-term, can be envisioned:

• short-term: to enhance feedback mechanisms intrinsic to the general system;

• long-term: all graphs pooled could act as the cognitive model itself or, at least, the base for the construction of the cognitive model.

Our description of the cognitive process as a multi-layered one is comparable with the description of the protocol stack model of a computer networking protocol suite.

8 CONCLUSIONS

In recent years, important changes have been introduced in the organization of freight transport and good distribution. The widespread of ICT solutions has deeply influenced transport management and logistics. Logistics of intermodal transport chains has been increasingly assisted by intelligent technologies. At the same time, agent-based approaches are increasingly used in control procedures applied to these chains.

In our paper, we explore some problems related both to basic computational aspects of agent sets and networking, and to intelligent control architectures. A hierarchy of agents (executive agents and creative agents) co-operates for better performances of control, with the concurrence of the items to be controlled that vehiculate their stories, making use of smart devices (RFID based) performing roles of story-agents. The cooperation between agents is seen as potentially useful for increasing the efficiency of the system. Besides, it eases data exchanges and checking operations, in order to comply with security and safety regulations.

According to principles of situation-based, case-based reasoning, the shift of control procedure from executive to creative levels is introduced as a way to manage responsibility and decision roles in the multi-agent system. We also discuss the possibility of adopting, in the multi-layered hierarchy of agents, knowledge networking and behaviour upgrading of agents that belong to a given layer, to increase the system performances. This leads to creative control features as a substitute of the classical use of superior (creative) agents.

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ABSTRACT

This paper explores the chances for increasing the level of Mediterranean seaport competitiveness allowed by technological innovations in transport systems, both in operations and organization of these infrastructures. The aim of the work is to study the effects of the adoption of technological solutions such as wireless communications and radiofrequency identification on the competitiveness of Mediterranean seaport infrastructures. Technological solutions designed to identify good items help operators in organizing activities in terminals and make maritime transport faster in delivering goods, by cutting the handling time and costs in seaport terminals. Seaports that adopt this kind of technologies, and the surrounding economic areas connected to seaports, have a greater attractiveness on shipping companies and operators, since they allow faster handling activities and easier checks on goods. Besides, the analysis of direct and indirect effects of the use of such technologies specifically focuses on the contribution that the use of these solutions gives in ensuring higher security levels, by increasing the level of information and knowledge associated to goods. The different types of security provided (e.g. for people, environment and goods) and the extreme flexibility of the technologies involved give the overall worth of the challenge.