DESIGN & EVOLUTION MANAGEMENT OF CITY LOGISTIC ORGANISATION

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ABSTRACT

Due to the large variety of independent stakeholders, City logistics may be considered as a adaptive and context sensitive System of Systems (SoS), even though it is embedded in a larger one at the city level.

The five basic conditions which characterise a SoS (operational and managerial independence, evolutionary development, emergent behaviour and geographic distribution) may be identified in Urban Freight Transportation (UFT) organisations ; some basic behavioural characteristics may be observed in UFT just like in other SoS such as the difficulties to communicate due to several and quite different governances, to define and share a common understanding between all participants or the non interoperability between systems and organisations or else the sometimes chaotic (unpredictable) nature of the traffic and goods circulation, etc.

Then SoS engineering principles and methodologies should apply to UFT design.

In this communication we propose to examine how systemic and organisational approaches can lead to a better control over the management and the continuous engineering of UFT organisations.

INTRODUCTION

The complexity of City Logistics lies mainly from the number of stakeholders which are involved in the transportation of goods and from the sharing of time and space with passengers transport. Stakeholders have different, some times contradictory own objectives, specific constraints and behaviour linked to their activity.

This variety makes very difficult the monitoring of Urban freight transport and the global optimisation cannot come from all the individual local optima.

Experiences to improve this urban distribution have been set up in many places, in many cases initiated by local authorities. Quite often these isolated demonstrations could not live for a long time for economical, technical and/or social reasons. On the contrary, other demonstrations grouping several stakeholders of different nature were successful although they solve only a problem restricted to a specific area or a specific type of distribution/customer requirements.

Some of these approaches are based on flows analysis although realistic data are quite difficult and expensive to obtain and may change in a few month which will unbalanced any decision made upon these data. Knowing these information leads to a bottom up design of solutions which are not decided and assessed regarding the whole UFT situation of the city. For instance knowing the flows of goods issued from each city centre shopkeeper may lead to the set up of a proximity storage and distribution center which would increase congestion or nuisances in other areas of the city.

Urban freight distribution must be monitored at the city level. However, since this logistics involve public authorities, private companies as well as individuals, setting up a managing organisation remains a questioning problem, both on the nature of the control that could be implemented over all stakeholders and on its evolution over the time and the changes in the various authorities which are concerned.
Systemic theory and more specifically Systems of Systems modelling brings new concepts and engineering processes which can be useful to identify the types of management that could be implemented.

The paper is split in 3 parts
- after a short presentation of the type of actions which are implemented to improve UFT, the first presents how the concepts of SoS apply to UFT organisations and which properties of SoS can be used to understand City logistics and its evolutions
- the second deals with the engineering and management of UFT when considered as SoS. Base on the Engineering SoS guide, a specific methodology is presented which points out the core elements of the design of city logistics organisation
- the last part of the paper details shows briefly how the properties associated to SoS can be used for the understanding of UFT organisations and the control of their evolutions

CONCEPTS

Solutions for UFT improvements

Urban freight transport solutions have been studied and experimented for quite some time now. Different categories of actions and best practices have been identified and many of them have been recorded in the European BESTUFS programme (2007); several demonstration measures have been launched inside the CIVITAS initiative European programme. In France several studies and some actions have been supported by the PREDIT (2008).

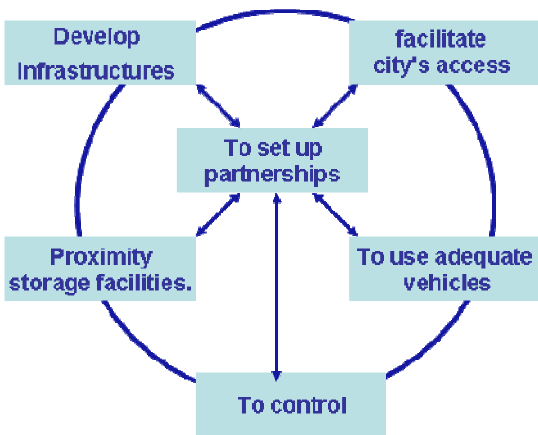

Figure 1 : Links between solutions for UFT

In each of these categories short or medium term evolutions can already be foreseen, some of them linked to the deployment of telematics, others due to development of technologies or of awareness of the stakeholders:

- **To develop infrastructures**. These actions are related to the implementation of all types of infrastructures which can bring some improvements in UFT ; they range from long term anticipation in land use planning to the adaptation of dedicated lanes (like bus lines for instance) for urban distribution vehicles. Evolutions will concern mainly access controlled zones and delivery bays. For both of them, new concepts such as status variation during the day (i.e. adapting the finality of the road space during the day) or new technologies (ex remote control of delivery bays occupation) will bring flexibility in the utilisation of the space.
- **To facilitate city's access**; actions in this category concerns all information systems and organisation which can be thought of in order to make easier the drivers' job to bring products in the city. Then signing equipments as well as software participate to these actions which are linked directly to the progresses of Information &Telecommunication Technologies; these address all stakeholders from local authorities to craftsmen with real time information systems or back office software. In the very next future, specific routeing messages will be transmitted to drivers to modify their routes according to traffic situation or global goods distribution will be organise through common information platform shared by haulers. This will also concern (linked to infrastructure) the future self routeing determination that RFID equipped products will have in the future.
- **To implement proximity storage facilities.** This type of actions concerns all types of storage which can be installed for the goods which will be introduced in the city. They can be private or public owned. Many experimentation cases (Browne and al, 2005) already showed the various ways of organising distribution from these facilities. The main evolutions will concern both the management and the global organisation of these facilities in the cities, in order to optimise the efficiency of distribution activities and make them really profitable. Then the different types of proximity storages will be combined in a city distributed according to the surroundings activities, on permanent or temporary basis (ex building construction, events...). Platforms activities will also extend to different services (home services for instance) or to final specialisation of supply chains. Some of the storage activities will be automatised (ex loading/ unloading, order preparation...) using already existing but adapted devices.
- **To use adequate vehicles.** Obviously important developments are yet to be realised in that domain; apart from existing clean vehicles which are more or less fit for city logistics, (ex Goupil vans, Modec or Maxcity trucks) new ones should be utilised in the next coming years. Even though the final disappearance of delivery vehicles will not be affordable or technically feasible in medium sized cities (i.e. use of urban pipeline transport, except for waste), several other concepts will be implemented, probably in a combined way in order to adapt the vehicles to the transported goods, final destination and cost effectiveness. Then from tricycles (ex La Petite Reine in Paris and Bordeaux) to specific automatised vehicles a large panel of solutions will be offered, based on the adaptation to the

utilisation (mass or unit flows) and transported goods, the automation level, motorisation and mode (ex rails, water…).

- **To monitor and control** means both to set up adapted, homogeneous and coherent regulations and the verification of their compliance by concerned stakeholders. The main evolutions will concern more the way the results are analysed and used for evaluation purpose of other actions than on the regulations themselves for which almost all possible experimentations have been realised.
- **To set up partnerships** is the key factor which is necessarily part of other improvements. This cannot be set alone, for whatever the negotiations between stakeholders deal with, there will be concrete modifications in the goods circulation. Several types of partnerships' building strategies have been experimented (ex FQP, Freight Quality Partnerships in England) involving main transport companies delivering goods in cities. The evolution will be on the ways to involve all stakeholders in the partnerships or the incentive given to increase their motivation.

All demonstrations showed that the success lies in strategies combining actions belonging to several of the above categories. From the organisation of Storage Centers coupled with appropriate vehicles and regulations accompanied by partnerships with shopkeepers and delivery companies, to the management of delivery bays with real time information to drivers or night deliveries (cf PEAK experiments), all these experimentation required a coordinated management of all actions.

However, several difficulties appeared in previous implementations which showed the limits of their benefits and sometimes their disadvantages or unforeseen side (perverse) effects. In short, the main reasons were linked to

- The confusion between local optima and global optimum; all actors look for to optimise their actions according to their own criteria and, as a consequence, this leads to a degradation of the general optimum which could correspond to the city objectives. Partnerships, as we will see later, are just a place to discuss of these points.
- The area under consideration was generally the hyper centre of the city; then the problems like congestion, decrease of security… were just transferred to the outskirts of the "safe" perimeter.
- Actions and experimentations were often considered independently of other improvements, in UFT as well as in global traffic and urban planning strategies.
- All improvements are based on technical progress and rarely encompass organisational and managerial dimensions.
- Data acquisition and reliability seems extremely difficult so modelling and simulation approaches cannot represent the reality and be a proper basis to forecast the evolution of flows.
- The differences in decision horizon of the stakeholders. Response time of actions decided by Local authorities are often quite long (10 to 20 years) since they involve behaviour changes in individuals while the longest decision's horizons of private companies are 3 years long, and for the smallest (like SMEs in delivery) quite smaller.

Although quite different in their definitions all these actions act upon the same parameters/ variables of the City logistics, in the restricted area of the urban community territory :

- products : nature, transport /storage constraints
- locations : areas which are concerned and their characteristics, detailed occupation of space,..
- time : access to the destination, schedules for access control zones,…
- organisation : definition of actors which are concerned and their relationships

Performance criteria of these actions are also common (economy/cost, customer satisfaction, environmental/social impacts) which facilitates comparison between forecasted actions through multicriteria approaches. :
The variety of actors in UFT, the "Brownian" movements of goods and the heterogeneity of objectives will always set constraints to the improvements technologies will propose. They point out the necessity to set up a kind of general management over the UFT in direct connection with the global transport and urban plans developed at city strategic level. However, since all cities are different according to past, present and future considerations there cannot be one model for all and we will consider the models which could be used for medium sized ones.

UFT as a System of Sytems

System of Systems is a set of independent systems that are related or connected to provide a given capability. The loss of any part of the system will degrade the performance or capabilities of the whole Individual systems interoperate and are interfaced with each other and are characterised by emergent propoerties.
In order to distinguish very large and complex but monolithic systems from true systems of systems Maier has defined five characteristics of systems of systems [Mai96, Car01].

The first characteristic of system of systems is the operational independence of the elements. If the system is decomposed, each element (constituent system) can still perform independently of the others. The elements of the system of systems are independent and useful in their own right. In UFT, this independence is realised at several levels. Firstly, groups of stakeholders are quite different (local authorities, operators, individuals,…), each group has its own types of objectives, operational rules which are determined by each entity and is submitted to constraints which can be specific or general for all members of a group. Conflicts may arise between groups. Inside each group all members are independent, sometimes competitors

The second characteristic is the managerial independence of the elements. Each constituent system has its own purpose independent of the other constituent systems and they are managed separately for that purpose. In UFT, each stakeholder defines its own strategy and objectives according its relations and situation in its environment, whether they are long term strategies or short term decisions to react to unforeseen situation. Local authorities will have political oriented strategies, transport companies strategies will be more economic oriented, etc.

The third characteristic is evolutionary development. The system of systems is not fully formed or finished. Its development and existence is evolutionary with functions and purposes added, removed, and modified as experiences are gathered. It continually evolves as needs change and newer technologies become available. The most significant examples of evolution in UFT are the consequences of the development of e-commerce or of clean vehicles. In the first case new legs have been created in supply chains for the organisation of the last mile distribution. In the second case, new goods distribution modes have been set up using tricycles or electric vehicles, sometimes with the creation of new types of stakeholders which provides new functions or new services like product identification /storage.

The fourth characteristic is emergent behavior. The system of systems performs functions and carries out purposes that do not reside in any component system. These behaviours are emergent properties of the entire system of systems and not the behavior of any component system. UCCs (Urban Consolidation Center) organisation represent a good example of the development of such innovative behaviour: mutualisation of storage and distribution resources over a urban area could not be realised by one company but can be initiated by local governments and involved several stakeholders.
In the same way, the development of traffic information systems allows now time reservation of delivery bays or the real time adaptation of delivery rounds ; these 2 functions have strong repercussions on the organisation of freight transport operators.

The fifth characteristic is geographic distribution. In many cases individual component systems are distributed over large geographic areas. In UFT the urban area is limited, and shared between all constituent systems. In this context “geographic” may be interpreted as meaning distributed, on either a local or wide area scale, and possibly on both simultaneously. Distribution refers to physical distribution and de-coupling of individual system capabilities. Thus separate systems operating within a restricted physical space, yet acting for a collective purpose, can satisfy the criterion of “Geographic Distribution” [WOR 09].

The five necessary conditions are respected and some basic behavioural characteristics may be observed in this UFT SoS such as the difficulties to communicate due to several and quite different governances, to define and share a common understanding between all participants or the non interoperability between systems and organisations or else the sometimes chaotic (unpredictable) nature of the traffic and goods circulation, etc. These are related to SoS paradoxes which have been outlined by [GOR 08] (Autonomy, Belonging, Connectivity, Diversity and Emergence) and reflect the properties developed by UFT systems to being able to live with these paradoxes [VER 09]

System of Systems properties

The main properties of SoS which can be considered for UFT organisation concern :

- the management and the control over constituent systems
- the network centric organisation and relationships between them
- the agility of each of them and of the SoS

Management

SoS are also identified with regard to the managerial control over the whole organisation. 3 characteristic situations have been pointed out although several intermediate forms of management and control may exist.

- **Virtual**: Virtual systems lack a central management authority. Indeed, they lack a centrally agreed upon purpose for the system-of-systems. Large scale behavior emerges, and may be desirable, but the supersystem must rely upon relatively invisible mechanisms to maintain it. A virtual system may be deliberate or accidental. Clearly, the majority of the current UFT organisations may be classified in this category as a consequence of the absence of actual coordination ; the implementation of basic regulations, like delivery hours, is the smallest action that can be undertaken and cannot be look at as a management measure. So the distribution lies upon more or less explicit behaviour of actors (for instance the congestion in certain streets at specific hours, mutualisation for last mile deliveries, e commerce retailers…)
- **Collaborative**: Collaborative systems are distinct from directed systems in that the central management organization does not have coercive power to run the system. The component systems must, more or less, voluntarily collaborate to fulfil the agreed upon central purposes. Obviously collaboration between UFT constituent systems covers a extended range of possible relationships, possibly different in nature and involvement for each stake holders.
- **Directed**: Directed systems are those in which the integrated system-of-systems is built and managed to fulfil specific purposes. It is centrally managed during long term operation to continue to fulfil those purposes, and any new ones the system owners may wish to address. The component systems maintain an ability to operate independently, but their normal operational mode is subordinated to the central managed purpose. Such an organisation appears difficult to implement for UFT systems in which public and private partners may have quite different and independent objectives. However on a very restricted area (in size and partners), such an organisation may stands efficiently like for instance the goods distribution of the Hotomachi shopping street association in Japan or the allocation of delivery bays/docks in Venice canals.

Network centric organisation

Since the constituents of UFT SoS are substantially independent, they collaborate only through exchanges related to shared or transmitted elements. Within UFT organisation, exchanges concern products which are transported by several stakeholder and mainly information on the various elements which describe the situations, from the traffic congestion to the nature of the products. Organisation in SoS must be network centric in order to facilitate message passing.

As a consequence interoperability efficiency between subsystems is one of the most important challenges to the optimisation of the whole. Interoperability may take various forms; most representative ones are for UFT :

- **physical** when it concerns products and material transported or the ability to optimise heir passing between stakeholders (for instance adequation of delivery bays, of unloading platforms,…
- **informational** which is the most common view of interoperability and is clearly linked to all Intelligent Transport software applications.
- **organisational** which is related to the matching of governance and operational procedures between entities, their ability to operate with confidence
- **conceptual** which is linked to the set up a body of philosophies, rules, processes, and related information ; for instance quality freight partnerships are a way to establish this type of interoperability in UFT organisations

Agility

Agility is the capability that the constituents possess for adapting their behaviour and modifying them according to the changes of external constraints and internal evolution of other constituents. Each constituent has its own agility and modifications are limited both by the nature and organisation of this constituent and the relations with other.

An agile constituent is organized for velocity and flexibility by reducing the number of vertical and horizontal layers in the organization chart and rearranging them around natural processes. Organizational functions are collocated into physical groups that work fast. Physical walls that stand in the way of good communication are removed.

Achieving agility requires four capabilities :

- **Speed** : this capability recognizes the pace at which a constituent system can sense and respond.
- **Ease** :this capability measures how nimble a constituent system is when things don't go as expected, as well as how easy it is for this system to sense change and respond.
- **Predictability** : Reliability can be even more important than absolute speed. The constituent system that can respond quickly and easily in three days every time is a more desirable trading partner than one that sometimes responds in one day, but other times takes six.
- **Quality** : a constituent system that senses and responds quickly, easily, and predictably, but with poor quality information or products, doesn't qualify as agile.

Agility is a quite important feature for UFT organisations. Some of the stakeholders, imbedded in supply chains are quite aware of this performance criterion. However, Public authorities even transport operators or shop keepers are not familiar to this capability which is linked to the ability to handle behaviour changes.

Approach of the evolution in organisations

By nature SoS are in perpetual changes issued from internal evolutions or external constraints modifications. Then long term management of SoS requires a continuous adaptation as well constant anticipation on the possible futures of each constituents and of the global overall system.
Of course the management mode, the quality of interoperability and the level of agility influence directly the ways SoS can evolve
Monitoring evolutions will reduce the risks of perverse deviances of the SoS or of perturbations decreasing the global efficiency.

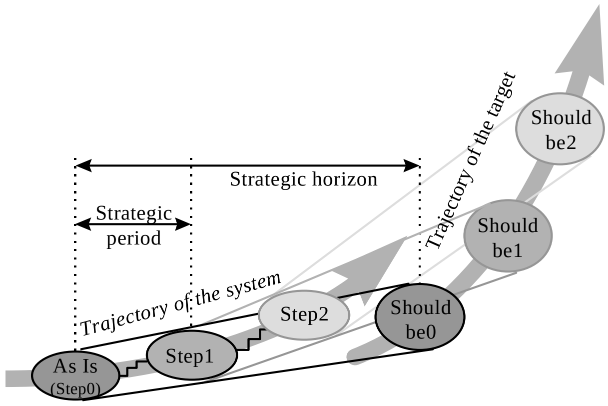

Fig. 2. Evolution process

The evolution of the system is characterized as a continuous process based on a combination of "steps"[MAL00]. Each step represents the evolution of the status of the system .

SHOULD-BE corresponds to the idealist vision of the UFT system at time *t*. It is expressed through the vector of operational performances expected by stakeholders. Associated to a strategic horizon this state will not be reached; during this lead time system environment will be modified requiring definition of different vector of performances. AS-IS corresponds to representation of the UFT system at time *t*. It gives a model of actual UFT system as well as the actual vector of operational performances. Successive STEP-n draw the evolution trajectory of the UFT system. The interval of time existing between two successive steps is the strategic period. It corresponds to the lead time at the end of which the UFT system must reconsider its trajectory (adaptation of its objectives with the evolution of the environment).

The evolution process depicted through these different conceptual states underlines three levels of management.

- The **Strategic Definition** level is based on the gap between the AS-IS and the SHOULD-BE in term of performances. Strategic decisions design the trajectory defining different STEP-n associated to coherent levels of performance which lead to the SHOULD-BE;
- The **Actions Planning** level operates in a world of models. Once existing UFT system has been modeled (AS IS), the design phase consists in modifying this model arranging processors interconnections and introducing new processors. This phase aims at giving the future model (STEP-1) the potential that ensure the UFT system to match operational performances provided by upper level. Actions Planning decisions aim at linking on one side the gap of operational performance between existing and future system and on the other side design objectives;
- The **Projects Management** level has in charge the integration of new processors. This level corresponds to a classical multi-project management system and then all

activities usable for such a management find their place within it and in particular activities referring to human resources involvement.

Conclusion

The scope of actions which can be implemented to improve UFT is quite large and involve many stakeholders, some of them contribute to several actions. Projects coordinating these actions have cross influences and acts on the same physical objects. Moreover, they must be integrated in transport /mobility strategies of the city and satisfy global objectives fixed by Local Authorities.
City logistics is then a complex system ; the analysis of its main parameters showed that it possesses all the characteristics of an adaptive and context sensitive Systems of Systems,
Considering this situation, SoS engineering may be used to develop a specific application in UFT which could be easily extended to all urban transport activities.

ENGINEERING & MANAGEMENT OF UFT

UFT organisations exist in each City since it is vital for city life : this never ending situation is common to all SoS. So their engineering process is rather an optimisation including innovative processes or behaviours than a pure creation. The control over the whole UFT system depends on parameters which are specific to each city and the result of this engineering. These parameters are linked to the properties of SoS identified in the previous chapter

Parameters for engineering UFT

Management

Management can overshadow engineering. Since each system element has its own product/project office, the coordination of requirements, budget constraints, schedules, interfaces, and technology upgrades further complicate the development of SOS. Answer: this is a major problem if you try to run the engineering of complex systems with traditional, efficient, control-oriented systems engineering [SHE 06].
The global management can be scaled on 2 axes, the type and the size of the city :

- The type of management (ie directed, collaborative or virtual) is the result of a strategic decision from local authorities. From this choice, different kinds of relationships will arise between partners, different actions, tools and indicators must be set up to facilitate the deployment of this strategy. The values of this parameter are continuous along the scale from completely virtual (no control like in quite small cities) to fully directed (in some cities areas).
- For UFT systems, the managerial organisation and control systems depend on several factors (culture, topology, ..) among which the size of the city predominates. Complexity grows with the surface and the population of the city's

territory. To face these problems, the management may be hierarchised according to areas, but there will be difficulties on the boundaries, according to the nature of the flows, but some flows may run out of this control…

Interoperability

This property can be split in 2 domains : physical and functional interoperabilities. Both can be measured either by existing models (for instance e Score methodology) or by multi criteria approaches which can mix different analysis angles.

- Physical interoperability is related to the flows of products and the efficiency of the transfers at the different changes points of transport modes, including storage activities. This can be measured by the adaptation of delivery bays to the demand, the efficiency of cross-docking on platforms, the last transfer to the customer….
- Functional interoperability covers both informational and organisation aspects of interoperability as mentioned in previous chapter. Information aspects are quite traditional (from semantic understanding to data exchange), organisation aspects concern the administrative nature, the size, the type of management of each constituent system

Agility

Agility can also be examined on a 2 axes approach : velocity and anticipation. Both can be measured in a continuous way along their own scaling [ ].

- velocity is related to the ability of the constituent to modify its own behaviour when changes happen, planned or unexpected ones. Evaluation can be realised in 2 ways :
  - indicators can be set up to measure real changes (like response time) then the value can be analysed through the type of changes and the size of the constituent
  - theoretical evaluation may be realised through characteristics of the constituent like the size, the status, the activity sector of the constituent.
- anticipation is the ability to forecast possible modifications due to external or other constituent evolutions. This is mainly related to the efficiency of medium and long term planning inside the constituents.

Engineering UFT

The collaborative and adaptive nature of UFT SoS, brings some changes to the various engineering processes which have been developed. As a result the core SoS System Engineering elements developed in the guidebook of the Department of Defense [DOD 08] may be specified and re arranged in 3 layers (cf figure below) : strategic, action planning and operational layers

On each level core elements exchange information and are processed iteratively. Relations between levels are symbolised by arrows. Environment constraints and evolutions influence decisions taken at all levels and in any of the core elements.

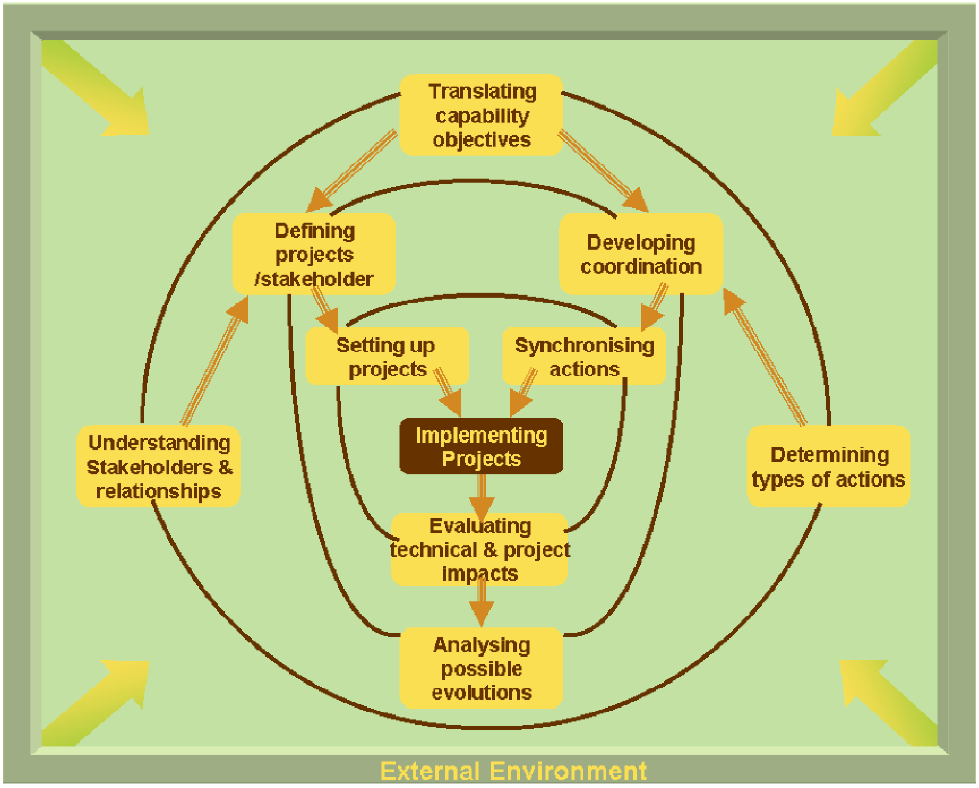

Fig 3 Core elements of UFT SoS (inspired of DoD Guidebook)

The hierarchical criterion of this decomposition lies upon details and aggregation of data which are taken into account by each core element. It is not the time span horizon like for instance the GRAI methodology since all the activities are rather long term ones. Actors involved in their realisation could be the same at all layer although they should be more numerous at the lowest.

Strategic layer

This layer deals with

- the adaptation of UFT global capabilities to external evolutions considering the actual and forecasted positioning of the UFT,
- the analysis of each constituent's behaviour and objectives.
- the identification of possible types of improvement actions.

These activities aim to determine the strategies that will be adapted and implemented by all stakeholders. Results will be

- the global quantified objectives that UFT organisation must reach and their positioning with regards to the environment
- the domain concerned by these objectives, from the areas in the city to the target groups of stakeholders

- the type of actions that could be implemented to reach these objectives, the limits and constraints, the forecasted barriers and a first global estimation of costs.
- the kind of management and control which is to be implemented and the relationships between stakeholders according to the discussions presented in the previous paragraph

The first concern at this layer is to determine the purpose and the global objectives of the UFT organisation : how it is linked with the transport strategies of the city, what are the improvements that could be expected, which area of the city is concern and main constraints, limits and barriers.
Then stakeholders can be identified, generally they are classified in target groups either by areas or by activity. Deep analysis of their behaviour, expectations, constraints and relations may lead to changes in previous definitions: the foreseen area may be not exactly the proper one, conflicts may arise between target groups objectives and/or with some of the global objectives, etc.
These activities lead to high level requirements and give a first approach of the dynamics of each group and their more or less involvement with general objectives. This also allows identifying functions to provide desired capability in a way that accommodates the variability in the environment and the different situations in which the capability may be executed.
From these definitions, the type of actions which could be implemented may be considered and a first approach of interrelation between their implementations may be analysed.

Action planning layer

The main purpose of this layer is to specify the type of actions that will be chosen to improve UFT according to the framework and objectives defined at the previous layer. 3 core elements have been associated to this layer:

- the definition of projects which will be realised by each constituent stakeholders
- the organisation of coordination mechanisms between these projects according their cross influences
- the identification of the adaptations to be realised for the future projects

Results will be :

- the description of the projects that will be allocated to and conducted by each stakeholders
- the main coordination elements between these projects and control procedures according to the management organisation defined previously
- the evaluation of the global efficiency of the actions and propositions for optimisation or modification of the projects.

Since possible (types of) actions have been defined at the strategic layer, the first activity in action planning will be to build projects in adapting the possible actions to the specific context and situations of the City. This will identify how different stakeholders could contribute to each project and the relationships between projects ; the table below gives a short simplified version of such analysis.

Projects	Transport DPT	City UFT Operator	Stakeholders delivery & Transport comp.	Stakeholders Shop keepers
Urban Consolidation Center	Provide warehouse and set up adequate regulations to facilitate developmt	Stores and delivers parcels and pallets of standard goods with electric vehicles	Bring goods to UCCs	Ask for procurement in UCC, store goods, trigger deliveries
Access control zones	Define zones and provide access	Is authorised to access according rules	Participate to the zoning, is authorised	Participate to the zoning

The second step concerns the cross influences between projects. They concern one or several variables of the city logistics (as identified in chapter one, like products, locations,…). Each project contains several actions belonging to different types and modifying the "value" of these variables. Systems dynamics may be used to model these influences at the variables level.
The next activity will deal with the identification of the relations between projects coming from the involved stakeholders, from the social impacts (required changes of behaviour) and from the technical features of the projects. Precedence or overlaps, synergies and difficulties, even impossibilities may be pointed out during this phase ; from this analysis, synchronisations actions or milestones may be defined in order to ensure the coherence between projects.
This is completed with the organisation of the evaluation which is realised for each project at the lower layer. In order to achieve compatible and comparable results between all projects, it is necessary to define a common evaluation methodology which will measure the deviations from the original objectives and point out the main causes of these

The third core element deals with adaptation/optimisation of the projects and or the general strategy. From the evaluation made at the lower layer, with comparison to the global objectives and in the framework of the proposed actions, the aim is to determine the modifications which have to be realised in the projects, either in the stakeholders parts or in the technical solutions which have been designed.

Operational layer

The role of this layer is to prepare the implementation of the projects designed at the previous layer . The associated core elements are

- the launching of projects by each stakeholders
- the operational synchronisation of the activities between all projects
- the evaluation of the on going projects

Each stakeholder will specify individually their own projects according to the technical and management coordination frameworks designed at the upper layer. Projects will be launched and the regulation between detailed activities realised during the implementation will be done through the synchronisation core elements. This synchronisation can be done through common milestones, relationships between detailed activities, resources mutualisation,… The framework of this has been set up by the coordination.

Evaluation concerns both the technical point of view (impacts evaluation) and the projects implementation points of view (process evaluation) as outlined below:

- Impact Evaluation - 'Technical point of view' refers to the impacts that the actions undertaken by the partners will have on environmental issues, social and security aspects, economic life of the city etc. This is based on quantified indicators and procedures for measurement defined in evaluation plans.
- Process Evaluation - 'Project point of view' refers to the process of the actions and aims to identify the forces and weaknesses, the barriers and facilitators which have been encountered during their set up. This is also related to management of tasks and specific tools will be set up at the beginning of the projects to measure this. The influence of external factors on the success of the measures such as political interventions, institutional and legislative frameworks etc must also be documented as this will have a direct bearing on the potential for transfer of the measures to other locations

Results will be

- projects definitions, planning and starts
- time supervision of the relationships between projects
- evaluation analysis of each projects and of the global improvements

EXAMPLE OF SOS APPROACH IN UFT

To identify the position of a specific UFT system and its possible evolutions regarding its management and general organization, it is possible to represent its situation regarding the properties mentioned above. The radar chart below, although using simplified scaling, shows the differences between 2 systems which could be an existing UFT organization and a future one resulting from the analysis of the objectives and the definition of a set of projects.

This example stands in a medium sized city. The current situation is characterized by (orange lines) :

- size : the application domain of UFT covers the city center
- anticipation : UFT concern a large amount of transport SMES, small shops. Demand forecasting exist in many of them however they do not have processes for medium and long term evolution and they are not aware of the possible changes of the general context in which they evolve (market changes, urban evolution,…..)
- adaptability is rather good ; these small organizations are able to react quickly to changes in their environment, like routes/ traffic modifications, new regulations,… However the largest ones, like local transport authority is rather slow to adapt its organization to its own changes.

- UFT management is lightly collaborative ; some concertation actions have been planned in the Urban Transport Planning, a quality freight partnership has been signed by the majority of the stakeholders which is rather not followed.
- Physical interoperability is limited to delivery bays organization and is regulated by delivery hours
- Functional interoperability almost does not exist ; information exchanges between stakeholders are mainly paper supported.

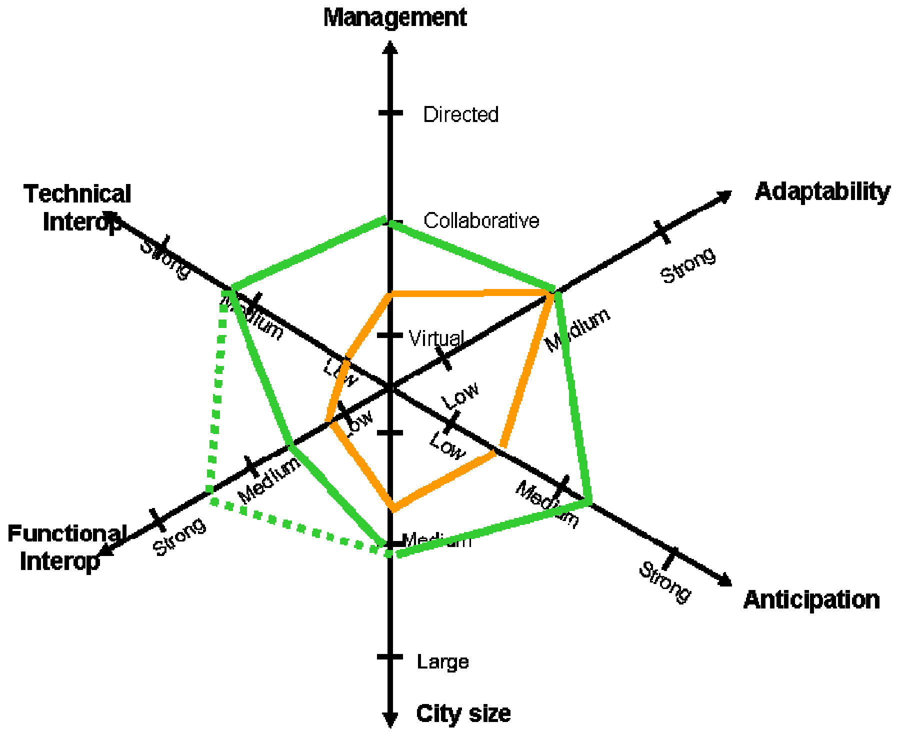

Fig 4 Example of UFT system evolution

The objectives for the future:

- to enlarge the application domain to new areas in the city
- anticipation :the objective is to help stakeholders to gain more awareness on the evolutions of their environment ; this can be achieved through information exchange tools to update stakeholders on future (possible) local UFT evolutions. Other actions were foreseen concerning the external evolutions but not decided.
- adaptability : no improvements are planned in this domain
- management should become more collaborative ; this can be realized first with the reinforcement of the QFP implementation then with the involvement of new stakeholders in the target groups already set up.
- improvements in technical operability will mainly come from the UCC project which will and the re organization of delivery bays which will be more adapted to the current flows .
- 2 levels are possible for functional interoperability. The lowest will accompany the above technical projects (ie electronic data exchange for deliveries and storage) ; the highest will include the integration of delivery software between the majority of stakeholders.

CONCLUSIONS

System of systems approach can lead to some new methodologies and tools to improve UFT organisations ; the relationships and the behaviour of the constituent sub systems of city logistics position them among SoS of which they possess the properties

This paper presented some first attempts to explore this way and to give some representations of possible enhancement of UFT design. One example of the application of the management properties which can be associated to SoS has been presented. Others, more traditional, have been mentioned. Several paths are still open, following the guidelines expressed by several researchers in the System theory field particularly those described for the engineering of adaptive and context sensitive SoS and the research works on system evolutions.

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