Proposal Decision Support Process for Urban Goods Delivery

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***Abstract*— This paper proposes a collaborative process to handle demands received by a carrier for urban goods' delivery. The purpose of this article is to provide support for carriers analyzing the demands, physical resources, human resources, risks and profitability, in order to decide processing internally or externally a goods' delivery demand or rejecting it. Such a process, called CUFP (Collaborative Urban Freight Process), is based on an analysis of urban movements of goods, divided into four stages: check out of extreme conditions, feasibility study, exploitation study and execution.**

Keywords- *Logistics and Urban Transportation, Urban Freight Delivery, Collaborative Delivery of Goods, Decision Support Process, Collaborative Urban Freight Process*.

1. Introduction

The evolution of information and communication technologies (ICT) has made the possibility to use new methods of collaboration between carriers, based mainly on the sharing of information. Without a minimum of logistical coordination, the urban space can quickly become congested, even saturated, generating pollution of such intensity that they eventually make unbearable residents' lives [1]. The development of ICT, including e-commerce reinforces the challenges of urban deliveries, because of its different modes: home delivery, delivery to Internet kiosks, shop delivery [2].

Urban deliveries, lead to the arrival of a multitude of small transport vehicles. Therefore, modeling and decision support systems for the management of urban deliveries have been developed and have given rise to many publications, i.e. which will be detailed later in this paper.

In this article, we propose a Collaborative Urban Freight Process (CFUP) conception, for carriers, helping to improve the management of urban goods deliveries demands. Such a process is intended to help the carrier to choose between processing a demand internally (on its own resources), externally (by another carrier in the collaborative network), or rejecting it. To this end, we have grouped and classified all the parameters that contribute to the analysis of goods urban delivery demands.

This paper begins with a state of the art of existing tools and models for modeling urban goods movements, followed by an activity diagram that illustrates the proposed decision support process' principle. This is detailed later to highlight all parameters involved in the development of an effective decision. Finally, the paper ends with a conclusion the possible extensions and perspectives of the exposed word in this article.

2. State of art

In the literature, several evaluation measures of urban movements' modeling systems are proposed [3]:

- Function of the model: urban goods movements models have several functions and goals,
  - Demand estimation: these models are related to forecasting urban goods demands [4],
  - Optimization: the function of these category of models is the routing optimization [5], related to Vehicle Routing Problems.
  - Simulation of actors' behavior: the function of these models is to simulate the behavior of the involved stakeholders [6].
- Modeling approaches:
  - Top-down: which is based on the choice of large scale variables, then conveyed to smaller scale, and using a predefined model such as the four step model [3], [5], [7] and [8].
  - Bottom-up: this approach is affected by the amount and quality of information available, and it is related to the analysis of data collected [9], [4], and [6].
  - Modeling units: such as trip, commodity delivery, movements, round or mixed models that have more than one unit.

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- Decision support models: several software programs have been developed for urban goods movements, such as: Wiver, Good trip and Freturb.

2.1. Models of demand estimation

A review of different methods of modeling transport demand was presented in [8]. In general, demand estimation models (a detailed state of art on these models is presented in [8]), use multi-stage models, based on the classic 4-steps approach (for more details about this approach, this reference is recommended [46]). Which is called after information and data processing, Land use forecasting, proceeds as follow:

- Trips generation: the estimation of origin and destination points for each zone,
- Trips distribution to associate origins with destinations,
- Choice of transport mode to calculate the proportion of trips between origins and destinations for a particular mode of transport, and
- Choice of the route which consists in assigning roads to trips.

This models of demand estimation has been used frequently for passenger transport, whereas the complexity of introducing the goods as an active agent [10], several approaches that consider the modeling units have been developed. The most common are:

trip based: the observation unit is the flow of vehicles which is estimated using trips generation indicators [10], for an allocation of trips on the roads of a city. Such as, the estimation of greenhouse gases [11]. To estimate the Origin/Destination (OD) matrices of the trips, several types of information are used: passive sensors (camera), and active sensors (vehicle detector) [12].

Commodity based: this approach considers the quantity of goods to be transported as a unit of urban movements modeling. The steps of this type of modelization are:

Firstly, for each zone of a city the needs of its inhabitants are estimated according to the demographic, socio-economic and geographic characteristics [3], the number of vehicles needed is then estimated, and the allocation of vehicles to the roads is the last step. An OD goods model taking into account empty trips was proposed in [13].

Delivery based or ***movement based***: this approach takes as a unit goods movements, which provides a link between the actors: carriers, shippers and transport system [3]. These movements are based on type of goods, type of activity, and number of employees [8].

Road based: considering the specificity of urban movements, standard roads are generalized, which allows us to estimate the distance and the average time for each road [14].

Mixed models: they take as a unit the quantity of goods, the vehicle and the movements; this gives a clear and general idea using all the parameters of urban transport. Nuzzolo and comi give an example of this approach [15].

2.2. Multi-agent simulation models

The need to identify the interrelationships between heterogeneous stakeholders and to measure their effect in the urban transport analysis, can be served through a multi-agent system, to represent the behavior of urban logistics actors. A Multi Agent System considers each stakeholder category as an independent entity, creating modular objects [16]. This system requires for their implementation derived concepts of the artificial intelligence like semantic-web and ontologies.

Ontologies have been proposed for the development of a model based on agents in the field of urban transport, the model includes heterogeneous stakeholders, and the interaction between these actors is well demonstrated [6].

Okdinawati, Simatupang and Sunitiyoso [17], proposed a multi-agent system, based on interactions between the stakeholders of a collaborative network, with the aim of increasing their profit. The agents designed are: Shipper, Carrier and Receiver in several stages (preparation, design and planning).

Wangapisit, Teo and Qureshi [18] presented a multi-agent system to evaluate the joint delivery system and parking management as measures of urban logistics.

Bazzan and Klügl [19] have elaborated a state of art on multi-agent simulation technologies in the field of transport and traffic. It was concluded that these models must include a high level of detail, such as daily activities, to make the system more realistic and flexible.

2.3. Business and decision support tools

Wiver [20], it takes Road-based as a unit, and follows the classic approach of 4-steps. This model has been applied to more than 15 cases in transport planning studies in Germany. It is integrated into the VISEVA program which is recently integrated into the VISSUM Framework.

Goodtrip [21], was developed to evaluate goods movement in the city. It estimated goods flow, freight traffic in the city and its impacts. The purpose of Good Trip is to calculate the volume by type of good for each zone. It is based on a commodity flow; it is constituted of several economic and logistical stages.

Freturb [22], is a specific tool for the diagnosis of urban goods in France. This Framework is the first that has considered the movement: the operations of collection and delivery as a modeling unit. More recently a version of this model have been developed [23], it was built according to this modules:

-Generation of purchase deliveries, pickups and purchase trips;

-Simulation of a street occupation by delivery vehicles illegally parked and delivery vehicles in circulation;

-Measurement of an instantaneous occupation of the road by these same vehicles.

Others modules have been then developed: distribution of inter-institutional flows and estimation of environmental impacts [24], e-commerce simulation [25].

A project named SIPLUS, is presented more recently [9], which aims to develop an ex-ante model for evaluating interventions and investments of urban goods' distribution, in favor of municipalities. This model, based on the analysis of a proposed list of city logistics measures classification, investment limits imposed by the government, and urban data on activities, citizens.

CLASS is a decision support system [7], which contains several modules:

-Input data: people, who live and work in each area . . ,

-Road network: network graph and its associated costs,

-Demand module which is based on mixed approach: commodity-based, delivery-based and truck-based,

- Assignment module for choosing and loading trips, and

- Output module that estimates all the indicators of the chosen scenario.

3. Principle operation of CUFP

Carriers play a major role in urban logistics, and by practicing smart collaborative approaches, in their activities, they can perform urban deliveries while respecting the organizational constraints of the city, ensuring the maximization of their profit and the satisfaction of their customers.

In supply chain collaboration, there are many strategies as collaborative planning forecasting and replenishment (CPFR), Vendor Managed Inventory (VMI), and efficient consumer response (ECR). . . that are applicable between manufacturers or between manufacturers and carriers. Analogs patterns are designed for collaboration among carriers to increase vehicle occupancy rate, and to optimize routing costs, therefore a carrier may not refuse a delivery demand even if its resources are insufficient to perform it, such as bilateral agreements, carrier networks: The market places or freight exchanges [26], the pooling process in transport [27], and the sharing of logistics platforms [26].

There are several freight exchanges, for example: https: //teleroute.com/, https://www.timocom.co.uk, https: //www.returnloads.net/. They are digital platforms that bring together carriers, shippers and customers; the gain advantage for carriers is to increase profitability by taking advantage of return trips.

- We note that, the physical resources are:
  - warehouses and maintenance centers, and
  - vehicles, they can be shared in two ways:
    - vehicle pooling: where the vehicle can be used by any collaborative network member,
    - freight pooling: which consists of giving the goods to the carrier who will visit the final destination [28].
- The information shared can be of different natures:
  - forecasts of the orders,
  - state of the vehicles,
  - information on road conditions and traffic. . .

This article takes interest in informational collaboration and proposes collaborative design system architecture CUFP uses by urban freight carriers to handle urban goods demands. It is part of the category of business and decision support tools and takes several modeling units: vehicle, tours and deliveries, therefore it's a mixed model.

The CUFP architecture is composed of two levels, the first one leads to choice between three alternatives: the internal solution, the external one or the rejection of the demand. For the second level, it helps to develop detailed planning for every selected solution at the first level.

3.1. First level

This level treats the demand in terms of extreme conditions and feasibility.

- Extreme conditions: these are conditions related to the verification of the disposition of physical resources such as special vehicles and means of loading and unloading, in case of a delivery demand concerning special products such as: toxic, refrigerating.
- Feasibility criteria: this study attempts to verify that a demand is economically viable and technically feasible. We divide this study on three axes:
  - Tariff feasibility: define the pricing of the service and ensure its relevance.
  - Temporal Feasibility: check the convergence of the delivery with the defined time segments, i.e. we define time segmentation as determination of departure dates for every tour during the journey, for example, for every two hours a departure of a tour is scheduled

- Feasibility of loading: check the availability of space in the vehicles available in the previously defined starting time segment and the compatibility of the loading units with each other.

The system at this level leads the carrier to choose one of three alternatives:

- Internalize the demand: process the demand by the carrier who received it with his own physical and material means.
- Outsource the demand: process the demand by a carrier that has not received it, it can belong to:
  - Collaborative Network: a group of carriers sharing physical, material, human and informational resources.
  - The freight exchange: a computer operating tool that allows a confrontation between the offer and the demand of transport, it contains several carriers belonging to different collaborative networks.
- Rejection of the demand: for demands that respond adversely to the condition of authorization or that are coming from customers belonging to the black list.

Figure1 shows the different stages of this level.

3.2. Second level

Processes and provides the action plan and detail for each type of solution.

- Internal solution: determines the ideal vehicle to use and the optimal routing. For this purpose, two studies were opted :
  - Exploitation study: consists in examining all the possible cases, then to determine the most optimal one by caring the following studies:
    - Planning and Optimization Study: to develop dynamic plans for the assignment of vehicles to depots, the assignment of loading units to vehicles and the assignment of vehicles to trips. This leads to study any possibility of optimizing these plans by considering several parameters. In this phase, the nature of the solutions will be defined explicitly: direct, indirect or mixed. Details of those natures of solutions are giving in section 4.
    - Profitability study: this study is doing for every nature of proposed solution in the previous phase, in order to assess the cost-benefit and minimize the cost. The benefits are qualified by evaluating the revenues and by determining the expenses in a specified way.
  - Execution study: this consists of real-time monitoring of vehicles to ensure that demands are delivered at the right time, in good conditions and that delivery men work efficiently. It also helps to evaluate risks, revenues and costs to have a comparison between estimated and calculated values, and actual values.
- External solution: the system using artificial intelligence tools in order to select the best carrier to entrust the execution of the demand, based on criteria of carriers' profile evaluation(carriers who belong to the same collaborative network)and according to the feasibility and the profitability of the demand. In the case where there is no external carrier that can fulfill the demand, the system sends this demand to an external freight exchange to be performed by a carrier that does not belong to the collaborative network. It also happens that some demands are directly referred to a freight exchange because they meet conditions that are not satisfied by members of the collaborative network: special merchandise, vehicle or destination.

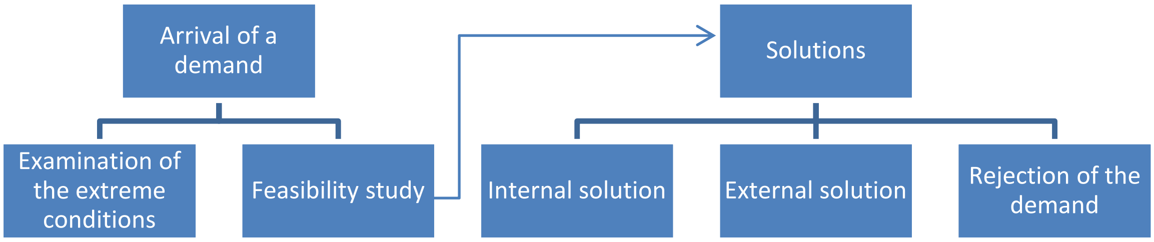

Figure1. Stages of the first level

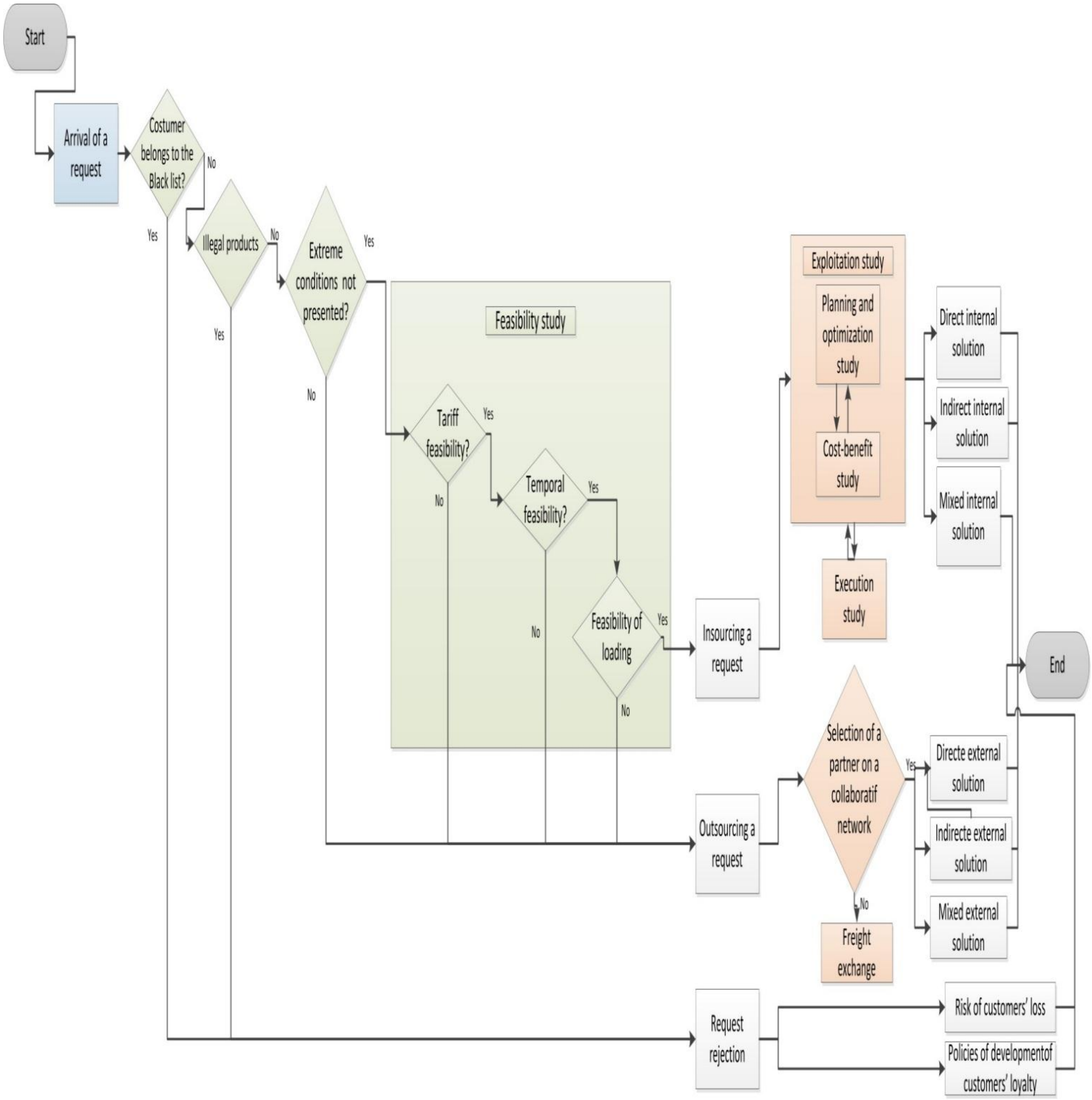

Figure 2. Global proposed architecture

- Rejection: if a demand is rejected, the system evaluates the risk of loss of the customer and proposes policy for customer loyalty.

There are several factors that affect directly the loyalty of a customer, such as: reliability, responsiveness, price, bad customer relationship and the non consideration of his demands and his complaints. In addition, there were two variables directly affect customer satisfaction, namely comfort and price [29].

Internal and external solutions can be direct, indirect, or mixed.

- Direct solution: it means that the delivery to the customer is done directly, by eliminating the intermediate steps like switching to the exchange points in the distribution network, which requires the use of a single vehicle. It can be done internally by the carrier who received the demand, or externally by another single carrier belonging to the collaborative network.
- Indirect solution: it consists of delivery by at least an intermediary (exchange deposits), or by changing the vehicle at least once during the delivery journey. Likewise, it is called internal if the carrier who received the demand makes the delivery. It is called external if another carrier belonging to the collaborative network makes the delivery via intermediate points: the system supposes trips with correspondence where several carriers intervene.
- Mixed solution: it is applicable, during the appearance of the events during the tour. It may undergo changes in the nature of the solutions, for example, the addition of the exchange points, the change of the vehicle during the trip or the addition of another carrier that will help to make the delivery.

Figure2 present an activity diagram that illustrates the general operation of the fore-mentioned process which each of its steps be explicitly detailed later.

4. Explicit Exploration of the CUFP

In this section, we detail for both levels of the proposed architecture, the various stages.

4.1. Demand processing at the first level

For the treatment of a demand at the first level, the proposed system suggest to check the following points:

Customer belongs to the black list

The "Black List", is a list with clients considered undesirable , it is due to the non-professionalism of the customers which is summarized on the following points:

- Customer involved in shady business,
- Does not respect payment deadline,
- Payment not made or in payment recovery phase,
- Return the goods without any reason,
- Non-presence of the customer in the moment of delivery,
- In dispute with one or more members of the collaborative network.

Therefore, if a customer belongs to the blacklist, the system reject his order immediately.

Illegal products

The rejection of a demand will be automatic if it concerns the transport of the illegal products, which are prohibited to circulate in all the territory. Without looking for an opportunity to outsource this demand, indeed the carrier cannot perform this demand whatever the motivations: profitability and provenance from a loyal customer.

Extreme conditions

This phase consists in examining the extreme conditions of a demand with the aim of rejecting-it, determining the possibility of studying its feasibility or directly transferring it to the outsourcing stage. This step is intended to optimize the processing time of demands.

These conditions can be define as regulations imposed by the carrier that gives a initial evaluation of a demand, to be rejected, outsourced or retained for the study of its feasibility, i. e. it is not a definitive acceptance of the demand. These regulations are generally related to the provision of ideally physical resources like specific vehicles for the transport of products of special nature: refrigerated, toxic. .

Feasibility study

If the demand does not include an extreme condition, the second phase is to study its feasibility. This study aims to verify that a demand satisfies all the technical conditions to be served internally. It is divides into several axes:

- Tariff feasibility

The purpose of this study is to define the price of the delivery service. It depends mainly on the nature of customer:

  - The loyal customers: a customer is faithful if the frequency and the profitability of his demands are high; the protagonists proceed in this case by contracts or pre-negotiated rates.
  - New customers: the carrier can be content with a small percentage of gain to recruit them. He must have a minimum threshold, which he cannot accept a demand with a lower price. Therefore, it

announces special rates: promotion or recalculated, and accepts negotiations.

- Temporal feasibility

After the validation of the price, we proceed to evaluate the delivery time imposed by the customer. This period of time depends mainly on contextual constraints. They relate to the road context and consequently to the accessibility of the destination places at the delivery date, this constraints include accidents, vehicle breakdowns, poorly programmed traffic lights, special events such as mass social events, political rallies, bad weather, etc [30], we regroup them as follow :

- Peak of periods and times: are affluence periods in the year, such days of national or local holidays. This directly affects the delivery time due to the traffic jams caused. As for peak hours, these are the periods of the day in which the traffic is densest. The grid and time windows must be taken into account to include effects of rush hours [31]
- The weather: bad weather conditions directly affect the delivery time, and restrict the access of the infected areas.
- Public Works: as infrastructure works or road reforms, also cause a longer delivery time due to traffic jams generated and sometimes a difficulty, or a ban on access to customer locations.
- The demonstrations: a demonstration multiplies the presence of the population in this zone, which makes the circulation very delicate and dangerous.
- Road accidents that can lead to disruption of traffic [32] and consequently a blockage or slowdown of traffic that affect negatively the delivery time.

- Loading feasibility

After studying the temporal feasibility, the study of the feasibility of loading consists of:

- Check the availability of material (equipment) and physical(drivers)resources in the starting time segment defined previously.
- Check the spatiotemporal availability of the vehicle: convergence in the same path at the same time.
- Check the layout of loading spaces, in terms of weight and volume, in the available vehicles. This disposition can be:
  - Complete: the existence of sufficient space for all loading units of a demand.
  - Partial: in this case, the demand can be served only if there is a possibility of splitting, otherwise the demand is considered as not feasible. The split delivery is characterized by several visits to customer, and for every visit, the carrier delivers a part of his demand.
- Check the compatibility of the loading units in the spaces available for the previously defined time segment, in case of a demand which contains non-compatible loading units with each other, the customer must accept the split delivery of his demand, having as constraints:
  - The maximum charging rate that a vehicle can support,
  - Delivery scheduling: LIFO in most cases.
- Respect the charge rate of a vehicle: the capacity limit in terms of loading units and its mechanic charge rate that includes wear of tires and maintenance, except for special cases such as: the urgency of a demand, a loyal customer’s demand. This is the same for the respect of the LIFO policy when unloading the loading units.

Parameters considered in the feasibility study are detailed in figure3.

4.2. Demand processing at the second level

In this level, the system provides to the carrier, for each solution selected at the first level, details of its operation.

For internal solution, we study its exploitation: development of resource allocation schedules, the optimization of theseplans by environmental, social, economic studies, and risks and profitability studies of the selected plans. Finally, we study the execution of the selected planning for real time monitoring.

For the external solution, we focus on the selection of the optimal partner, to entrust him with the ececution of the demand which cannot be treated by internal resources.

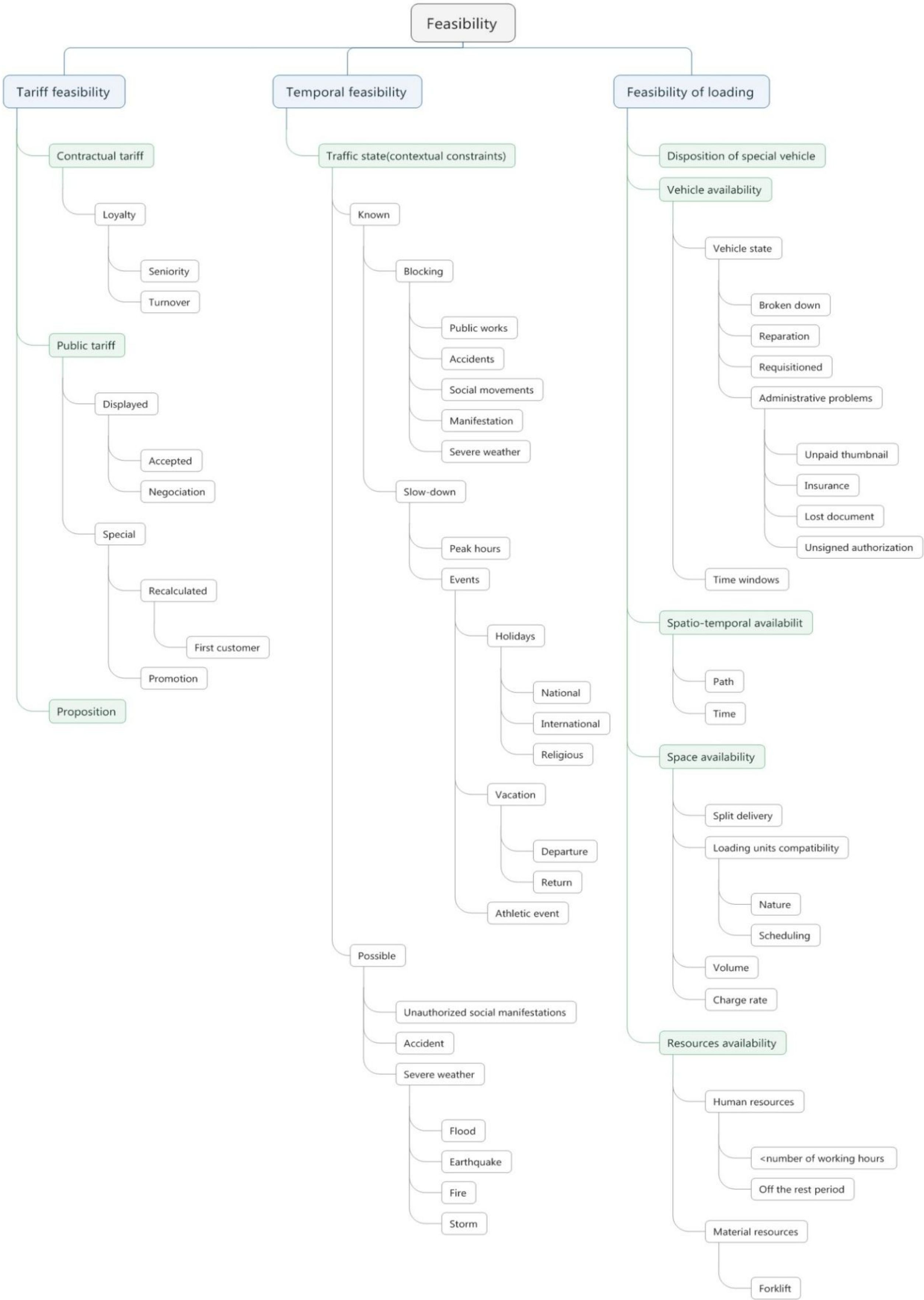

Figure 3. Feasibility study

4.2.1. Internal solution

We detail different steps to process an internal solution.

- Exploitation study

If the demand is feasible, that is, it responds favorably to the feasibility conditions, and that it does not include extreme conditions, the next phase is the study of its exploitation, in other words, we study its planning, optimization and profitability.

  - Planning

For planning, we use dynamic planning algorithms for:

    - Assignment of vehicles to departure points,
    - Assignment of loading units to vehicles,
    - Assignment of drivers to vehicles and
    - Assignment of vehicles to tours.

These algorithms are based on the rules and the related scenarios for each parameter: Vehicle, route, loading unit, zone, tour and delivery, which allows us to set the number of tours per vehicle, the sequencing of the tours and, the resources to use.

  - Optimization study

We study any possibility of optimization that includes taking into consideration:

    - Different risks: Accident, damage to the loading units.
    - Different aspects of demand: Economic, social and environmental.

This allows us to choose the most optimal resources: Vehicle, driver, depot and route. Indeed, the feasibility stage reveals all available resources that can meet the demand; the optimization stage determines the most optimal among them.

Environmental study

This study focuses on the dimension of sustainable development, mainly to minimize the emission of fuel and all air pollutants. In general, this study summarizes the caracteristics that affect the vehicle level consumption.

The use of Heavy Goods Vehicles induces environmental impacts, such as pollution, noise, vibrations and visual intrusion [33].

All these factors contribute directly to the consumption of a vehicle, and subsequently to the volume of gases emitted.

In London, wireless sensors network for air pollution monitoring infrastructure is proposed to collect real-time, large scale and comprehensive environmental data from road traffic emissions for air pollution monitoring in urban environment [34].

City of Padua in Italy is a good example of a city in which *green logistics* approaches have been applied using electric delivery trucks, this has as a first economic result the possibility to make deliveries at any time during the day, although it was only possible at specific times [35].

Risk study

The study of the risks is a prevention of any event likely to cause a dysfunction in the process of the delivery, indeed the study of the risks makes it possible to:

- Anticipate the risks and the implementation of the means of prevention and protection.
- Reduce the consequences of such an event on the human, material and financial levels.
- Determine the adaptability of a vehicle to the risks to which it is exposed.

The risk study assesses the different risks that urban freight can have, based on their cuases. These risks are related to:

- The loading unit: theft or damage. These risks are related to the driver's driving style and performance.
- Vehicles: Accidents and contraventions. These risks are related to contextual constraints related mainly to the driver performance and to the natural disasters [36], road conditions and urban infrastructures conditions. The land instability is one of the major factors that determines urban infrastructures [37].
- Traffic: congestion that can be caused by contextual constraints, and factors related to road infrastrctures [38].

These risks generally lead to delivery delays, which pushes the carrier to practice customer loyalty techniques such as: refunding, profit-sharing and paying penalty costs to customers. This negatively affects the profitability of the demand.

Social study

The social study prensents the evaluation characteristics of drivers and cutomers, in order to classify drivers according to their efficiency , and to satisfy customers. This study aims to improve customer service and the vitality of the staff for a better efficiency of drivers.

The societal evaluation indicators are: compliance with specifications, compliance with regulations, items sampled per person and per hour, work efficiency, perceived quality, perceived value of the product and error percentage sampling [39].

We assume that for the evaluation of drivers, we rely on indicators to estimate physical condition and interaction with customers. This allows assigning the best driver to the tour. Driver behavior can be modeled using vehicle tracking, lane change, acceptance of vehicle spacing, and route selection [40].

Rewarding actions for successful drivers to work efficiently, such as the introduction of bonuses and the allocation of extra time off.

For the evaluation of customer satisfaction, introduce the notion of time of service in tour planning. This time includes filling out a service evaluation form, receiving complaints and returning orders.

In the case of delay, the rewards offer is desired, such as: reducing fees or adding additional items.

Economic study

The purpose of this study is to improve the efficiency or the gain, the idea is to study the efficiency of the order: revisit tour planning, and if there will be a more optimal combination before the critical delay, the planning will be readjusted.

For this purpose, we evaluate all possible scenarios in terms of routing costs, it is the variable costs that can change from one combination to another. For other types of costs: Fixed costs and insurance, have already been evaluated and do not vary according to route planning.

In figure4, parameters considered in this study are detailed.

- Profitability study

The study of profitability allows measuring the optimality of the resources chosen and the routing plans established, depending on the revenue generated and the associated costs [41] for each proposed solution, the aim is to minimize the costs while maximizing profit.

In the feasibility phase, we are certain that the demand is feasible in terms of tariff, that is, it will generate gains. In this step, we accurately quantify the gains by estimating revenue and determining expenditures in a specified manner. This step consists of evaluating the revenue according to the fee schedule, and determining the costs that will be detailed in the following.

Revenue evaluation

The evaluation of the price to be communicated to a customer does not only depend on the distance traveled or the volume to be transported, but also depends on another very important factor which is customer loyalty. Indeed, the profit margin is a linear function with customer loyalty, it is important both for loyal customers with whom we have signed contracts, and less important for new customers.

Gain = Tariff + loyalty feature or a new customer.

The calculated price is equal to the expenses or the costs plus the profit margin. Indeed, for a new customer the profit margin can be lousy or marginalized. It takes a commercial or promotional character to guarantee a competitive price.

Calculated price = cost + profit margin.

The fee schedule defines the transport costs of loading units [42], according to several parameters: weight, volume, distance, filling rate, and Type of vehicle used.

Therefore, the price cannot be lower than the costs evaluated in this grid.

The proposed price to a customer depends on the price list and the gain margin. The latter depends on the customer nature: loyal or new.

Cost evaluation

The costs generated to accomplish a demand can be classified under several categories: fixe, variable costs and insurances.

Fixed costs such as rent or depreciation in case of purchase,

Fees paid to insurance against the different types of contraventions and possible risks, such as: Theft and allowances.

Variable(routing)costs depends on several parameters, such as time and distance [42].

Costs of urban transport are in general estimated by optimization algorithms [43].

Figure5 assess in details the parameters of benefit and costs estimation.

4.2.2. External solution

This solution consists of spreading the demand to all the carriers belonging to the collaborative network, and every carrier assess individually the demand at the first level: extreme conditions and feasibility study, and in the second level: evaluation of costs and the development of the different plannings, then the system retains the set of the carriers who accept to carry out the demand, and assess the different possible cases according to the several criteria. Awasthi, Adetiloye and Crainic, [44] proposed four classes of partner selection for city logistics planning: benefits, costs, opportunities and risks.

We propose the following classification of the partner selection in figure6.

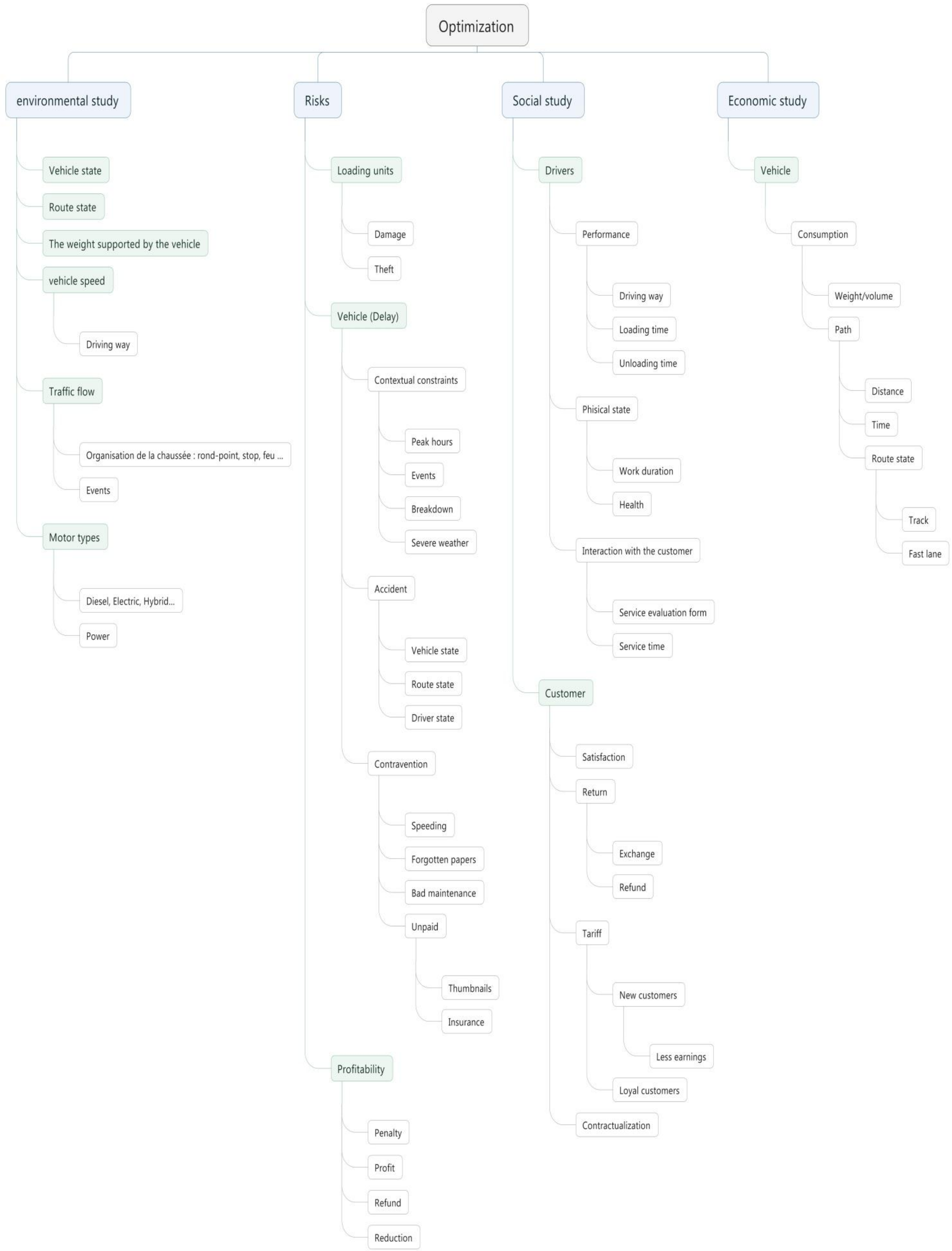

Figure 4. Optimization study

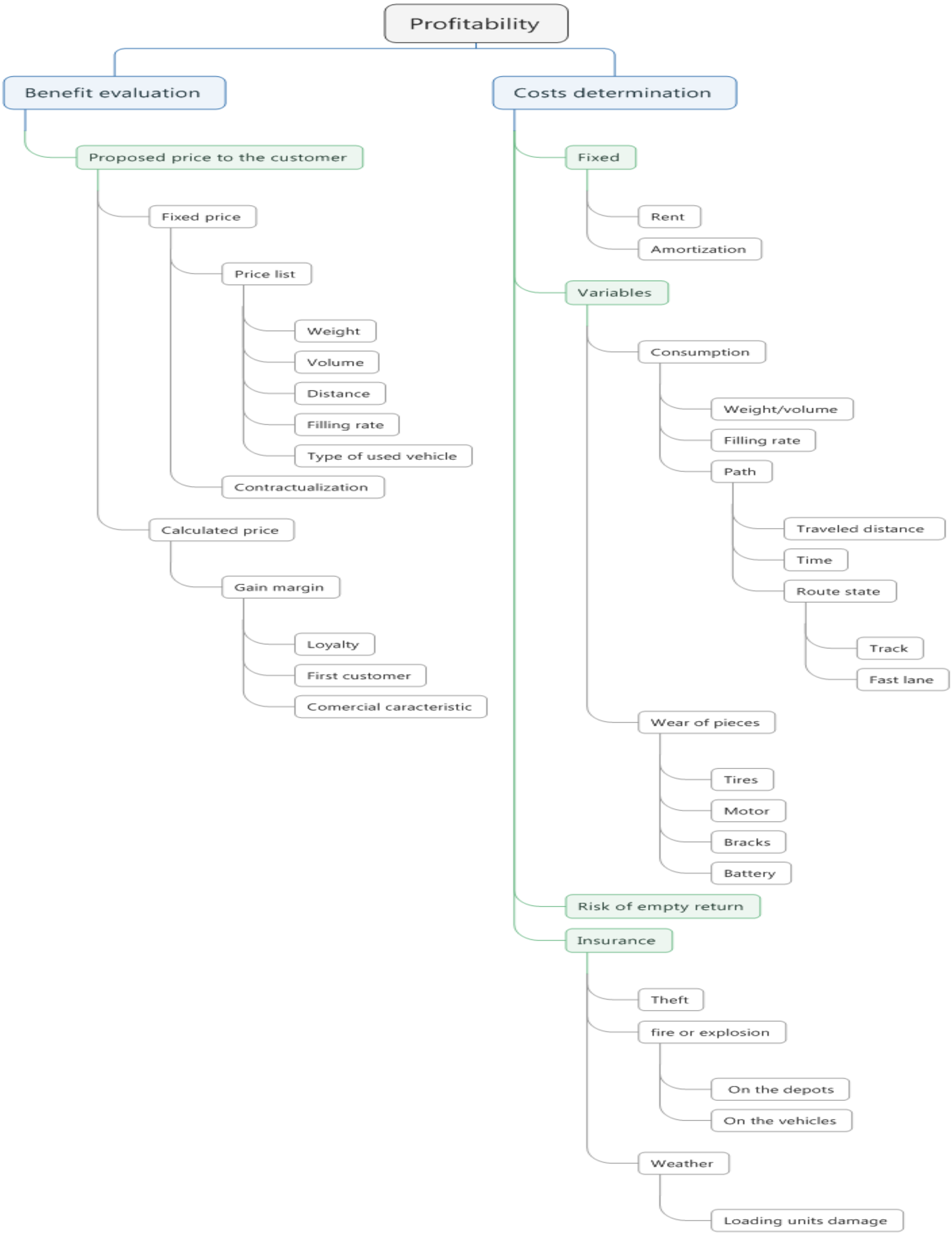

Figure 5. Profitability study

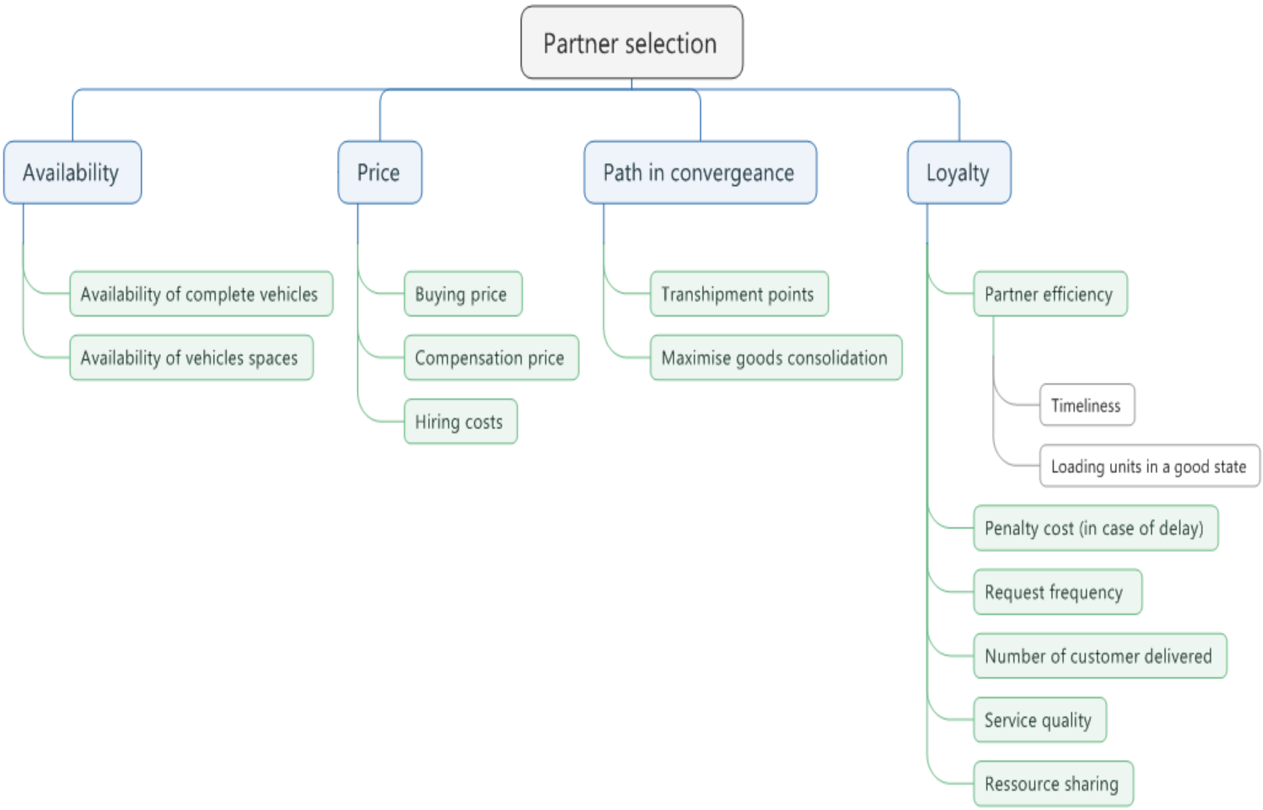

Figure 6. Partner selection

The objective of the system is to retain the carrier who can carry out the demand with the least cost, while taking into account the parameters cited above. The price paid by the retained carrier to the carrier who tranfers its demand (Price C2), is equal to: Price C2≤Cost C1, Price C2=Cost T2. The last step is the final acceptance of the carrier, and the benefit sharing among concerned carriers [45].

If no carrier in the collaborative network is willing to accept the demand, the system redirects it to an external freight exchange, and the partner evaluation process remains the same as in the collaborative network.

The proposed architecture of urban freight transportation demands, helps the carrier to choose to process its demand internally or externally based on the examination of extreme conditions and, feasibility study at the first level. It also offers plannings and their optimization for the internal solution, and a set of criteria for selecting partners in the case of external solution, at the second level of the solution.

5. Conclusion

In this paper, we have proposed a process for urban freight transportation. Such process is based on all urban delivery parameters: physical, humain and material recources, contextual conditions, risks, profitability and traceability. It is a model that constitutes a reference for urban carriers for the evaluation of urban demands.

In future publications we will focus on strengthening collaborative approaches(the second level of the system).

The proposed solution will also be enriched by human recources sharing in condition that the legislation of the concerned countries is favorable. This aspect allows traditional actors to have scientific and technological tools needed to deal with the new trends of urban transport such as Uber.

The implementation of this tools, based on scientific methods, and Artificial Intelligence techniques, will form the base of our future researches.

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