# Configuration and Response to calls for tenders: an open bid configuration model

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**Delphine Guillon**[1,2] and **Abdourahim Sylla**[1,3] and **Élise Vareilles**[1] and **Michel Aldanondo**[1] and **Éric Villeneuve**[2] and **Christophe Merlo**[2] and **Thierry Coudert**[3] and **Laurent Geneste**[3]

**Abstract.** During bidding process, bidders have to submit offers which will suit the customers' requirements. The OPERA project aims at building a decision support tool to help bidders to design offers using CSP and compare them on orignial indicators. The objective is (1) to help bidder to have the same routine for bid answerings (2) to help them to design more accurate responses and more efficiently. One of the major tasks during bidding process is offer elaboration, which is in our case, 90% a configuration problem and 10% an innovative design one. Four industrial partners are part of the OPERA project: two in the secondary sector and the two others in tertiary one. This paper presents the first results of this project for open bidding configuration. Therefore, we have built a first version of an open generic bidding model which gathers three types of offers data: (1) context characterization data, (2) data defining the product or service and (3) data defining its delivery process, in case of success. Context data allow to characterize the customer profile, the call for tender characteristics, the bidder profile and the environmental factors. The product is decomposed on subsystems and components using a bill of materials and we propose some tracks to extend our model to services. The process is composed of activities, characterized by a couple (resources, workload). This model has been tested on one use case for each industrial partner. This paper is illustrated by a generic instance of a bike open bidding configuration.

## 1 INTRODUCTION

The response time to calls for tenders has been greatly reduced in the last decades. In a more and more global and competitive environment, companies have now to bid very quickly and very efficiently to calls for tenders. Their bids must be competitive both in quality and selling price if they want to have a chance to win. In such a context and with the increasing number of calls for tenders, companies cannot afford to spend time and resources to study in details their bids. They have now to rationalize, systematize and make more reliable bids definition.

Our aim is to design a tool dedicated to the bidding process in order to help bidders to respond quickly and efficiently to call for tenders. The tool will help a team of consultants to have the same routine for responding to bids. Therefore we propose to build a knowledge-based system or KBS, to help companies to define their bids in such a way they suit the best customers' requirements. We consider that defining a bid corresponds to partially configure at the same time a product or a service and its delivery process [25]. In this paper, we propose a generic bid decomposition and an open generic model for both products and services to support the bidding process. The KBS will be based on this model.

This work is part of a French project, named OPERA, which aims at tackling this problem of response to calls for tenders. OPERA is a French acronym for "Outils logiciels et ProcEssus Pour la Réponse à Appel d'offres", which means "Software tools and Processes for Bids". The OPERA project has started in November 2016 and involves four industrial partners which are daily confronted to this problem of response to call for tenders. In this panel, two of the companies are from the secondary sector while the two others are from tertiary one.

After an initial phase of 6-month interviews, we have found out that the definition of a bid corresponds for 90% to a configuration problem and 10% to a design one: this means that we are mostly in a configuration problem (Assemble-to-order situation), with a small part of new items to be designed (Engineer-to-order situation) [21]. Therefore, we call this particular problem an open bid configuration problem. In addition, a general bid structure as well as a generic bidding process have started to emerge from these interviews. These initial findings lead us to propose the first version of a generic model for open bid configuration.

The rest of the paper is structured as follows: first in section 2, we sketch the OPERA project scope : the four companies involved in the OPERA project are introduced as well as the interview process. We conclude this section by presenting the OPERA tender response process in the light of the literature review. Second, in section 3, the general bid structure is drawn and leads us, in section 4, to the definition of the generic model for open bid configuration dedicated to products. In section 5, a focus is specifically made on the extension of this open product model to services. A discussion and some perspectives conclude our article in section 6. An example of an open bike configuration illustrates our proposals throughout the article.

## 2 OPERA PROJECT SCOPE

In the past six months, the four companies involved in the OPERA project were interviewed about their tendering process. Two main findings have led us to consider the tendering problem as an open bid configuration one. Let us start by describing the four companies and the interview process we have followed.

### 2.1 OPERA Companies

The four companies involved in the OPERA project are daily confronted to the response to call for tenders problem. They answer more

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than 100 calls for tenders per year without any guarantee to win.

Two of the companies are from the secondary sector: one of them designs and produces computer numerical control (CNC) machines, and the other one designs and assembles control systems for harbor cranes. The two other companies are from the tertiary sector: one is a professional consulting and training firm, specialized in Supply Chain, Lean Management and industrial methods and the other one is the global leader in innovation and high-tech engineering. Three out of the four companies are SMEs and all of them are present on the world market.

Regarding the tender response process, it mainly relies on some human expertise and know-how. But there are very few experts in that field within the companies and they all have their own way to answer to calls for tenders. None of the companies has a dedicated knowledge-based system able to support this process. Only one company has an Excel file dedicated to the financial part of the tender response: this Excel file helps them quoting the bid by estimating the financial risks incurred. The four companies really want to improve their tender response process in order to be more confident in the proposed bid by capitalizing on good practices, by standardizing their ways of doing things and by assessing risks.

## 2.2 OPERA Interview Process

In order to capitalize on the companies' know-how on tender response process, we conducted interviews during the last 6 months. We had a monthly one-day meeting with each of them.

Our questionnaire included the following sections:

1. Definition of a bid: which data are needed ? Which documents are produced ? Which decisions are made ?
2. Description of the tender response process: which steps are followed ? Which activities are carried out ? Which people are involved ? etc.
3. Description of the product or service: which items are necessary ? How is the technical part designed ? etc.
4. Description of the risk management: does a risk management process exist in the company ? How are risks taken into account ? What is their impact on the bid solicitation ?
5. Description of the bid knowledge management: is the knowledge capitalized ? How is it shared between bid experts ?

This first round of answers have allowed us to identify a first generic structure of response to tender and to consider this problem as an open configuration problem. Indeed, $90\%$ of the response correspond to a configuration problem, i.e. the selection of relevant items in the item catalog, whereas $10\%$ correspond to a design problem, i.e. the design of some specific items to fulfill some specific customer's requirements. Answering to a call for tenders is therefore a mix of configuration and design.

## 2.3 OPERA Tender Response Process Definition

[4], [5] and [7] have studied the bidding process. According to [7], it includes four activities: analysis of opportunity, design of technical offer, calculation of selling price and proposal to the client. [13] describes this very competitive environment.

Two types of call for tenders can be distinguished: public ones and private ones [5]. Public tenders are clearly specified. The final customer has to put companies in direct competition on very strict conditions. Private calls for tenders are less formal. Three out of our companies are used to submit only to private tenders. Only one is used to public one. Thus our model aims at being as more generic as possible to be used for the both types of call for tenders.

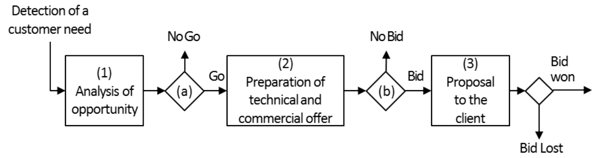


**Figure 1.** Bidding process, adapted from [7]

The OPERA bidding process, as described in Fig. 1, is a combination of the literature review and the results of the 6-month interviews. The bidding process starts when a company detects a customer's need. It can be a formal invitation to tender or the knowledge that a particular customer needs something new. The company has then to analyze the opportunity to bid. It is the first step of the bidding process. We have identified two major decision steps:

**Go/No go decision:** A decision is made to answer or not to the call for tenders. In the literature [7], this decision is called "Bid/No Bid".

**Bid/No bid decision:** A decision is made to submit or not a bid to the customer. For instance, if the bid is not ready on time or if finally, it seems complicated to propose a solution in the bidder's scope or if the offer does not generate enough margin, the bidder can decide at the end "No bid".

For the four companies involved in the OPERA project, the *Go/No Go* decision is made after a macroscopic financial analysis. If the call for tenders is financially promising or strategic, the bidding process is launched. It appears that only less than $5\%$ of responses are not submitted in the *Bid/No Bid* decision step. The first *Go/No Go* decision point is therefore critical for the companies but is out of the scope of the OPERA project.

Our work focuses on the activities between the *Go/No Go* and *Bid/No bid* decision points, as detailed in Fig. 2.

First, the product or service as well as the delivery process have to be defined. Second, a partial risks analysis is carried out to provide more realistic costs and due date. We have to point out that the definition of the bid is an iterative process. There can be several round trips in order to clearly define the offer. These loops can have several reasons: either the cost or due date do not fit the customer's requirements (too expensive or too long), or the project is too risky for the company (there is a big risk to loose money), or the specifications have changed due to the fact that the customer has changed his mind. The KBS should help the companies to build different bids on the same specifications, to compare them following relevant criteria (selling price, due date, risk, confidence) [25] and to select the one which suits the best both customer's requirements and companies' skills.

# 3 GENERIC BID STRUCTURE FOR PRODUCTS

In this section, we firstly clarify the concept of bid (see subsection 3.1). Then, the identified data and knowledge needed to define a bid have been structured in four different sets. The first one characterizes mainly the context of the call for tenders (see subsection 3.2), the second one, the bill of material (see sub-section 3.3) and the third one, the delivery process and the potential risks incurred (see subsection 3.4).

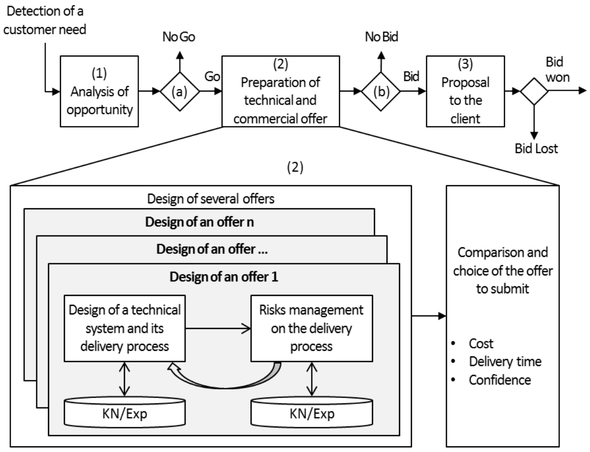


**Figure 2.** Part of the OPERA Bidding Process

## 3.1 Bidder and Customer Bids

From the interviews, two kinds of bids have emerged and have to be distinguished:

- The **bidder bid** gathers all the information, documents, data, work, that have been done or used during the bidding process. All the data, information and knowledge used to define the bidder bid are collected and stored in the knowledge bases in order to be reused for future bids.
- The **customer bid** corresponds to an extract from the bidder bid and is submitted to the customer after the *Bid/No Bid* decision point. Indeed, a large part of the work carried out by the company during the bidding process is simply not provided to the customer. Most of the time, the customer bid always contains a description of the bill of material (or BOM) and the selling price, with sometimes the provisional schedule of the project.

In this paper, we only focus on the definition of the bidder bid. The bidder bid is divided into two parts: the first one corresponds to the bill of material and the second one to its delivery process, taking into account the key resources and the major risks. A partial analysis of the risks is mandatory first, to better evaluate the delivery time, second to post the associated cost on the project cost and third, to be aware of the potential hard points during the project.

## 3.2 Bid Context

The context of the response to call for tender has a strong impact on the bid, for both the BOM and the delivery process [2]. We have started to identify the key elements of the context of the invitation to tender which have an influence on the bid.

Four types of key elements seem to stand out and characterize (1) the customer's profile, (2) the call for tender characteristics, (3) the bidder's characteristics and (4) the environmental factors. These elements will allow the bidder to propose an offer which will fit the customer's requirements observing the whole call for tender context.

**Customer's profile.** First, the customer's profile can have a very strong impact on the definition of the bidder bid. For instance, a regular or a strategic customer can involve some specific resources or item high quality or Technical Readiness Level (TRL). Therefore the company has to identify a list of features characterizing potential customers. For each invitation to tender, the potential customer has to be described thanks to all the selected features.

**Call for tender characteristics.** Second, the characteristics of the call for tenders can also have an important impact on the offer. For instance, the bidder can choose to submit different offers for a public market or for a private one.

**Bidder's characteristics.** Third, the bidder characteristics, i.e. context within the company responding to the call for tenders, can have an impact on the bid. For instance, the workshop load or the backlog state (at the time of the bid) might have to be considered while defining the bid. A bad estimate can be catastrophic and may result in non-compliance with the commitments made in the bid, which is especially true for the delivery time.

**Environmental factors.** Then, the environmental factors, i.e. context which is external to the company, can also play an important role on the choice of some items of the bid. For instance, identified competitors or detecting the emergence of a new market can have an impact on the company's financial margin. In some cases, the season or the weather can affect the delivery process. It is therefore important to take these kinds of information into account from the beginning.

## 3.3 Product decomposition

### *3.3.1 Bill of materials*

The second part of a bid corresponds to the bill of material or BOM. This BOM relies on a generic model of the product catalog. The definition of the bid is based on this generic model but not only. As previously mentioned, the interviews have revealed that 90% of the bid BOM correspond to a configuration problem [19], [26] whereas the remaining 10% to a design one. The generic model has therefore to cope with the 10% of design.

In the OPERA project, we have restricted the number of levels for the BOM to three: at the top, the final product, in the middle, the sub-items composing it and at the bottom, the components. In Fig. 3, an instance of BOM for a bike is presented.

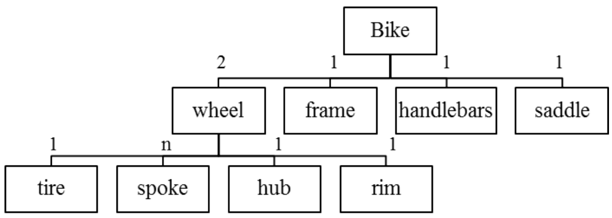


**Figure 3.** Instance of Bill of material for a bike

The BOM is gradually building up by decomposing the final product into sub-items and components. This decomposition is based on concepts that are linked to each BOM item [8]. In the OPERA project, we link to each concept of the ontology [24], a constraint satisfaction problem. Two types of concepts of the ontology have been identified:

- those corresponding to already known items and for which a generic model exists, i.e. representing the set of all possible combinations. These concepts are mainly used for the configuration problem (90% of the bidder bid BOM).
- and those which are new and have to be designed. These concepts are mainly used for the design problem (10% of the bidder bid BOM).

An existing concept gathers some knowledge about itself: features, definition domain and relations between features. For instance, in our bike example, one item associated to the *Wheel* concept, is characterized by a diameter, a spoke number and a price, one item associated to the *Bike* concept is characterized by a size and a price, one item associated to the *Tire* concept has a diameter and a price, as shown on table 1, whereas an item associated to a *New* concept brings together no features other than price.

**Table 1.** Item Knowledge Concepts Example

| Concept | Features | Definition domain |
|---|---|---|
| **Wheel** | Wheel Diameter | [12, 29] inch |
| | Spoke Number | [16, 20, 28, 32, 36] spokes |
| | Wheel Price | [100, 1600]€ |
| **Bike** | Size | [16, 25] inch |
| | Bike Price | $\geq$ 0€ |
| **Tire** | Tire Diameter | [12, 29] inch |
| | Tire Price | [100, 600]€ |
| **New** | Price | $\geq$ 0€ |

Knowledge embedded in concepts (existing or new) can be enhanced during the bidding process: some features with their definition domain can be added as well as their relations within a concept.

#### *3.3.2 Key Performance Indicators*

Usually the bidder design more than just one offer to respond to a call for tender. We propose to use some key performance indicators (KPI) to characterize each offer and to help the bidder to compare them and choose the one which will suit both customer and bidder requirements in the best way. Each item of the BOM is characterized by relevant KPI. Those are at least the cost and the confidence.

**Cost.** First, we obviously have to compare the different designed offers on the cost. The aggregation of the cost of bottom item of the BOM (mainly components) and each integration will allow to calculate the cost of the product. Depending on the company and on what is key for it, we can also use price or margin.

**Confidence.** We also propose to use confidence as defined by [25] to evaluate the confidence of the bidder on the ability of the company to design and deliver a product, aggregating the confidence for each components

Depending on the product and the company, one can take into account weight, speed or energy consumption of the product in the KPIs. These KPIs are aggregated bottom-up and help the decision-maker to compare different offers and make the best decision about the one to choose and submit to the client.

### 3.4 Delivery Process for Products

The third part of the bid is dedicated to the delivery process. This delivery process is composed of the key activities that have to be carried out inside company [16], [23].

#### *3.4.1 Why configuring the delivery process during the bidding process ?*

In order to be able to correctly respond to a call for tender, companies cannot just stop after the definition of the product or service. They also have to think about the delivery process in order to evaluate more accurately:

- the delivery time proposed to the customer,
- the cost of the delivery process,
- the risks which might occur during the delivery process.

**Delivery time.** The delivery time is most of the time the major criteria to respect as it is part of the agreement. In case of delay, some late fees can have to be paid by the company. It is therefore critical for companies to evaluate it as accurately as possible.

**Cost.** Sometimes, the cost of the delivery process has to be included in the whole bid selling price, for instance the cost of a delivery in a foreign country. Don't include this cost could induce an important gap between the evaluated cost and the real cost, meaning that the company's margin can dramatically drop.

**Risk analysis.** A partial risk analysis should also be carried out to identify as early as possible the major problems which can occur during the project (in case of a success). The analysis of the major risks' impact (on cost and time) is critical to better evaluate the delivery time, the bid's cost (and therefore the company's financial margin) in both an optimistic and pessimist situations. Indeed, an answer to a call for tenders is the first commitment between a customer and a potential supplier. It seems quite difficult to radically change the price or delivery time after a first bid on the same specifications.

#### *3.4.2 Proposition of a generic delivery process for products*

In the OPERA project, for the secondary sector companies, the generic delivery process is a sequence of activities. The activities are the most important ones regarding the bidding process, and have been identified by the bid experts. From the interviews, a generic delivery process has been proposed, as presented in Fig. 4. This generic delivery process is composed of five activities:

**Design and Scheduling studies.** In this activity, all the new items have to be designed and integrated to the bill of material. We also plan the Gantt chart of the project.

**Procurement.** All the components and raw material have to be supplied.

**Manufacturing.** The components have to be manufactured to build the final product,

**Assembling and Testing.** The components have to be assembled and the final product has to be tested and must comply with the specifications.

**Delivery and Commissioning.** The final product is delivered to the customer.

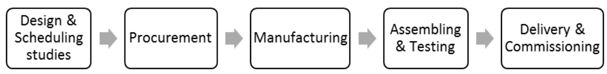


**Figure 4.** Instance of Product Delivery Process

#### *3.4.3 Key features identification*

For each activity, the bid experts have to identify the key features. Those are the ones which have emerged from our interviews:

- duration: each activity may be shorter or longer, depending on several facts, such as allocated resources, risks, complexity, etc.,
- key resources and workload: each resource is characterized by a type (human or machine), a level (slow, fast, junior, senior, etc.) and a workload (under-loaded, loaded, overloaded),

- key risks and impacts: each major risk which could occur on the delivery process has to be described and its impacts on the project (cost and time) have to be defined. It will help the bidder to anticipate possible inconvenient events and propose a bid with a cost and a due date including these possible events.

We will also use for the delivery process the same key performance indicators (KPI) as for the product part (see section 3.3.2): we evaluate the cost of each activity and resource as well as its duration. We can also use the confidence define by [25].

For each bid, this delivery process is configured with respects to the bid context and the BOM.

# 4 OPEN BID CONFIGURATION MODEL FOR PRODUCTS

In this section, we first present how an open bid configuration model can be formalized as a constraint satisfaction problem. This problem is built in parallel with the BOM: at each decomposition, a new CSP is added and integrated to the current problem thanks to concepts and their relationships. Then, we illustrate our proposals on the open bike example and make a synthesis of our proposals.

## 4.1 Open Bid Configuration for Products & CSP

We have chosen to model the open bid configuration problem as a Constraint Satisfaction Problem (CSP) as the open bid configuration problem is for 90% a configuration problem [12]. CSP allows to model knowledge and to reason on it to find all the solutions consistent with the current problem.

CSP has been defined by [20] as a triplet $(\mathbb{V}, \mathbb{D}, \mathbb{C})$ where :

- $\mathbb{V} = \{v_1, v_2, ..., v_k\}$ is a finished set of variables,
- $\mathbb{D} = \{d_1, d_2, ..., d_k\}$ is a finished set of definition domains of variables,
- $\mathbb{C} = \{c_1, c_2, ..., c_m\}$ is a finished set of constraints on variables where a constraint describes allowed or forbidden combinations of variables' values.

Constraints allow:

1. to prune the solution space by limiting the value combinations that the variables can simultaneously take (compatibility constraints)
2. to modify the structure of the solution space by adding or removing elements (variables or constraints) to the current problem (activation constraint) [18].

The open bid configuration model relies on the construction of the final constraint bid model by the combination of several CSPs. At the end of the bidding process, the final bid model gathers in the same model, the CSP describing the BOM and the one describing the delivery process.

As previously said in sub-section 3.3, the BOM is building up by decomposing the final product into sub-items and components, each one associated to a specific concept. Each concept is described as an unattached CSP, allowing to configure it. Even if the concept is new, it has an impact on the final product. Constraints between the concepts can also be defined by bid expert in order to propagate the valuation of a variable in a specific concept to the variables of the other ones.

Concerning the delivery process, each activity is formalized as a CSP and linked to the activity network thanks to end-to-end relationships. The association of a concept to the final product creates the links between the bill of material and the generic delivery process [28] [22]. This association activates the constraints between the product and the process in order to propagate the choices made on one side to the other one, and vice-versa.

At the end of the bidding process, the internal bid is completely defined, meaning that all the variables are valuated in such a way that all the constraints are consistent.

## 4.2 OPERA Application

In OPERA, the bid is building up following the open bid configuration model.

First, the bid context has to be described. For instance, the workshop load (inside context) can have a big impact on the ability of the plant to produce the product on time. If the workshop is over-loaded, the risk of being late has a high probability to occur whatever the product. This impacts, for instance, the duration of the manufacturing and assembly activity which will see its lower bound increase. Therefore, the delivery date will be impacted.

Concerning the bill of material, let's consider that the final product is a well-known bike, composed of two wheels and two tires, also known, as presented in Fig. 3. In that case, we are in a pure configuration problem. First, when building-up the bill of material, the higher item is associated to the concept *Bike*. This association has two main impacts:

- the first brick of the bid model is laid: the associated CSP is instantiated,
- the generic delivery process is linked to the bill of material.

Second, the bike is decomposed into two sub-items with the same concept, that of *Wheel*. This association has two main impacts:

- the second brick of the bid model is laid: the associated CSP is instantiated twice and linked to the previous one by the constraints between concepts. In our case, we assume that there exists a constraint between the *Bike* concept and the *Wheel* one. This constraint specifies the allowed combinations of values for the size of a bike and the diameter of a wheel, as illustrated in table 2.
- the generic delivery process is updated regarding these new variables (not explained here).

Third, the wheels are decomposed into components, one of which is associated to the *Tire* concept. This association has two main impacts:

- the third brick of the bid model is laid: the associated CSP is instantiated and linked to the previous one by the constraints between concepts. In our case, we assume that there exists a constraint between the *Wheel* concept and the *Tire* one. This constraint specifies the diameter of the wheel equals the one of the tire, as presented by the eq. 1.
- the generic delivery process is updated regarding these new variables (not explained here).

$$Wheel :: Diameter = Tire :: Diameter \qquad (1)$$

Now, let's consider that product is a unknown bike, meaning that at least, one of its item is associated to the *New* concept. For instance, let us consider that the rim is the new component. This association (rim, *New*) has two main impacts:

Table 2. Bike inter-Concepts Constraint Example

| Variable 1 | Variable 2 |
|---|---|
| Bike::Size | Wheel::Diameter |
| 16 | $[13, 14]$ |
| $[17, 19]$ | $[14, 17]$ |
| $[20, 22]$ | $[18, 22]$ |
| $\geq 22$ | $\geq 23$ |

- a new brick of the bid model is laid: the associated CSP is instantiated but not linked to the previous one by a constraint between concepts, as no relation can be established in advance.
- the generic delivery process is updated regarding these new variables. As one of the items is associated to a *New* concept, the finalization of the design activity lasts longer than for a pure configuration problem and there can be a risk of integration of the new component in the existing bill of material.

### 4.3 Open Bid Configuration Model for Products: Synthesis

The open bid configuration relies on four sets of information, allowing to characterize the context of the call for tenders, the bill of material, the delivery process and the potential risks incurred, as presented in Fig. 5.

The **context of the call for tenders** is useful to characterize the customer, the call for tender itself, the bidder and the environment, as they have a potential impact on the product and its delivery process.

The **bill of material** is top-down building up by the decomposition of the product into sub-items and components. For each item, we associate a concept gathering its knowledge formalized as an unattached CSP, if any. Each time a concept is added, the open bid configuration model is upgraded with the new CSP.

These concepts have a strong impact too on the **delivery process** features, such as duration, key resources and major risks. The delivery process is directly associated to the final product and is completely configured during the bidding process.

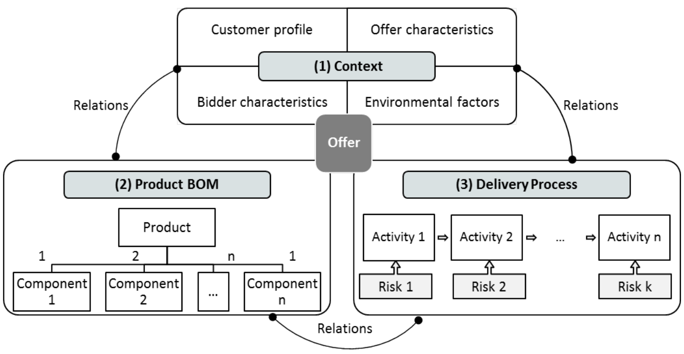


**Figure 5.** Offer modeling for bidding process in the secondary sector

## 5 MOVING TO AN OPEN GENERIC BIDDING MODEL FOR SERVICE PROVISION

In this section, we first highlight the main differences between product and service configuration in bidding process. Then, we discuss how our open bidding model can be extended to services and conclude with further works.

### 5.1 From Product to Service Bids

[17] describes the problem of modularization and configuration of services. But since our work deals with bid configuration during call for tenders process, we focus on Business-to-Business (BtoB) services, and not Business-to-Customer (BtoC) ones. We also restrict our study to pure services (and not product service systems). For both service provision companies we are working with, and it is usually the case during bidding process, each business is different because of changes in the customer's needs. Some parts might be the same as on a past case, but past offers cannot be exactly reused. As explained by [6], these companies "need to balance meeting the needs of individual customers with ensuring a satisfactory degree of efficiency in the deployment of services". This arises the need for service configuration.

[12] and [3] have studied service configuration. As reported in [12], service configuration seems similar to that of physical products but the results of research on mass customization of goods may not be directly applicable. There is relatively little research on configurable services and on developing suitable configurators. [15] highlights the gap dealing with mass customization of services, configurable services, and configured in services based on a review of product mass customization and configuration. Three main differences have been identified [9]:

- Products in manufacturing organizations are highly tangible ; services and especially the service delivery process are less so;
- Related to this, production flows are transparent in manufacturing and less transparent in services. The same holds for problems and irregularities;
- Finally, the customer is much less involved in the production process in the manufacturing domain than in services. The interaction with the customer determines the quality of the service.

In the context of bidding process, we can extend a part of our model in a trivial way: companies still have to identify the bid context, define the nomenclature of items and characterize the delivery process. Thus part (1), (2) and (3) of Figure 5 stay the same. The important difference for service provision offer is the link between everything: How to move from an open product configuration model to an open service configuration model for bidding process ? (Fig. 6).

[11] and [27] define service as a process. Can a service be resumed by its delivery process ? We think not and we try to define how we can decompose a service in a kind of nomenclature, such as a deliverable breakdown structure (DBS).

In [14], Goldstein et al. explain that "From the service organizations perspective, designing a service means defining an appropriate mix of physical and non-physical components". They precise that "service components are often not physical entities, but rather are a combination of processes, people skills, and materials".

For [1], a service can be decomposed into *service elements*. These service elements "represent what a supplier offers to its customers". They precise that "a service element can be decomposed into smaller service elements, as long as these smaller elements can be offered to customers separately, possibly by different suppliers." Thus the criteria to decompose a service could be this one: each element can be offered separately.

In this sub-section, we voluntarily use the generic term of *nomenclature* in contrast to *bill of material or BOM* which is more specific to products.

Indeed, we have to point out that the links between the item nomenclature and the delivery process differ between the companies of the secondary and tertiary sectors. Two main differences have been identified:

- Firstly, for the secondary sector companies, the delivery process correspond to the one carried out to produce the final product (higher level item of the nomenclature), whereas for the tertiary sector companies, it seems that it is not always the case. A service is composed of several deliveries composed of several work-packages which have all their own delivery process, i.e. there potentially exist as many delivery processes as the number of the lower level items.
- Secondly, for the secondary sector companies, the activities of the delivery process are always carried out inside the company. A the end of the process, the product is ready to be delivered. In contrario, some of the activities of the tertiary sector companies, are carried out outside the company, directly on customers' premises. Therefore, the delivery process is decomposed into two types of activities: those carried out in the company and those carried out in the customer's premises. In this section, we only present the delivery process for the secondary sector companies. Nevertheless, a special focus is made in section 5 on the tertiary sector companies.

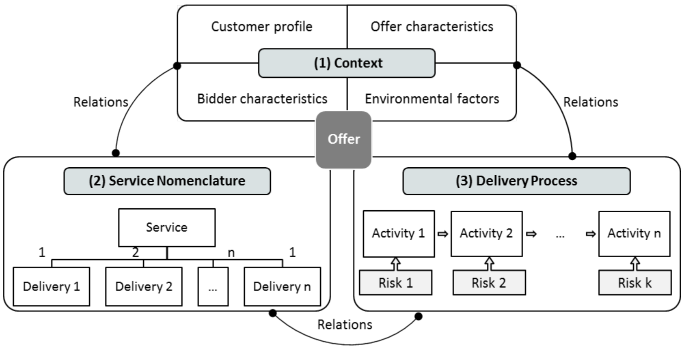


**Figure 6.** Offer modeling for bidding process in the tertiary sector

### 5.2 Service Model: Discussions

Tertiary companies mainly differ by the type of deliverables they produce. For the two companies of the tertiary sector, we have identified two types of deliverables:

1. tangible deliverables,
2. intangible deliverables.

For the tangible deliverables, the customer is mostly interested by the results of the delivery process. The customer expects a very specific deliverable and is not especially interested in the delivery process. For instance, one out of the OPERA industrial partners respond to call for tenders for Computational Fluid Dynamics (CFD) studies. We can't decompose the deliverable in deliveries. Indeed, the deliverable is not material as the way that it is not an assembly of components. Here, the deliverable is the result of calculations. This result is what the potential customer is interested in. (S)He is not interested in the delivery process, as long as (s)he has the result of the asked calculation. Only the quality and the compliance with the commitments matter.

For intangible deliverables, there is no physical deliverable. The potential customer is more interested in the delivery process itself. In training for instance, the customer is mostly interested in the fact that people who are trained reach a specif skill level. To define such an offer, the bid has to specify the given courses, the addressed topics in the training and how the training will go on, which is actually a part of the delivery process (activities carried out on customer's premises). A large part of the configuration of the bid consists in deciding which courses to give, which topics to discuss, how much time to give to each topic and who will be the trainer. This kind of bid definition is quite closed to the one for products in the sense that it consists in selecting and picking the relevant courses for a course catalog, as studied in [10].

## 6 DISCUSSION AND FUTURE RESEARCH

In this paper, we have presented our first result to define an open generic model for bid definition. We consider that defining a bid corresponds for 90% to a configuration problem and for 10% to a design problem. We consider two types of bids: the bidder bid, which is built up in companies and the customer bid, which is submitted to the customer. Our work focuses on bidder bids. We have identified a generic internal bid structure which is decomposed of three different sets of knowledge: the one characterizing the bid context (customer profile, call for tender characteristics, bidder profile and environmental factors), the one characterizing the item nomenclature and the last one, characterizing the delivery process.

We have instantiated this model for products and show the interest of our proposals. A use-case dedicated to products is actually in progress. We then have discussed about its applicability to services and highlighted the fact that depending on the types of the deliverables, the open model for products can easily be used. We have seen that the open service bid model seems quite similar to the one for products when the deliverables is intangible and when the items can be chosen in a item catalog.

We still have to work on how to define an open bid configuration model for both products and services, independent of the type of deliverables. This open configuration model will also integrate a new metrics to characterize bids: the confidence of the bidder in the customer offer [25]. This new metrics is partially based on the notion of risks which are partially analyzed during the bidding process.

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[4] http://gind.mines-albi.fr/en/projet/opera

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