

# BROKERAGE FUNCTION IN AGILE VIRTUAL ENTERPRISE INTEGRATION – A LITERATURE REVIEW

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*The paper present a review of the brokerage function as it is defined within different Agile and/or Virtual Enterprise (A/V E) models throughout the literature, including the broker's function within the Broker function taxonomy, BM\_Virtual Enterprise Architecture Reference Model, as well as their comparison. Many authors see a broker, and the corresponded brokerage function, as one of the principal agents, or a mechanism, for agility as well as for reconfigurability of the A/V E organization structure (by some authors the reconfigurability is the basic function of agility). However, the function of the broker, and its position in the A/V E organizational structure, has been defined in different models ranging from entrepreneurship function, resource selection function, through scheduling function etc. The analysis shows that there is a great heterogeneity of the broker functions, or definitions.*

## 1. INTRODUCTION

As a definition of broker (Porto Editora, Webster), we can find: funds or stocks commission agent, intermediary, dealer of second hand good and agent. However, for the purpose of this work is more important that we understand the set of his attributed functions. Other expressions associated to the broker designation are cybermediaries, which means organizations that perform mediation tasks in the world of electronic commerce (Sarkar, 2000), or resources manager, which means the Agile/Virtual Enterprise (A/V E) configuration manager (Putnik, 2000). Considering the functions attributed to the broker under the several models of the Agile/Virtual Enterprises, he is a necessary agent, but assuming different functions according to the frame-working model. Actually the broker is a flexible/dynamic agent because for each A/V E he will have to perform several functions according to requests from initiator.

If we consider the service supply chain models, between the broker and the A/V E, or other A/V E units (other that broker, when the broker is a part of A/V E), in different instances of the A/V E project, as represented in Figure 1, he can act as the initiator, and/or a supplier, and/or a direct intermediary and/or an indirect intermediary.

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The original version of this chapter was revised: The copyright line was incorrect. This has been corrected. The Erratum to this chapter is available at DOI: [10.1007/978-0-387-35585-6\\_68](https://doi.org/10.1007/978-0-387-35585-6_68)

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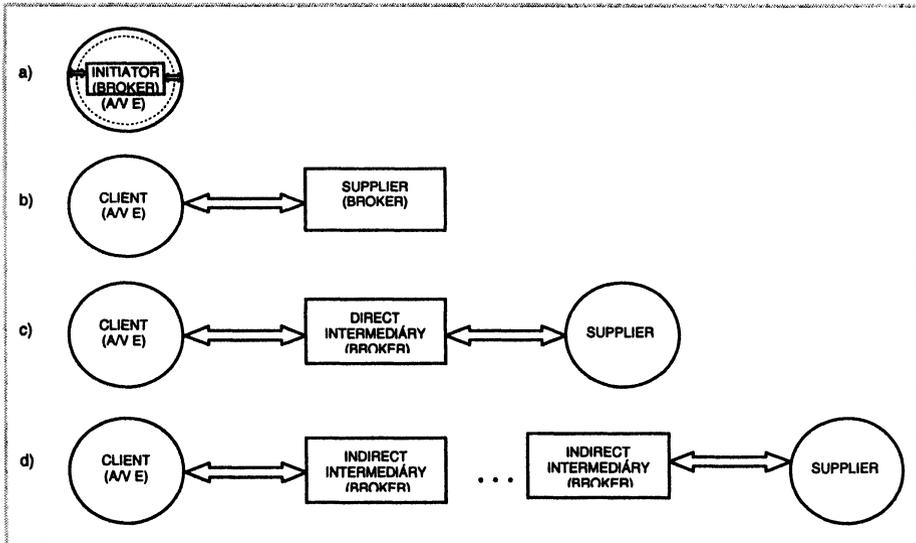


Figure 1 - Service supply chain, between the broker and other A/V E units (adapted from Hands et al, 2000)

- When the broker behaves as the A/V E initiator, the service supply chain itself does not exist.
- The chain is minimal and broker and other A/V E units are the chain extremes and the connections with others do not exist. An example is when the broker is asked to create a focused market of resources.
- The chain is ternary, and the broker is the indirect intermediary between other A/V E units, i.e. between the client and supplier. For example, when the broker participates in a negotiation process.
- A long supply can be established between other A/V E units, i.e. between the client and supplier, introducing broker's interoperability in a market of brokers.

## 2. THE NEED OF A BROKER IN A/V E

Not just with the emergence but also with the growing of the electronic market, i.e., the growth of on-line suppliers of services and products, and Internet users (potential consumers), the necessary conditions to the affirmation of the virtual enterprises as a present and future enterprise organizational model are created. With the elimination of the client/supplier barriers for which the electronic market is responsible, it should be predicted the elimination of the traditional intermediaries, as the wholesalers and retailers, allowing this way price reductions that, in some cases, could reach 60% (Sarkar, 1995).

However, the emergence of the electronic broker can be justified with the answer to questions such as: how does the consumer locate the supplier; performs a purchase; finds the required products and services at a fair price, and in which supplier can he trust. Mediation between suppliers and clients, introduced by the broker, is, according to (Hands et al, 2000), the ideal solution to overcome this kind

of problems. Also in the understanding of (Resnick et al, 1994), the importance of the broker is justified by cost reduction, privacy increase either client or supplier, more information available to the client, namely about product quality and market satisfaction, decrease risks from non-fulfilment involved parts, and improving the prices efficiency creating mechanisms that induce only the adequate sales.

(Putnik, 2000), still refer that high agility (dynamic, real-time A/VE structure reconfiguration – the ideal goal is the reconfiguration within one second), intended to A/VE, will be achieved with broker introduction only. The broker contributes decisively for the high performance of the A/VE agile design (project) and operation. Still according the same author, A/VE virtuality is related with the fact that the physical structure from enterprise could be hidden to the project manager, that in fact, only is obtained with the broker intermediation between two control levels from A/VE structure. In this sense the broker serve like an agent of the virtuality, or the broker supply the mechanism of virtuality.

### 3. BROKER FUNCTIONS TAXONOMY

Several authors have expressed the functions that broker should assume within an A/VE, including also electronic commerce, and several software platforms already exist to support its performance. In (Hands, J. et al; 2000) are referred several electronic brokerage projects, such as: common Brokerage Architecture Project; OSM (Open Service Model); OFFER; Metabroker; OMG / CommerceNet and Gaia Project (generic Architecture for Information availability). However, the comparison between the broker models proposed by different authors cannot be explicit unless it is created taxonomy for its functions. This taxonomy allows the creation of referential model for the evaluation and comparison of several proposed broker models.

In the domain of the possible functions for the broker actuation we have verified two possible groups, one involving the functions directly available to the client (A/VE), which we have designated by *explicit functions*, and the other involving support functions to the first group, designated by *implicit functions*.

**Definition 1 – Explicit Functions** – functions that the broker make available to its client. For example: selection of resources, integration of resources.

**Definition 2 – Implicit Functions** – functions (tools) that the broker uses to support the execution of the explicit functions. For example: selection of algorithms for resources selection, interaction with other brokers.

In some cases the same function in one model is explicit and in another implicit). At the second level, we have classified broker's functions as shown in table 1.

**Table 1 – Broker's functions taxonomy.**

|                               |            |  |
|-------------------------------|------------|--|
| <b>BROKER'S<br/>FUNCTIONS</b> | - EXPLICIT | <ul style="list-style-type: none"> <li>- Initiation of the virtual enterprise</li> <li>- (Focused) market of resources creation (resources identification)</li> <li>- Resources selection</li> <li>- Resources systems selection</li> <li>- Resources systems Integration</li> <li>- Resources integration scheduling</li> <li>- Resources systems reconfiguration</li> <li>- Resources monitoring and reliability analysis</li> <li>- Resources control</li> <li>- Information dissemination</li> <li>- Virtual environment provision between the client/server levels</li> </ul> |
|                               | - IMPLICIT | <ul style="list-style-type: none"> <li>- Interaction with another brokers</li> <li>- Resources market / virtual net creation</li> <li>- Resources market maintenance</li> <li>- Selection of resources selection</li> <li>- Negotiation</li> <li>- Guarantee confidentiality between client / supplier</li> <li>- Create mechanisms that support transactions risks</li> </ul>   |

The sequencing of the list of functions does not mean a sequence of the broker actuation. Also the fact of describing the functions separately does not mean that the real actuation of the broker cannot integrate simultaneously several of its functions, in order to attain increased performance<sup>1</sup> levels. The detail of functions of Table 1 is described following.

### ***Explicit Functions***

**Virtual enterprise initiation.** In this function the broker acts as an entrepreneur, because as a business opportunity shows, he identifies immediately the necessary activities to match the business opportunity. Based on the list of activities of the value chain defined by the broker, he projects the supply chain, integrating clients, suppliers, external suppliers and enterprises, in order to create a competitive supply chain. Once created the virtual cooperation, the broker starts to perform tasks of coordination.

**(Focused) market of resources creation (resources identification).** This function allows the identification of resources, searching a market of resources or not, which satisfy the requisites of the requested service, namely, in first instance, functional requisites, and other as cost, time, quality, availability of searching time and others introduced by the client. The broker can be the owner of the market of resources.

<sup>1</sup> This issue that here will not be studied, but is certainly a relevant aspect to achieve the desired A/V E flexibility.

**Resources selection.** In all phases of the process of configuring the system of A/V E, it is necessary to perform, in broad sense, the selection of resources (Ávila et al, 2000). We include here the isolated selection of a resource, i.e., the resource that best performance shows in face of service requisites required by the client. This function is more evident in electronic commerce framework, as at most of the times a unique resource is able to satisfy the client.

**Resources systems selection.** Sometimes a unique isolated resource is able to satisfy the totality of the requisites of the service required by the client; in this case it is required a system of resources<sup>2</sup>. This function is more evident when the requisites of the service are a Tasks Plan<sup>3</sup> of the product production cycle. Here the selection is more complex, given that the performance evaluation is done on the system of resources and not on a resource isolated. Obviously the selection of resources is a special case of the selection of the system of resources, and the support algorithms to this function are to be more structured. We think this is one of the most critical functions for the good performance of the A/V Es configuration process.

**Resources systems integration.** It consists on the integration of the resources belonging to the selected system of resources, through the passage of parameters of the integration mechanism, as the localisation of client/supplier communication protocols, process plans, data formats, etc. It is included also the establishment of contracts to assure the commitments between client / supplier and other participants on the organization.

**Resource integration scheduling.** As the resource integration itself is a process and implies several sub-processes it is necessary to define their ordering (of the sub-processes) and their mapping onto time intervals in accordance with the resource integration process development.

**Resources system reconfiguration.** This is the task of new resources integration and the remotion of others as the enterprise has to integrate new functionalities, new technologies or new behaviours, to replace resources that become damaged, that don't exist any more, has abandoned the AV E, to increase/reduce productivity<sup>4</sup>, or to integrate ones more competitive. The reconfiguration problem is an equivalent problem to the selection (configuration) and integration of resource systems for the A/V E, i.e., the reconfiguration can bring substitution / remove / insertion of new resources, or resource systems. The system reconfiguration is a design process, including the A/V E dissolution, that is one of the reconfiguration instances.

**Resources monitoring and reliability analysis.** This function is to control the resource's performance in order to identify eventual failure and to define the resources properties evolution during the A/V E operation.

**Resources control.** This function is the task of resources control within the responsibilities and organisational policy attributed by the manager, "principal", or "upper control level".

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<sup>2</sup> Set of resources that related between them and with capacity to integrate, are able to satisfy the client services requisites.

<sup>3</sup> Set of tasks (simple or complex), with their temporal interdependencies, which define the product production cycle (Ávila et al, 2000).

<sup>4</sup> If we consider the normal product life cycle, it is known that in entry phase and in grow phase the volume of production tends to increase until reach the stability phase, and by the end it declines.

**Information dissemination.** This task is carried on in two ways, i.e., from supplier to the client and vice versa. From supplier to the client through the broker can be an efficient channel for new products / services advertising. In opposite way the supplier could extract from broker, through his market knowledge, which are the tendencies of the market as a base for identification of new business opportunities or correction of planed business.

**Virtual environment provision between the client/server levels.** When broker is employed, as an interface between two control levels, the broker can act in a way that the physical structure of the lower executive level (server) can be hidden for the upper management level (client) of the enterprise control structure. The broker is visible for the client level, but the structure (agent), that executes the task, or server level, is invisible, virtual (hidden by the broker) to the client level. The same is valid for the inverse way. We can say that one control level (lower or upper) is virtual for the other (upper or lower). The reason of this architecture is to provide capability of the A/V E reconfiguration without interruption of the productive process.

### ***Implicit Functions***

**Interaction with other brokers.** The broker can interact with other brokers, either recurring to the service of another broker, in this case as a client, or acting as a service supplier to another broker.

**Resources market / virtual net creation.** The first task is look for enterprises and institutions with competences and complementary competitive resources and capacity to work together. The goal of this phase is to create common target and promote trust between entities involved. The partners accept an understanding memorandum with rules where anticipate criterions for new entrances, procedures to share risks, costs and profits.

**Resources market maintenance.** From the moment that net is created, broker is responsible for maintenance and collaboration improvements between the members. The broker develop technical normalization actions, monitor the members performance, keep conflicts resolution and promote learning inside the net organizing seminars, workshops and others.

**Selection of selection algorithms.** The complexity of resource systems selection is function of solution space and grows exponentially with the number of tasks/operations in the sequence and the number of resources capable to execute them (Ávila et al, 2000). Then, the selection of the most efficient algorithm to select the system resources, according to time and other performance requirements is of vital importance for the good broker performance.

**Negotiation.** Normally based in economic goals, for example the auctions (open or sealed) practice is extensible to other negotiation parameters related with the client service requisites. The influence that broker can develop close to supplier and the fact that transactions mediated by broker are subject to economies of scale will be preponderant in this negotiation process.

**Guarantee confidentiality between client / supplier.** Either the client or the supplier can wish remain anonymous, or to protect some important information within the transaction. In these cases it will be the concern of the broker to provide his actuation without identify the parts, or units, involved.

**Create mechanisms that support transactions risks.** The client could refuse to pay after receiving the product/service, or the supplier did not guarantee a post sale service adequate for the product. These are practices that broker can lessen with the threat of publishing on infringes inside resources market, or providing assurances to cover the bad actuation from any parts.

Other broker functions could be created, e.g. functions that consider culture factors, i.e. permit cultural integration (communication mode, religion holidays, etc), of different agents involved.

#### 4. REVISION AND ANALYSIS OF BROKER MODELS

In agreement with the broker functions taxonomy presented in the previous chapter, now we go to analyse the broker models, table 2, preconized by some authors and by some Virtual Enterprises projects, where we include our project (BM\_Virtual Enterprise).

Table 2 - Broker models analysis.

| Legend: Y - Yes;<br>N - No;<br>U - Undefined.       |   | BROKER MODELS                           |                             |                              |                               |                         |                               |                         |                             |
|---|---|---|-----------------------------|------------------------------|-------------------------------|-------------------------|-------------------------------|-------------------------|-----------------------------|
|   |   | BM_Virtual Enterprise (Putnik G., 2000) | GAJA (Hards J. et al, 2000) | (Flores M., Molina A., 2000) | (Franko U., Hickmann B, 1999) | (Kasnet J. et al, 1999) | OFFER (Bichler M. et al 1998) | (Barbar M. et al, 1995) | (Reinick P., Avery R. 1994) |
| EXPLICIT FUNCTIONS                                  | A/V E Initiation                                    | N                                       | U                           | Y                            | Y                             | Y                       | U                             | U                       | U                           |
|   | Focused resources market creation                   | N                                       | U                           | U                            | U                             | U                       | U                             | U                       | U                           |
|   | Resources selection                                 | Y                                       | Y                           | Y                            | Y                             | Y                       | Y                             | Y                       | Y                           |
|   | Resources systems selection                         | Y                                       | U                           | U                            | U                             | U                       | U                             | U                       | U                           |
|   | Resources systems integration                       | Y                                       | U                           | U                            | U                             | U                       | U                             | U                       | U                           |
|   | Resources integration scheduling                    | Y                                       | U                           | U                            | U                             | U                       | U                             | U                       | U                           |
|   | Resources system reconfiguration                    | Y                                       | U                           | U                            | U                             | U                       | U                             | U                       | U                           |
|   | Resources monitoring and reliability analysis       | Y                                       | Y                           | Y                            | Y                             | Y                       | U                             | Y                       | U                           |
|   | Resources control                                   | Y                                       | U                           | U                            | U                             | U                       | U                             | U                       | U                           |
|   | Information dissemination                           | Y                                       | Y                           | U                            | Y                             | Y                       | U                             | Y                       | Y                           |
| Virtual environment provider for the client's level | Y   | U                                       | U                           | U                            | U                             | U                       | U                             | U                       |                             |
| IMPLICIT FUNCTIONS                                  | Interaction with another brokers                    | Y                                       | Y                           | U                            | U                             | U                       | U                             | U                       | U                           |
|   | Resources market / virtual net creation             | N                                       | Y                           | U                            | Y                             | U                       | Y                             | U                       | Y                           |
|   | Resources market maintenance                        | N                                       | Y                           | U                            | Y                             | U                       | Y                             | U                       | Y                           |
|   | Selection of selection algorithms                   | Y                                       | U                           | U                            | U                             | U                       | U                             | U                       | U                           |
|   | Negotiation   | Y                                       | U                           | U                            | U                             | Y                       | Y                             | U                       | Y                           |
|   | Guarantee confidentiality between client / supplier | Y                                       | U                           | U                            | U                             | U                       | U                             | U                       | Y                           |
|   | Create mechanisms that support transactions risks   | Y                                       | Y                           | U                            | U                             | Y                       | U                             | Y                       | Y                           |

Analysing table 2, we verify two main features. The first one, and may be the most immediate, is that does not exist uniformity in functions attributed to the broker in the A/V E models in which he participate<sup>5</sup>. The second one is that none of models broker contemplates the entire taxonomy of the broker's functions presented, either explicit or implicit. From this analysis we can predict that only one broker could not be able to satisfy all the functions solicited by different A/V E models. In this case the A/V E must manage the integration of different broker's functions adequately.

## 5. CONCLUSIONS

The comparison of broker's models, based on the broker function taxonomy presented have permitted to conclude that don't exist broker's functions uniformity in the models reviewed and none of them contemplate all the broker's functions presented, either explicit or implicit, that translates in some way, the heterogeneity of the existing models.

This heterogeneity brings problems on integration, interoperability, and portability of brokerage function when the brokers conceived on different models come to cooperate within one virtual enterprise. Therefore, we believe that this problem needs more attention and research. The second important conclusion is that the A/V E should have to manage the integration of different broker models.

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5 There are A/V E models, which don't refer broker functions and are supported mainly in intelligent agents technology.