24 DYNAMIC PROCESS ORGANISATION

Sodki Chaari[1,2], Frédérique Binnier[1], Joël Favrel[1], Chokri Ben Amar[2]
(1) INSA de Lyon - Laboratoire PRISMa / IF502 - F69621 Villeurbanne Cédex, FRANCE
{Sodki.Chaari, Frederique.Biennier, Joel.Favrel}@insa-lyon.fr
(2) ENI de Sfax – Laboratoire REGIM / Route de Soukra, Sfax, TUNISIA
Chokri.benamar@enis.rnu.tn

Enterprises are evolving towards a more agile, dynamic and adaptive organisation that can make quick responses to the market and customer requirements. This carried out an increasing need for enterprises to get involved in collaboration strategies. Moreover, new IT organisation, namely Service Oriented Architectures (SOA), can be introduced to implement opened and agile information system. To align the enterprise strategy and the information support system organisation, we present a cooperation model based on SOA, called service oriented enterprise. Thanks to a multi-level process organisation, simple combination and filtering rules can be applied to build dynamically customised distributed processes on demand.

1. CONTEXT

Today, with the high competitive changing economy environment, lots of organisations have redesigned at least some of their systems and reviewed their process structures and strategies to take advantages of new business opportunities often leading to Collaborative Business. These collaborative organisations are set according to short term goal and implement dynamic and on-demand Virtual Enterprises (VE) (Kwon et al. 2003). To fit the required agility level required by such adaptive organisations, an efficient and agile information system must be set to support common process enactment and execution. This leads to take into account both the organisational constraints to establish efficient common processes and the technical inter-operability constraints.

While focusing on enterprise organisation, one can use enterprise modelling approaches. Due to these different levels of collaboration, a virtual enterprise organisation leads to two different strategies: either the VE is considered as a standard enterprise (in this case modelling methods must be adapted to fit the planned duration and respect enterprise autonomy) or the VE is seen as a set of co-operating organisations (in this more agile case a particular attention is paid on shared business processes).

While focusing on the IT side of collaborative business, a particular attention must be paid on inter-operability constraints. This leads to adapt the traditional information system organisation to support the necessary openness. Emerging technologies such as the Service Oriented Architecture (SOA) (Baglietto et al., 2005), ontologies (Yang et al., 2005) are generally perceived as core technologies to successfully deal with these challenges.

Please use the following format when citing this chapter:

Chaari, S., Binnier, F., Favrel, J., Amar, C. B., 2006, in IFIP International Federation for Information Processing, Volume 224, Network-Centric Collaboration and Supporting Fireworks, eds. Camarinha-Matos, L., Afsarmanesh, H., Ollus, M., (Boston: Springer), pp. 229–236.

Introducing SOA for enterprises information system can reduce dramatically the funds required to start up a business. Services are readily available for integration and orchestration. Moreover, while each service has a machine understandable representation, discovering the convenient service could be achieved in a dynamic and automated way. Hence, enterprises will be able to form on-the-fly, project-driven and on demand alliances. As the number of services increase, a particular attention must be paid on an automated service combination.

Nevertheless, enterprises define differently the service's granularity level. It can be associated to a whole workflow with several tasks or a single elementary task. Consequently, enterprise must "re-think" their business process organisation to find the suitable relationships with these services. Using object oriented approach, enterprises can attain this goal by modelling and decomposing recursively their business processes. Resulting business objects are turned into appropriate services either by adding a convenient interface directly, or by associating them into composed services. Thus, the IT support and the associated services are "prepared" both for an internal and an external use.

Furthermore, the inter-operability level requirements involves taking into account semantic constraints. A key idea is to use ontology to empower services with semantic descriptions. (Hu and Du, 2004) defines ontology as an "explicit specification of a conceptualization". Ontologies allow an effective services discovery and ensure a good management and organisation of available services space.

This paper focuses on the major difficulties which arise when building the inter-enterprise process. We argue that enterprise must be re-organised according to collaborative basis to benefit of market opportunities. Consequently processes must be defined in an adaptive way. Next, we present a multi-level framework based on SOA that can be used to assist the dynamic combination of enterprises services resulting in a collaborative inter enterprise process which provide a value-added service to users leading to a Service Oriented Enterprise organisation (SOE).

2. INTER ENTERPRISE PROCESS ORGANISATION

VEs require a lean and evolving structure, able to protect the flexibility and reactivity of each partner. Moreover, enterprise-engineering projects are rather long and their cost can be a bar. This can be overcome by connecting engineering processes to more efficient diagnostic processes to guide the way standard solutions are chosen. Such a bottom-up modelling approach proposed in the GRECOPME framework (Biennier et al., 2002) relies both on an efficient "collaboration" diagnosis and on re-usable collaborative business processes. Of course, in order to preserve enterprise autonomy and to favour the emergence of the global synergy, collaborative business processes and their support systems have to be adapted to this multi-enterprises context. In order to support these collaborative business processes, inter-organisational workflow systems can be set. For this purpose, different points of view can be developed:

- Each enterprise protects its own autonomy and has its own workflow. In this case, workflow interactions must be defined to provide a global organisation (Casati and Di Scenza, 2001), tasks managers can be co-ordinated thanks to tasks

dependency relationships as proposed in the METEOR2 system (Miller et al., 1997).

- A centralised common workflow is defined and is turned into activity charts so that a decentralised execution, split among the different partners, can be used. Such an analysis process is proposed by (Muth et al., 1998) and makes a heavy use of Transaction Processing systems to provide the shared information consistency.
- A B2B workflow based approach can be derived from traditional EDI or C-Business environment: For this purpose, (Van der Aalst, 2002) proposes multiple descriptions of shared business process: public and private workflows are defined concurrently and the global consistency is achieved thanks to well-defined information exchange format (Bussler, 2002).

Both of these process organisations rely also on the interconnection of the enterprises IT support. Turning the monolithic information system organisation to a more dynamic one may be achieved thanks to service oriented architecture. These component based architectures are mostly business process oriented: thanks to the orchestration level, elementary services can be combined so that rather customised processes can be built from standard elements. To fit the enterprise needs, this IT architecture can be worthy combined to enterprise process oriented modelling tools as ARIS (Sheer, 1993) so that the IS can be tuned efficiently.

While the Service Oriented Architecture principle can be worthy used to define customised IT support and to improve the IT inter-operability thanks to common interfaces, the IS complexity remains a brake to the openness. Consequently, a particular attention has to be paid on the global corporate information system organisation so that it can evolve without loosing its consistency. To fit this last requirement, one can use the urbanism paradigm (Longepe, 2003): the information system is split in rather independent units associated to different business areas, so that local changes should not impact the full system. Coupled to the SOA organisation, it means that the engineering phase is achieved in a hierarchical way: for each business areas, business processes are identified and split among activities, processes and lastly operations associated to services (figure 1). This leads to a multi-dimensional organisation, clustering processes and information parts according to "independent" business areas.

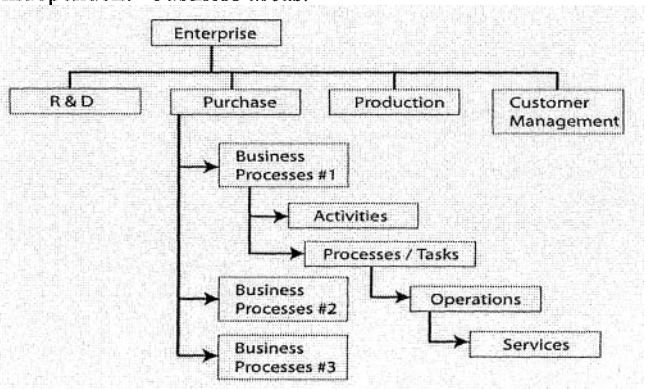

Figure 1 – Information system urbanism principle and its connection to services

Nevertheless, such an information system urbanism strategy leads to rather static organisations exhibiting poor collaborative abilities between the different business areas. In this case, organising shared processes consists in orchestrating independent process without taking into account the organisational consistency: for example juxtaposing different planning strategy in a supply chain when sub-processes do not share a common goal may be leading to a bull-whip effect.

Consequently, a technological inter-operability is not enough while building collaborative organisations: enterprises must be re-organised according to collaborative opportunities and processes must be defined in an adaptive way so that they can be re-orchestrated easily.

To support fast and efficient process organisation, one may use a dedicated orchestration process. This leads to service selection and assembly. After discovering the convenient services, consistency controls must be implemented while orchestrating these services. We found various approaches to service orchestration from academia and industry. (Medjahed et al., 2003) present a framework for orchestrating atomic services, which are semantically described using non-functional properties such as their function, their category and their QoS. Other approaches for service orchestration including model checking, modelling service composition as Mealy machines, and automatic composition of finite state machines (Fu et al., 2002). Automatic services composition is the "ultimate" goal of most composition efforts. Hence, (Berardi et al., 2005) presents a framework describing services' behaviour as an external execution tree and then translates it into finite state machines. In (Hamadi and Benatallah, 2003) Petri nets are used as tools to modelling service orchestration. Each service is associated to one Petri net describing service. They define a net for each service and composition operators that perform composition sequence to produce new services.

Nevertheless, these approaches focus on particular technical points. To support dynamic service binding, leading to dynamic virtual organisations, a more complex framework is required.

3. SERVICE ORIENTED ENTERPRISE ARCHITECTURE

Building dynamically a collaborative process involves taking into account both enterprises own organisation and dynamic service binding abilities. This leads to apply the urbanism paradigm globally on the enterprise organisation and not only on the IT system (Biennier and Mathieu, 2006). This approach leads to re-organise the enterprise according to activities that can be exposed to other partners and assembled dynamically and then to couple this enterprise organisation to the IT support, leading to a service oriented organisation.

To reach this goal we start from an organisational point of view, using basic elements to describe an enterprise i.e. activities, resources (including IT resources) and actors. Analysing these elements and their relationships according to several enterprise modelling approaches leads us to define basic properties attached to them and to re-organise them in a multi-level architecture, paying a particular attention to the inter-enterprise process combination requirements (see figure 2):

- **On the enterprise side**, we have to define a fragmentary organisation that can be used as elementary bricks to set a common process, and its links with the IT support system. To fit this requirement, we propose a 4-level organisation:
  - **Enterprise entities level**: contains the set of the basic enterprise entities: activities, resources, individuals, organisational units.
  - **Business object level:** this level is used to manage different business objects according to the business domain such as product, order, customer, payment and so on. This representation includes at least its business name and definition, attributes, behavior, relationships, rules, policies, and constraints. Business objects can be conceptual, i.e., analysis/design objects, as well as implementation objects, which are independent, language neutral and persistent objects that require a middleware infrastructure to run.
  - **Business component layer**: this layer is used to gather basic activities that exhibit common functional characteristics and goals into different business components. Business components are designed as packages encapsulating a well defined set of business objects. Each business component is made of two parts: first the interface that can be exposed and an internal part related to the own enterprise process organisation fitting the enterprise own business rules and defining precisely interaction between business objects. This involves that each business component are closely associated to resources and actors.
  - **Concrete services level:** This level consists of the real services implementing the information system. Each business component is related to an ordered set of "concrete services" orchestrating the related process. This level includes service-oriented design and development incorporate a broad range of capabilities, technologies, tools, and skill sets that include:
    - Managing services lifecycle: it includes identifying, designing, developing, deploying, finding, applying, evolving, and maintaining services.
    - Adopting best practices and tools for architecting services-oriented solutions in repeatable, predictable ways that fits changing business needs.
    - Delivering service oriented solutions fitting quality and QoS requirements.
- **On the collaborative process organisation side**, we define a 2-level organisation:
  - **Inter-enterprise common process**: this layer is used to describe the common process that must be built. The common process consists in orchestrating different virtual services, selected and bounded dynamically according the needs.
  - **Virtual services level**: This layer is used to describe in a generic way the services exposed by the different enterprises. These services are associated to basic functionalities that can be combined to set the common process (figure 3). As far as their implementation is concerned, these virtual services are associated to functions that business components can expose to be invocated and used by partner enterprises in cooperation scenarios. Differently, virtual service will act as exposed interfaces of the business components. Then

combination constraints are used to define the way concrete services should be assembled to be interfaced in the common process.

The dynamic binding process is organised as a selection followed by an assembly phase. To support an efficient selection process, we use the basic descriptors taken from the meta-model (figure 2) so that an efficient filtering process can be used.

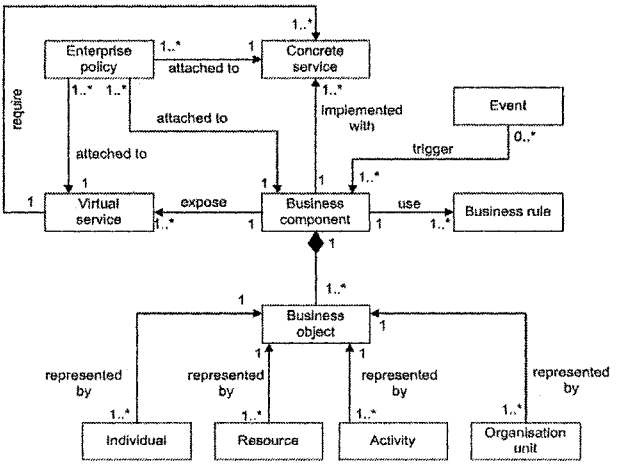

Figure 2 – Enterprise architecture's meta-model

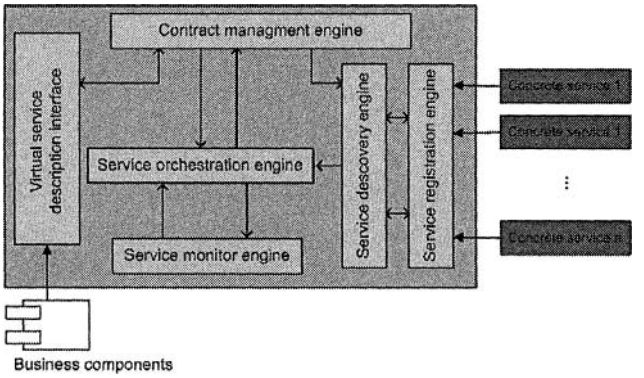

Figure 3 – Virtual service architecture

A simple ordering process example can be used to illustrate this service combination process. In such a case, the customer defines the product quantity and asks for the expected delivery date and product fees. As far as the manufacturer is concerned, creating the convenient process involves combining production and supply services. First, selecting the convenient partners involves defining competencies related to the ordered products. By this way, adapted partner selection can occur. Then, building the distributed ordering process mixes customer,

manufacturer and its supplier production, supply and pricing processes. This involves that each partner exposes its virtual services namely ordering and production planning interface. As far as the ordering processes are concerned, the related business component gathers both the ordering process support system and the pricing algorithm. Then this business component is interfaced with the production business component so that delays can be adjusted. Despite of its simplicity, this example mixes different enterprise elements with standard interface:

- Entities/ Resources: estimate, request estimate.
- Activities: sending document, receive document, checking document.
- Individuals: customer, manufacturer, supplier.

Then the business component level includes associations between different businesses objects according to the different enterprises needs and business rules. In our case, we can define the following business component: (send document, customer, manufacturer), (send document, manufacturer, supplier), (receive document, manufacturer, customer), (receive document, supplier, manufacturer), (checking document, customer, manufacturer), (checking document, customer, manufacturer, supplier) that can be re-assembled to build dynamically the shared business process.

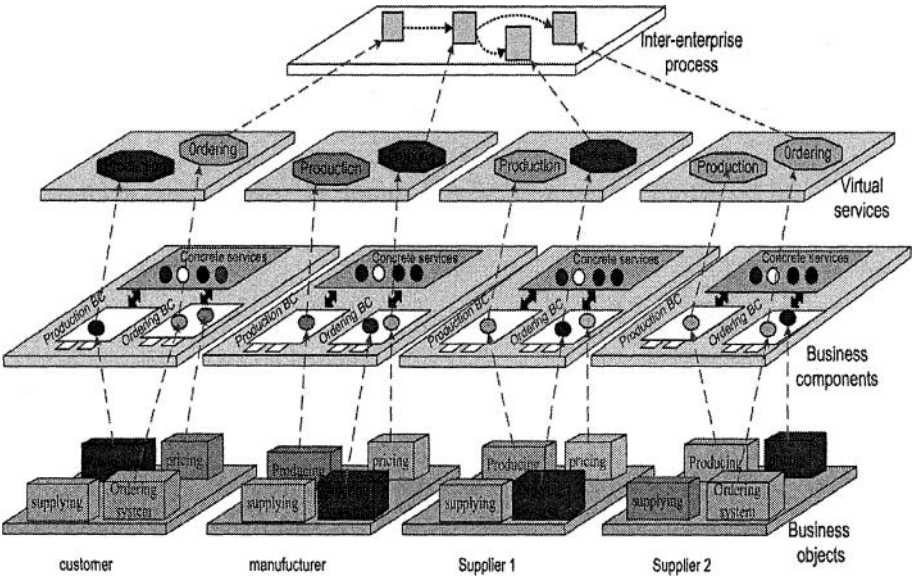

Figure 4 – Dynamic binding of virtual services

4. CONCLUSION

To support dynamic collaborative organisation, a dynamic process enactment service must be provided. This involves building both a common process and the dedicated IT support system. In this paper, we present how enterprise architecture can be re-organised to set a service oriented enterprise which can support inter-enterprise cooperation. This architecture, based on the IT SOA, is organised into

different levels (business objects used to model enterprise process are associated to virtual services and finally to concrete services) so that the global infrastructure is closely related to the enterprise business strategy and exhibit convenient agility abilities. Several filtering processes are used to select the convenient services to bind and then an assembly process is set. Further works will deal with the automated integration of syntactic inter-operable services so that the combination scope can be extended.

Acknowledgements

This work is partly inspired by the GOSPI - INTERPROD project funded by the Rhône-Alpes area council.

5. REFERENCES

1. Baglietto, P., Maresca, M., Parodi, A. and Zingirian, N., 2005, Stepwise deployment methodology of a service oriented architecture for business communities, Journal of information and software technology (47), pp. 427-436.
2. Berardi, D., Calvanese, D., and Mecella, M., 2005, Composition of Services with Nondeterministic Observable Behavior, in: *Proceedings of the 3rd conference on Service Oriented Computing*, B. Benatallah, ed, Springer-Verlag, Amesterdam, pp, 43-85.
3. Biennier, F., Boucher, X., Hammami, A., and Vincent, L., 2002, Towards a modelling framework for networks of SMEs, in: *Proceedings of the 3rd IFIP Working conference on infrastructures for virtual enterprises*, L. Camarinha-Matos, ed., Kluwer, Algarve, pp. 11- 18.
4. Biennier, F., and Mathieu, H., 2006, Organisational inter-operability: towards enterprise urbanism. To appear in I-ESA electronic proceedings. March 2006.
5. Bussler, C., 2002, The application of workflow technology in semantic B2B integration, Journal of distributed and parallel databases (12), pp. 163-191.
6. Casati, F., and Di scenza, A., 2001, Modeling and managing interactions among business processes, Journal of systems integration (10), pp. 145-168.
7. Fu, X., Bultan, T., and Su, J., 2002, Formal verification of e-services and workflows, in: *Proceeding of the workshop on Web Services, E-Business, and the Semantic*, C. Bussler, R. Hull, and S. McIlraith, eds, Springer-Verlag, Toronto, pp. 188-202.
8. Hamadi, R., and Benatallah, B., 2003, A Petri net-based model for web service composition, in: *Proceedings of the 14th Australasian Database Conference*, Adelaide, pp. 191-200.
9. Hu, H., and Du, X., 2004, Adopting Ontologies and Rules in Web Searching Services, in: *Proceeding of 1st symposium on Computational and Information Science*, J. Zhang, J. He, and Y. Fu, eds, Springer-Verlag, Shanghai, pp. 1047-1053.
10. Kwon, Y., Lee, H. K., Lee, S. and Lee, J., 2003, The virtual enterprise: redefining the concept, *Lecture Notes in Computer Science*, volume 2713, Springer-Verlag, pp. 249-258.
11. Longepe, C., 2003, The Enterprise Architecture It Project: The Urbanisation Paradigm, Kogan Page Science, ISBN:1903996384.
12. Medjahed, B., Bouguettaya A., and Elmagarmid, A.K., 2003, Composing Web services on the Semantic Web, Journal of very large database (12), pp, 333-351.
13. Miller, J.A., Sheth, A.P., Kochut K.J., and Singh, H., 1997, WebWork: Meteor2's Web-based workflow management system, Journal of intelligent information system (10), pp. 185-213.
14. Muth, P., Wodtke, D., Weissenfels, J., Dittrich, A., and Weikum G., 1998, From centralized workflow specification to distributed workflow execution, Journal of intelligent information system (10), pp. 159-184.
15. Sheer, A.W., 1993, Architecture of Integrated Information System (ARIS), in: *Proceedings* of the JSPE/IFIP TC5/WG5.3 workshop on the Design of Information Infrastructure Systems for Manufacturing, Tokyo, pp. 65-84.
16. Van der Aalst, W., 2002, Inheritance of inter-organizational workflows to enable business to business E-commerce, Journal of electronic commerce research (2), pp. 195-231.
17. Yang, H., Li, Z., Chen, J., and Xia, H., 2005, Web services composition based on ontology and workflow, in: *Proceedings of the 6th conference on Advances in Web-Age Information Management*, W. Fan, Z. Wu, and J. Yag, eds., Springer-Verlag, Hangzhou, pp. 297-307.