Describing GORMAS using the FIPA Design Process Documentation and Fragmentation Working Group template

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Abstract. This work presents a way to describe GORMAS, an Agent-Oriented Software Engineering methodology, using the template proposed by the FIPA Design Process Documentation and Fragmentation Working Group. This template uses SPEM 2.0 notation and it is aimed at identifying the fragments of each process, in order to extract and reuse them in some different processes.

Key words: agent-oriented software engineering, design process, fragmentation, GORMAS

1 Introduction

When developing Multi-Agent Systems (MAS), designers should be provided with methodologies and design processes that can help them to achieve well-designed systems. In the last years, the community of Agent-Oriented Software Engineering (AOSE) researchers has proposed several methods (see [1] for a survey on this topic). Some of the most recent methodologies are a refinement of previous methodologies, such as GORMAS [2], that refines INGENIAS [3], and ANEMONA [4] methodologies. Some others are the composition of different processes, such as MEnSA [5], that integrates concepts from Tropos [6], Gaia [7], SODA [8] and PASSI [9]. Therefore, it can be seen that designers of new methodologies make use of fragments from existing methods. It is necessary to be equipped with techniques that help designers to extract the fragments of a given design process. For example, the Situational Method Engineering (SME) [10] paradigm provides means for constructing ad-hoc software engineering processes following an approach based on the reuse of portions of existing design processes, the so-called method fragments stored in a repository, called method base. Each existing design process can be considered as composed of self-contained components, named fragments. Nowadays, a standard definition of fragment does not exist, so it is an open issue for designers, that have to decide what is a fragment in each method. Therefore, techniques for fragment selection and composition are required.

To give support in these topics, the IEEE FIPA Design Process Documentation and Fragmentation working group[1] (IEEE FIPA DPDF WG) is working on providing a solution in terms of a shared and easily adoptable specification for the documentation of the design process and of the process fragment. More in details, this working group aims to propose a definition of method fragment to be used during a situational method engineering process, the fundamental elements of which it is composed, and the metamodel on which it is based. The first step (currently undergoing) is the identification of the most suitable metamodel and notation for the process: (i) for the representation of the existing design processes from which the fragments have to be extracted; and (ii) for the representation of fragments themselves. This step will outcome in the definition of a proper template for the description of agent-oriented design processes. Such a template will, obviously, refer to the selected process metamodel and will suggest the adoption of good practices in documenting existing processes as well as defining new ones. The final step will be the definition of the Method Fragment Structure and Documentation Template. This template claims the authors to use SPEM 2.0 notation to describe their processes, in order to achieve a standardization. Currently, this FIPA group is working on specifications of the following methodologies: ADELFE [11], ASEME [12], ASPECS [13], INGENIAS [3], PASSI [9], SODA [8] and GORMAS [2].

This paper describes an application of the FIPA DPDF WG template to a specific MAS methodology. The main objective of this work is to describe the GORMAS methodology by means of the template proposed by the IEEE FIPA Design Process Documentation and Fragmentation working group. By using this template, we are looking to achieve the following:

- To facilitate the knowledge and diffusion of the GORMAS methodology by using a standardized description of the process.
- To make an assessment of the possibilities that the proposed template offers, evaluating its advantages and the changes that the document could need.
- To establish the fragments of the GORMAS process, that can be reused to improve other proposed processes.

The rest of this work is organized as follows. Section 2 describes the FIPA DPDF WG template. Section 3 gives an example of using the template with the GORMAS process. Section 4 presents a discussion on the proposed template. Finally, section 5 gives our conclusions on this work.

2 FIPA DPDF WG Template

In the same way that the Unified Modeling Language (UML) [14] does, the template [15], proposed by the FIPA DPDF WG to describe a process, identifies the fundamental concepts in the definition of design processes (regarding Agent-Oriented Systems) independently of the notation (text, icon, diagram, etc.) used for defining such concepts.

[1] `http://www.pa.icar.cnr.it/cossentino/fipa-dpdf-wg`

The design process documentation template proposed in this specification is also particularly relevant to researchers and practitioners working on Situational Method Engineering (SME) [10] approaches. SME proposes the reuse of fragments from known methods to obtain ad-hoc methods suitable for specific development situations. The method fragment (i.e. a portion of a design process) is the key-concept in SME and, although different definitions can be found for it, all of them share the idea of fragment as a self-contained component. Following this idea, in order to build a new process, designers have different previously defined fragments available that can be assembled [16, 17]. The method fragment process, must then be focused on the definition of these fragments, by requiring the whole process to be previously described in a standard way that makes identifying and defining them easier. Therefore, this must be the main aim of the FIPA DPDF WG specification, being important to provide here the means of defining the whole process from which fragments will be obtained.

The proposed template is suitable for process definition, since it has been conceived without referring to any specific process or methodology. Moreover, the template has a simple structure resembling a tree. This allows the definition to be given in a natural and progressive way. The proposed documentation is composed of three *main sections* (*Introduction*, *Phases of the Process*, and *Work Product Dependencies*). The *Introduction* section contains an *overview* of the process and a description of the *metamodel* used on it. The second section is split into as many subsections as phases that the process has. Every subsection contains a description of the *activities* executed in that phase, the *roles* that are involved into it and the *work products* that will be generated in this phase.

Finally, the template allows presumably easy use by process designers with a background on software engineering. It relies only on a few initial assumptions common in the field. Moreover, the notation suggested for documenting the process is the SPEM [18] standard with few extensions.

The next section uses this template for the GORMAS methodology.

3 Describing GORMAS with the FIPA DPDF WG template

The GORMAS methodology was completely described using the DPDF WG proposed template. This description can be found in a technical report [19] which is available on the web[2]. Due to space limitations, in this section we will only describe the Mission Analysis phase of GORMAS using the proposed template.

3.1 Introduction

GORMAS (**G**uidelines for **OR**ganizational **M**ulti-**A**gent **S**ystems) defines a set of activities for the analysis and design of Virtual Organizations, including the design of their organizational structure and their dynamics. With this method,

[2] `http://www.dsic.upv.es/docs/bib-dig/informes/etd-05182010-133045/GORMASTechRep.pdf`

all services offered and required by the Virtual Organization are clearly defined, as well as its internal structure and the norms that govern its behavior.

GORMAS is based on a specific method for designing human organizations by Moreno-Luzón *et al.* [20], which consists of diverse phases for analysis and design. These phases have been appropriately adapted to the MAS field, to catch all the requirements of the design of an organization from the agents' perspective. Thus, the methodological guidelines proposed in GORMAS cover the typical requirement analysis, architectural and detailed designs of many relevant *Organization-Centered Multi-Agent Systems* (OCMAS) [21], (such as SODA and INGENIAS) methodologies, but it also includes a deeper analysis of the system as an open organization that provides and offers services to its environment.

3.2 Phases of the process

The proposed guideline allows being integrated into a development process of complete software, which may include the phases of analysis, design, implementation, installation and maintenance of MAS. GORMAS methodology is focused on the analysis and design processes, and it is composed of four phases (see Fig. 1), covering the analysis and design of a MAS: first phase is **mission analysis**, that involves the analysis of the system requirements, the use cases, the stakeholders and the global goals of the system; the **service analysis** phase specifies the services offered by the organization to its clients, as well as its behavior, and the relationships between these services; the **organizational design** phase defines the structure for the Virtual Organization, establishing the relationships and restrictions that exist in the system; and finally, at the **organization dynamics design** phase, communicative processes between agents are established, as well as processes that control the acquisition of roles along with processes that enable controlling the flow of agents entering and leaving the organization. Additionally, some norms that are used to control the system are defined. Finally, the organization dynamics design phase is responsible of designing guides that establish a suitable reward system for the organization. Implementation is carried out in the THOMAS [22] framework which mostly covers the organization software components that are required, such as organizational unit life-cycle management, service searching and composition and norm management.

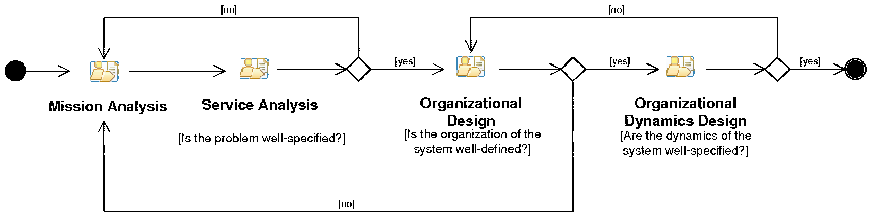

Fig. 1. GORMAS design process

This methodology allows designing large scale, open and service-oriented MAS, where organizations are able to accept external agents into them. In order

to model this kind of systems, GORMAS is supported by a CASE tool named EMFGormas [23], that uses the MDA Eclipse Technology.

3.3 Mission Analysis phase

The *Mission Analysis* phase, the first of the GORMAS methodology, involves the analysis of the system requirements, identifying the use cases, the stakeholders and the global goals of the system. This phase involves two different process roles, four work products (one model diagram and three text documents) and one guidance document, as described in figure 2. This phase is composed of five activities. The process flow at the level of activities is reported in figure 3.

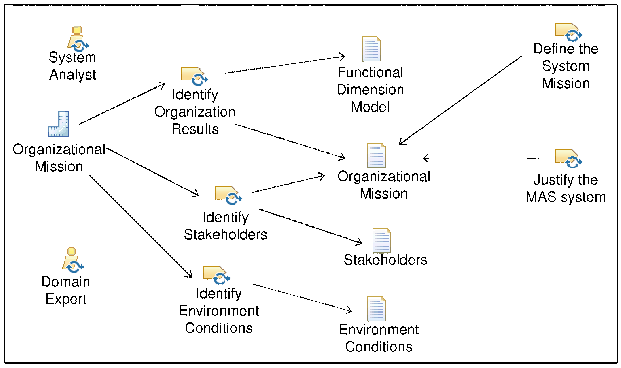

Fig. 2. Resources and products used in mission analysis phase

As a result of the activities carried out in this phase, a diagram of the *Functional Dimension Model* is drawn, detailing the products and services offered by the system, the global goals (mission) pursued, the stakeholders, the existing links between them, the system results and the resources or services needed.

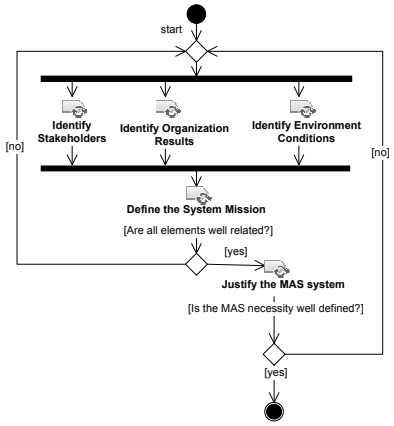

Fig. 3. Activity diagram of Mission Analysis phase

Process roles. There are two roles involved in the *Mission Analysis* phase: the System Analyst and the Domain Expert. The *System Analyst* is responsible for: (i) defining the mission and the context of the organization, by means of identifying the system results, the stakeholders and the environment of the organization; (ii) creating the documents that define the mission of the system; and (iii) defining the *Functional Dimension Model* diagram. The *Domain Expert* is responsible of supporting the system analyst during the *Mission Analysis* phase, by giving him all the information that he could need.

Activity details. In the Mission Analysis phase, the following concepts are defined:

- The global goals of the system (mission).
- The services and products that the system provides to other entities.
- The stakeholders with whom the system contacts (clients or suppliers of resources/services), describing their needs and requirements.
- The conditions of the environment or context in which the organization exists (i.e. complexity, diversity, restrictions, etc.).
- The justification of the existence of the MAS system that it is being designed, in order to look that the GORMAS definition on a MAS could contribute on defining an organization.

In order to identify all these items, five activities are needed, detailed in table 1. These activities are aimed at looking for the system mission, by means of: (i) identifying the organization results; (ii) identifying the stakeholders; and (iii) identifying the environment conditions. Moreover, global goals of the system are described. Finally, it is necessary to justify whether the GORMAS approach for creating organizations is suitable for the current problem under study.

Activity	**Activity Description**	**Roles Involved**
Identify organization results	Describe the results (products or services) that the system provides, to understand what the result is, what it does and who is interested in.	System analyst and domain expert
Identify stakeholders	Identify and describe the main stakeholders that the organization is related to (external actors, clients, users, etc.)	System analyst and domain expert
Identify environment conditions	Identify and define the kind of environment in which the organization will be developed, knowing if it is a physical environment or a virtual environment; if it is a distributed environment, etc.	System analyst and domain expert
Define the System Mission	Identify the global goals pursued by the system. These goals compose the mission of the organization.	System analyst and domain expert
Justify the MAS system	Justify the existence of this kind of system, comparing it to other existing similar systems (that can use agents or not), and analyzing the advantages and disadvantages, and the singularities of the proposed system.	System analyst

Table 1. Mission Analysis phase activities

Work products. The following section describes the products generated on the *Mission Analysis* phase. Firstly, the *Functional Dimension Model* diagram is defined, and three documents, related to organizational mission, stakeholders and environment conditions are generated (see table 2).

Fig. 4 describes their relation with the elements of the GORMAS metamodel [19]. In this figure, each of the work products reports one or more elements from the GORMAS meta-model; each MAS meta-model element is represented using a UML class icon and, in the documents, such elements can be Defined, reFined, Quoted, Related or Relationship Quoted, as explained in the template [15].

Name	**Description**	**Work Product Kind**
Functional Dimension Model	A diagram using the GORMAS graphical notation (based on GOPPR notation) that details the specific functionality of the system, based on services, tasks and goals.	Behavioral
Organizational Mission	A document describing the basic aspects of the organization that will be defined.	Structured text
Stakeholders	A document describing the stakeholders that will take part in the organization.	Structured text
Environment conditions	A document describing the conditions that the environment of the organization will have.	Structured text

Table 2. Product for Mission Analysis phase

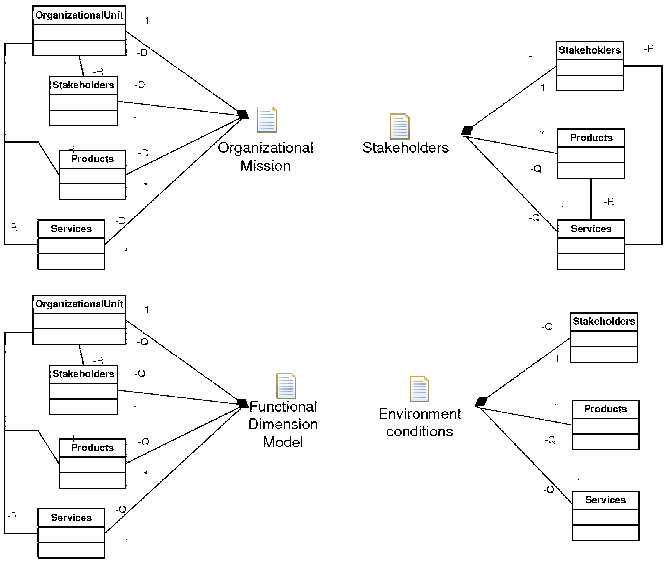

Fig. 4. Mission Analysis phase. Relations between work products and metamodel elements. Caption: D: defined element, introduced for the first time; F: element refined; Q: quoted element, already defined; R: element related with another element.

Organizational Mission. This document is employed to define the mission of the organization. It is a structured text document, whose template is shown in

table 3. As shown, it is necessary to give a name, a domain and an environment for the organization. Additionally, it is necessary to set the results that the system will provide and the stakeholders that are interested on keeping a relation with the organization. Finally, a justification for designing the system must be provided.

Organizational mission
Name: general name of the system or organization to be generated
Domain: kind of market or interest area of the organization
Results: set of products or services offered by the organization to its clients - *Purpose*: Description of the motivation because this result is offered. - Is it *tangible*?: If the result is storable, printable and/or reusable, it is a product. If it is a used up functionality, then it is a service.
Stakeholders: actors that set up the market of the organization. - Is it a *consumer*?: the actor consumes the products or services that the organization provides. - Is it a *producer*?: the actor provides some resources or services that are required by the organization to work.
Kind of environment: location of the system (unique or distributed): Ability to access to the real and physical world.
Context restrictions: a set of restrictions that are imposed by the context or environment of the organization, and could affect to its structure, services, etc.
Justification: reason of the existence of the organization - *Similar systems*: to detail the existing systems that provide a similar orientation than the one we are considering. - *Advantages*: set of advantages that we want to offer with the new proposal, i.e. optimal use of the resources or services. - *Disadvantages*: limitations that the new proposal has. - *Singularities*: competitive elements of the organization.

Table 3. Template for Organizational Mission document

Stakeholders. This document is employed to describe the stakeholders of the organization, that have been defined in the Organizational Mission document. It is also a structured text document, whose template is shown in table 4. The identification of the stakeholders must be completed by providing the kind of stakeholder, the objectives that each group follows, their products and services provided and required, the benefits obtained by them and their position into the organization.

Stakeholders	
Name	An identifier for the stakeholder
Beneficiary	Indicate if the stakeholder is a primary (essential) or a secondary beneficiary.
Type	Indicate if the stakeholder is a client, a provider or a regulator.
Objectives	Describe the objectives pursued by the stakeholder.
Requires	A set of products and/or services that the stakeholder consume.
Provides	A set of products and/or services that the stakeholder offers to the organization.
Frequency	To point out if this stakeholder contacts the organization frequently, occasionally or in an established period of time.
Benefits	Describe the benefits that the stakeholder wants to achieve.
Decision power	Indicate if their needs are affecting to the requirements of products or services.
Under the influence of the system?	Indicate if the organization can affect the interests of the stakeholder.
Contribution	To point out what the organization obtains for its relationship with stakeholders.

Table 4. Stakeholders document

Environment conditions. This document is employed to describe the environmental conditions in which the organization will be placed. It is a structured text document, whose template is shown in table 5. This document analyzes five

conditions: the change rate, the complexity, the uncertainty, the receptivity and the diversity of an environment.

Environment conditions
Change rate: Are the stakeholders constants through time? Are their requirements constants? Are they modified in a cyclical and a predictable way? Is it possible to estimate the consumption of a product? Is the demand of a product or a service constant through time? If the answer is affirmative, the environment is stable. If not, it is an unstable or dynamic environment.
Complexity: Is there a lot of different elements? Are there a lot of clients? Are there a lot of types of products and services to offer? Are there a lot of types of providers? Are providers not related between them? If any of the answers is affirmative, the environment is complex. If not, it is a simple environment.
Uncertainty: If the environment is dynamic and complex, uncertainty is high. If the environment is stable and simple, uncertainty is low.
Receptivity: Are the inputs and resources available? Are they obtained in an easy and secure way? If the answer is affirmative, the environment is munificent. If not, it is an hostile environment.
Diversity: Are different groups of clients served? Is it provided a set of different products or services, with no relationship between them? If any of the answers is affirmative, the environment is diverse. If not, it is a uniform environment.

Table 5. Environment Conditions document

Functional Dimension Model. This work product is a GORMAS diagram. GORMAS uses a UML-like graphical notation called GOPPR [24] (used to define diagrams in INGENIAS and ANEMONA methodologies), but adding some entities proposed by GORMAS like services and norms.

As stated before, the *Functional Dimension Model* details the specific functionality of the system, based on services, tasks and goals, as well as system interactions. Figure 5 shows an example of a *Functional Dimension Model* diagram. An Organizational Unit representing the system (UPV), as well as the stakeholders (Students, Governing organs and Teachers), the objectives pursued by the organization ('Efficient management of the financial resources', 'Increase scientific production'), the products (Databases and Bills) and the services (Budget mnt. and PhD mnt.) of the system are defined on this diagram.

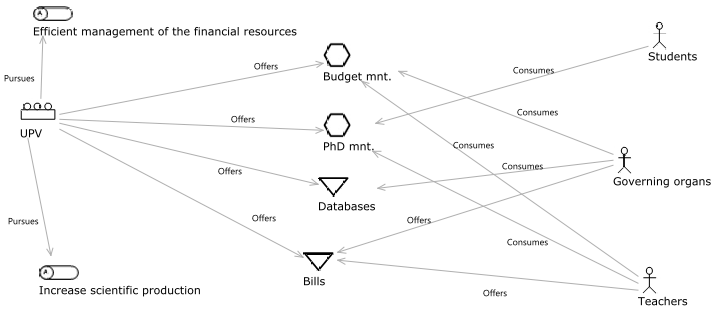

Fig. 5. Example of a *Functional Dimension Model* diagram

4 Discussion

This section describes the advantages and disadvantages presented by the proposed template. On the one hand, the advantages found during this work are:

- This template allows describing a development process using a standard language like SPEM 2.0. The use of a standard will improve the comparison of GORMAS with other methodologies.
- The phases of the GORMAS methodology were clearly depicted in its original definition. Therefore, a correct fragmentation of the process was easily obtained after applying the template to GORMAS.
- The metamodel used by the GORMAS methodology has its own section inside the template, providing a clear and easy-reading description of it.
- The activities developed inside every phase of GORMAS can be easily defined. Therefore, the methodology is not only described in an overview, but in a detailed way.
- The work products are described and an example is given. Additionally, their evolution during the whole process is shown and their dependencies.
- The roles participating in the process are identified and the activities that they are responsible for are identified.
- Several tables are used in order to improve the identification of some elements such as the work products and the activities of the methodology.

On the other hand, these are the disadvantages of this template:

- The *Phases of the process* section of the template describes the functionality of every phase by means of its activities, and the tasks composing each activity. Activities are provided with a deeper description than tasks. However, in the *Organizational Dynamics Design* phase of our example, tasks are more important than activities as they contain the most relevant information related to this phase. In order to solve this problem, we defined the tasks of *Organizational Dynamics Design* phase using the best possible way that the template guidelines allowed us, by means of descriptive tables. Designers should be allowed to describe tasks in a similar way to activities, i.e. with a similar deep description, so as to achieve the desired level of detail in every phase of a process.
- The template has not a discussion nor conclusion section. It can be very useful to add a section like this, in order to provide developers with the possibility of remarking or pointing out some features that could be considered as important. Additionally, a section describing guidance documents can be very interesting, in which work products were described.
- The template provides a deep and detailed description of a design process, but it does not include a 'light view' of the process. This feature reduces the focus of possible future readers, that will be mainly bounded to process designers and developers.
- The adaptation of a methodology from its classic representation to the representation proposed by the template must be done by a human. That is, we must know how to deal with human errors, that could make a methodology not to be properly translated to the structure of the template.

As seen, there are more interesting advantages than disadvantages on using this template. The use of a well-known standard graphic language such as SPEM

2.0 drives the methodologies to a better understanding of their processes and approaching them to the standardization. Moreover, the usage of this template will improve the task of identifying and extracting the fragments of a methodology. These fragments will be available for the rest of the AOSE community, that would use them to improve their existing methodologies or to create new design processes based on a compilation of these fragments.

Possibly, the main lack of AOSE is a standard methodology. Using this template, all the methodologies will adopt the same structure, allowing the authors to compare them to test every feature of the processes, in order to find which is the methodology that best solves a concrete problem. After this analysis, there will be possible to define a methodology, taking the best from the existing methodologies, that could be considered as a standard.

5 Conclusion

This work presents the template to describe an AOSE methodology proposed by the IEEE FIPA DPDF WG. As an example, the GORMAS methodology, used to describe Virtual Organizations, was described using this template. After using this template over a concrete design process, it becomes expressed in a standard notation such as SPEM 2.0 and their fragments are identified. In our concrete example, GORMAS became properly translated into the structure of the template. Nevertheless, there could be some methodologies whose adaptation to the template is harder. As a conclusion, we can state that the template allows to describe a methodology in a proper way and it is recommended to adopt it to improve the understanding and study of the design processes.

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References

1. E. Argente, G. Beydoun, R. Fuentes-Fernandez, B. Henderson-Sellers, G. Low, and F. Migeon. Modelling with agents. In *Postprocedings of AOSE 2009*, page In Press. Springer, 2010.
2. E. Argente, V. Botti, and V. Julian. Organizational-Oriented Methodological Guidelines for Designing Virtual Organizations. In *Proc. 10th International Work-Conference on Artificial Neural Networks*, page 162. Springer, 2009.
3. J. Pavón, J. Gómez-Sanz, and R. Fuentes. The INGENIAS methodology and tools. *Agent-Oriented Methodologies*, pages 236–276, 2005.
4. V. Botti and A. Giret. *Anemona. A Multi-agent Methodology for Holonic Manufacturing Systems*. Springer Series in Advanced Manufacturing. Springer, 2008.
5. R. Ali, V. Bryl, G. Cabri, M. Cossentino, F. Dalpiaz, P. Giorgini, A. Molesini, A. Omicini, M. Puviani, and V. Seidita. MEnSA Project - Methodologies for the Engineering of complex Software systms: Agent-based approach. Technical Report 1.2, UniTn, 2008.
6. P. Bresciani, P. Girogini, F. Giunchiglia, J. Mylopoulos, and A. Perini. Tropos: An agent-oriented software development methodology. *Autonomous Agent and Multi-Agent Systems*, 8:203–236, 2004.

7. F. Zambonelli, N. R. Jennings, and M. Wooldridge. Organisational abstractions for the analysis and design of multi-agent systems. In *1st Int. Workshop on Agent-Oriented Software Engineering*, pages 127–141, 2000.
8. A. Omicini. SODA: Societies and Infrastructures in the Analysis and Design of Agent-based Systems. *Agent-Oriented Software Engineering*, 1957:185–193, 2001.
9. M. Cossentino. From requirements to code with the PASSI methodology. *Agent-oriented methodologies*, pages 79–106, 2005.
10. S. Brinkkemper. Method engineering: engineering of information systems development methods and tools. *Inf. Softw. Technol.*, 38(4):275–280, 1996.
11. C. Bernon, V. Camps, M.P. Gleizes, and G. Picard. Engineering adaptive multi-agent systems: The ADELFE methodology. *Agent-oriented methodologies*, pages 172–202, 2005.
12. N. Spanoudakis and P. Moraitis. The Agent Systems Methodology (ASEME): A Preliminary Report. In *Proc. 5th European Workshop on Multi-Agent Systems*, 2007.
13. M. Cossentino, N. Gaud, V. Hilaire, S. Galland, and A. Koukam. ASPECS: an agent-oriented software process for engineering complex systems. *Autonomous Agents and Multi-Agent Systems*, 20(2):260–304, 2010.
14. J. Rumbaugh. Notation notes: Principles for choosing notation. *Journal of Object-Oriented Programming*, 9(2):11–14, 1996.
15. M. Cossentino. Design Process Documentation Template. Technical report, FIPA, 2010.
16. J. Ralyté and C. Rolland. An assembly process model for method engineering. In *Advanced information systems engineering*, pages 267–283. Springer, 2001.
17. D.G. Firesmith and B. Henderson-Sellers. *The OPEN process framework: An introduction*. Addison-Wesley Professional, 2002.
18. V. Seidita, M. Cossentino, and S. Gaglio. Using and extending the SPEM specifications to represent agent oriented methodologies. In *9th Int. Workshop on Agent Oriented Software Engineering (AOSE), Estoril, Portugal*, 2008.
19. S. Esparcia, E. Argente, V. Julian, and V. Botti. GORMAS: A methodological guideline for organizational-oriented MAS. Technical report, Universidad Politecnica de Valencia, 2010.
20. M.D. Moreno-Luzón, F.J. Peris Bonet, and T.F. González Cruz. *Gestión de la calidad y diseño de organizaciones*. Pearson Educación, SA, 2001.
21. E. Argente, A. Giret, S. Valero, V. Julian, and V. Botti. Survey of MAS Methods and Platforms focusing on organizational concepts. In *Recent Advances in Artificial Intelligence Research and Development*, volume 113 of *Frontiers in Artificial Intelligence and Applications*, pages 309–316. IOS Press, 2004.
22. A. Giret, V. Julian, M. Rebollo, E. Argente, C. Carrascosa, and V. Botti. An open architecture for service-oriented virtual organizations. In *PROMAS 2009 Post-Proceedings*, pages 1–15. Springer, 2010.
23. E. Garcia, E. Argente, and A. Giret. A modeling tool for service-oriented open multiagent systems modeling tool. In *Proc. 12th Int. Conf. on Principles of Practice in Multi-Agent Systems*, volume 5925 of *LNAI*, pages 345–360. Springer-Verlag, 2009.
24. S. Kelly, K. Lyytinen, and M. Rossi. MetaEdit+: A fully configurable multi-user and multi-tool CASE and CAME environment. *Lecture Notes in Computer Science*, 1080:1–21, 1996.