

# ADICT: Acquisition, Development, Integration and Configuration of heterogeneous components for information systems TIN2007-64753

Xavier Franch

Dept. Llenguatges i Sistemes Informàtics, Universitat Politècnica de Catalunya (LSI – UPC)  
franch@lsi.upc.edu  
UPC-Campus Nord, Omega building, room 122  
E-08034 Barcelona (Spain)

**Abstract.** This work reports on the activities undertaken in the ADICT Project TIN2007-64753. The purpose of this project is studying, understanding and applying methods, models, techniques and languages (hereafter, support utilities) for: 1) the acquisition of reusable components (that can be commercial, open source, legacy, or any other type); 2) the development of in-house components; 3) the integration of these heterogeneous components in order to obtain the baseline IS; 4) the configuration of this IS to be adapted to the peculiarities of the operative environment. These support utilities have to be the basis for the effective and efficient creation or renewal of the organizational IS.

**Keywords:** Software Components, Information Systems.

## 1 Project Goals

Currently, Information Systems (IS) in the organizations are usually composed of several components of different characteristics. It is possible to find in these systems commercial components (COTS, Commercial-Off-The-Shelf components), such as ERP or CRM components, that coexist with other that are inherited from legacy systems, that have been obtained from the open source community (OSS, Open Source Software), that have been developed in-house, etc... The organizations that face this new situation need new concepts, methods and tools that take into account the whole involved processes and that been able of synchronize these different types of components.

The ADICT project has four main goals: 1) to acquire, classify and characterize the knowledge about the typology of SI components; 2) to define support utilities (i.e., methods, models, techniques and languages), and build tool support, for the acquisition, development and integration of heterogeneous IS components, as well as the particularization of the obtained IS; 3) to synchronize adequately these support utilities, in such a way that they may coexist even considering the heterogeneity of the components; 4) to identify and solve the limitations presented by the support utilities used in the project.

This project is the continuation of the project TIC2004-07461-C02.

## 2 Project Success

The results of the project are (remark: the tools mentioned here are listed at section 3.7):

1. We have formulated methods for dealing with heterogeneous components:
  - RECSS, a method for eliciting requirements for OTS-based systems [14].
  - DHARMA, a method for building the enterprise hybrid architecture of OTS-based systems [24][41].
  - WORMS, a method for creating a call-for-tender document for OTS-based systems deployment [31][36].
2. We have used the goal-oriented  $i^*$  framework, as cornerstone for the modelling of system requirements and architectures with heterogeneous components:
  - *Methods*. In addition of the methods mentioned above, that are based on  $i^*$ , we mention:
    - PRM, a method for reengineering process models with the help of  $i^*$  models [4].
  - *Semantics*. Basically we have addressed semantic in two directions: exploring the concept of inheritance that is needed in several contexts of component-based systems [12], and proposing a metamodel for  $i^*$  to serve as reference for ours and others' work [48]. Also we have addressed how to improve the quality of requirement models [32].
  - *Application*. We mention the use of  $i^*$  as an architecture description language [3] and the design of an exemplar representing one particular domain of component, mobile office devices [23][43].
  - *Implementation*. In the form of standards and tool support:
    - iStarML, an XML standard for the interchange of  $i^*$  models between tools [10][44]. Several tools have been connected.
    - HiME, a tool for editing  $i^*$  models with full usage of inheritance [40].
3. We have conducted several works on exploring the scope, characteristics and limitations of reusable components.
  - *COTS components*. [1] formalised the concepts used in OTS selection methods from the process point of view. [6][25] focused on assessing the meaning of information quality to practitioners that conduct OTS selection processes.
  - *OSS components*. [30] explored the challenges of OSS marketplace in the industry, which is serving as the baseline for several empirical studies that we are currently conducting.
  - *Tool support*. The use of wiki tools [28] has also explored as a way to support reuse in OTS-related processes.
4. We have gained insights about in-house development with focus on the systematic definition of software architectures considering the information represented in requirements. We formulated a first contribution using the classical strategy of treatment assignment [2] that was later enriched by introducing an ontology on architectural knowledge [34] partly supported by our empirical findings in [35]. We have formulated a proposal of new architectural style [37].
5. We have focused on the generation and evaluation of solution alternatives, again with special focus on architectures (but also in social systems) and again using  $i^*$  as main conceptual tool. We followed a line of research about  $i^*$  metrics that has resulted in a paper proposing a catalogue of metric patterns [15] and then we made an in-depth analysis of business process modelling metrics with more than satisfactory results [29]. On the other hand, we have gone on with the study of quality models, one of our classical lines of research. We gained more

insights on the use of quality models through large-scale experiences [9] and about the adequacy of our DesCOTS tool. Also, we learned more about the impact of non-technical features on selection processes, linking these features with CMMI levels as a way to integrate them in practitioners' best practices [13]. Last, we mention that the proper management of quality models at the level of metamodeling required exploring and solving some ambiguities when using UML for building these metamodels, and we introduced in [17] the notion of induced association that was later generalized into induced relationship [39], supported by a metamodeling prototype called QUINST [19].

6. We have paid special attention to a particular type of system, service-oriented systems, in which may be considered as the seed of the next project proposal. Coming from our collaboration with the Johannes Kepler University at Linz we presented several papers with special emphasis on the relationship between service-orientation and feature-orientation and the opportunities emerging for adaptable systems [5]. In this context we started to develop some proposals for conducting testing and monitoring of this kind of systems that resulted in some publications [7][20][38] and also some software implementing them (SALMon and WeSSQoS systems).
7. We have addressed knowledge reuse from several perspectives. On the one hand, coming from our collaboration with the Centre Henry Tudor, we proposed the notion of requirement pattern as a way to elicit and document in an efficient and accurate manner the requirements for OTS call-for-tender processes [8]. This notion was further explored to formulate a method, PABRE, that is being validated in real cases at Luxembourg [22][42]. Claudia Ayala's PhD presented a comprehensive approach for the management of reusable knowledge in OTS selection processes based on taxonomies and quality models.
8. We have invested a lot of effort in one particular OSS initiative, the Moodle community. In this context, we undertook (and still are working on some) several collaborative projects (see section 3.4), we developed several code packages of interest (see section 3.7 for a summary of the most important contributions) and presented the results in several conference papers [18][21][26][27][33].

To sum up, we think that we have achieved a significant scientific progress towards the objectives of the ADICT project (with still 8 months to go). Especially goals 1 (acquisition, by means of models and processes), 3 (integration, by means of hybrid architectures) and 4 (customization, e.g. call-for-tender processes and service-oriented architectures) are currently achieved to a great extent.

Concerning difficulties, the greatest one has been transferring the results to industry. We are still pursuing more industrial case studies for validation of the results.

### 3 Indicators of Results

We include next information restricted to the period of the project (from Oct. 2007).

#### 3.1 Progress of the research team

During the project, the following milestones have been achieved:

- 3 PhD thesis defended: G. Grau, C.P. Ayala, M. Alier (all cum-laude).

- 5 research-oriented master thesis defended advised by group members: D. Ameller, C. Carreón, E. Mora, M. Oriol, J. Piguillem.
- Several students are joining the project: O. Collell, D. Colomer, C. Palomares.
- Hosting 2 MSc and PhD students who came with grants: O. Cabrera (March-July 2009, CENIDET, México), C. Becerra (Nov. 2009-March 2010, U. Técnica Santa María, Chile).

### 3.2 List of publications

We have 47 publications published or in press since Oct. 2007, most of them underwent through a peer-review process, and a few book chapters were invited (but also with a later revision). The complete list appears in the appendix. The table below includes some classification criteria:

	Total	Scope	Indicator	Review	Joint	Editorial	Others
Journals	6	I: 5 R: 1	X: 1 SC: 2	F: 3 S: 3	2	Elsevier: 1 Wiley: 1 Springer: 1	T: 1
Conferences	24	I: 20 R: 4	A: 1	F: 23 A: 1	7	IEEE: 8 ACM: 1 LNCS: 5 Other Springer: 3	T: 1 S: 2 P: 1
Workshops	12	I: 8 R: 2 N: 2		F: 12	3	IEEE: 1 LNCS: 1 CEUR: 3	
Book chapters	5	I: 3 N: 2		I: 5		MIT Press: 2 Springer: 1 Ra-Ma: 2	

Scope of the publication or conference: I: International; R: Regional

Indicator: X: with impact factor; SC: SCI-indexed; A: best paper award received

Review: F: full paper; A: abstract; S: selected from former work; I: invitation

Joint: with other research groups

Editorial: we highlight some reputed editorials and collections

Others: T: description of tool; S: published as short paper; P: presented as poster

One best-paper award (IEEE RCIS'09).

Concerning editorial responsibilities:

- Xavier Franch was Proceeding editor or co-editor of: 10 events at CAiSE'08 (published by CEUR proceedings); iStar'08&'10 (CEUR proceedings); JISBD'07 (Thomson); CibSE'10 (Univ. del Pacífico, Cuenca, in press).
- Xavier Franch was co-editor of a special issue of the SCI-indexed *Journal of Systems and Software* (Elsevier), 2008; IEEE America Latina special issue for JISBD'07, 2008.

### 3.3 Participation in academic events

The members of the group have been and are being involved in the following academic events:

- Organizing committees:

- Xavier Franch was General Chair of the 16<sup>th</sup> IEEE International Requirements Engineering Conference (RE, <http://www.upc.edu/gessi/re08/>), held at Barcelona (Spain), Sept. 2008.
- Carme Quer was General Chair of the 11<sup>th</sup> Workshop on Requirements Engineering (WER, <http://sites.upc.edu/~www-gessi/wer08/>), held at Barcelona (Spain), Sept. 2008.
- Juan Pablo Carvallo is being General Chair of the XIII Conferencia Iberoamericana de Software Engineering (CIBSE, <http://www.uazuay.edu.ec/cibse/>), held at Cuenca (Ecuador), April 2010.
- Xavier Franch has been and is being workshop co-organizer of the following workshops:
  - o 3<sup>rd</sup> International Workshop on i\* (iStar, <http://www.cin.ufpe.br/~istar08/site/>), held at Recife (Brasil), February 2008.
  - o 4<sup>th</sup> International Workshop on i\* (iStar, <http://www.cin.ufpe.br/~istar10/>), to be held at Hammamet (Tunisia), June 2010.
- Program committees:
  - The members of the group have been, or currently are, Program Committee chairs of the following conferences and workshops: CIBSE'10 (X. Franch), WER'09 (C. Ayala), WER'08 (J.P. Carvallo), ICCBSS'08 (J.P. Carvallo), JISBD'07 (X. Franch)
  - The members of the group have reviewed papers for the following journals: ACM TOSEM; IEEE Software, IEEE TSE, IEEE TSC; Springer ISF, Springer JCST, Springer REJ, Springer SQJ, Springer SoSyM; Elsevier AES; Elsevier IST, Elsevier SCP; Wiley SPII; IET IEE Proceedings; World Scientific IJSEKE; Cambridge University Press KER.
  - The members of the group have been, or currently are, members of program committees belonging to more than 40 conferences and workshops, among them: CAiSE, RE, ER, REFSQ, SPLC, SAC, ICCBSS, CBSE, SEAA, IESS, PoEM, WER, JISBD, JSWEB, IDEAS, CIBSE, SBES.
- Other positions in conferences: Finance Chair (P. Botella, RE'08), Local Chair (C. Quer, RE'08), Workshop co-chair (X. Franch, CAiSE'08), Doctoral Symposium co-chair (C. Ayala).
- Steering committee memberships: RE (X. Franch), JISBD (P. Botella, X. Franch), CIBSE (X. Franch).
- The Moodle initiative: M. Alier is: core developer member; Moodle representative at IMS Global Learning Consortium; member of Open Knowledge Initiative; Google Summer of Code Mentor for IMS Global Learning Consortium and Sakai foundation; member of the Spanish Moodle conference (Moodleoot.net) permanent committee.

### 3.4 Projects and Industrial experiences

Title of the project or contract	Principal Investigator	Budget (Euros)	Funding agency and project reference	Project period
<b>European projects, bilateral actions and other projects with international participation</b>				
S-Cube: Software Services and Systems Network	Klaus Pohl (Univ. Duisburg-Essen)	Money for travelling	CEE – FP7 program, FP7-ICT-2007, Network of Excellence	2008-12
Involving Standards in the ADOxx v1.0 Metamodelling Compiler - The iStarML Integration	Xavier Franch Gutiérrez	7.810	MEC – Acción Integrada Austria (AT2009-0015)	2010-11
Service Oriented Device & Delivery Architecture (SODA)	Enric Mayol Sarroca	58.382	ITEA (CEE), PROFIT (Spain)	2006-08

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Requirements Engineering in Multi-stakeholder Distributed Systems	Xavier Franch Gutiérrez	6.280	MEC – Acción Integrada Austria (HU2005-0021)	2006-07
<b>National-wide networks</b>				
Red de desarrollo de Software dirigido por modelos (DSDM)	Antonio Vallecillo (UMa)	24.000 (total)	MEC (TIN2008-00889-E)	11/2008 - 11/2010
Red de Líneas de Producto (ELEPES)	Oscar Díaz (UPVasco)	40.000 (total)	MEC (TIN2006-27690-E)	1/2007 - 12/2008
Calidad del Producto y Proceso Software (CALIPSO)	Coral Calero Muñoz (UCLM)	48.000 (total)	MEC (TIN2005-24055-E)	12/2005 - 12/2008
Red de desarrollo de Software dirigido por modelos (DSDM)	Antonio Vallecillo (UMa)	48.000 (total)	MEC (TIN2005-25866-E)	12/2005 - 12/2008
RED para la promoción de la Calidad de Datos en Sistemas de Información Empresariales (DQNet)	Ismael Caballero (UCLM)	24.000 (total)	MEC (TIN2008-04951-E/TIN)	11/2008 - 11/2010
<b>Spanish funded projects</b>				
LAYERS4MOODLE	Marcos Cuevas (Padaván Network)	66.499	Plan Avanza TSI-020302-2009-35	03/2009 - 12/2009
<b>Other national grants</b>				
16th IEEE International Requirements Engineering Conference	Xavier Franch Gutiérrez	12.000	MEC (TIN2007-30891-E)	05/2008 - 12/2008
Eleventh Workshop on Requirements Engineering (WER'08)	Carne Quer Bosor	1.700	MEC (TIN2008-01583-E)	08/2008 - 08/2009
<b>Technology transfer (collaboration with companies)</b>				
Integral Assessment of Services	Pere Botella López	9.310	Contract with S4E	09/2009 - 12/2009
Design and execution of the test suites for the DRAC system, v0.9 and v1.0	Xavier Franch Gutiérrez	9.000	Contract with UPCNet	06/2009-09/2009
Asesoría en el diseño del sistema Layers	Marc Alier Forment	25.000	Contract with Layers.com/Padawan S.L.	11/2009 - 07/2010
Use procedure documentation of the DRAC system	Xavier Franch Gutiérrez	6.000	Contract with UPCNet	10/2008 - 02/2009
Assessment in the Functional Specification of the new Information System for the PDI activity	Xavier Franch Gutiérrez	6.000	Contract with UPCNet	11/2007 - 03/2008
Assessment in the formulation of the Business processes of the new Information System for the PDI activity	Xavier Franch Gutiérrez	12.000	Contract with UPCNet	06/2007 - 10/2007

### 3.5 Other initiatives

The members of the group have participated, or are currently participating, in the following networks and platforms:

- NESSI (Networked European Software&Services Initiative, <http://www.nessi-europe.com>)  
European Technology Platform on software and services.  
The group is member of NESSI (representative: Pere Botella), and also member of the NESSI WG on Software Engineering (Pere Botella, Xavier Franch).
- INES (Iniciativa Española de Software y Servicios, <http://www.ines.org.es/>)  
Spanish Technology Platform on software and services.

The group is member of INES, elected member of the INES Board (Pere Botella now holds a vicepresidency for institutional relations) and member of the NESSI WG's on Software Engineering (representative: Pere Botella), Service Engineering (representative: Pere Botella), Future Internet (representative: Marc Alier) and AEI (Strategic Research Agenda, former Pere Botella, now Enric Mayol)

- DELLISS (DEsigning Lifelong Learning for Innovation in Information Services Science, <http://www.delliiss.eu/>)  
An European project funded under the program "Education, Audiovisual & Culture Executive Agency" from the European Union, FIB (School of Informatics) is the UPC partner, and Pere Botella is member of the project

### 3.6 Collaboration with other research groups

We are collaborating, or about to collaborate, with the following research groups represented by the mentioned researchers (they are listed in alphabetical order of institution):

- Centre Recherche Publique Henry Tudor, Luxembourg, responsible Eric Dubois. The collaboration started at 2005 and it is currently very active. We have collaborated in the construction of a requirement pattern catalogue for conducting call-for-tender selection processes. Joint activities from Oct. 2007: 2 publications [21] (awarded best paper) [21][42] and a catalogue of requirement patterns.
- Centro de Investigación de Producción de Software (ProS), UPV, responsible Oscar Pastor. This collaboration has started recently and we are joining efforts in the requirements engineering and model-driven development disciplines. We are applying for a coordinated project for the next period 2010-12. Joint activities from Oct. 2007: 1 technical report [45] with participation also of a researcher from the Universidad Federal de Pernambuco (Brasil).
- Centro Nacional de Investigación y Desarrollo Tecnológico (CENIDET), México, responsible Raúl Santaolaia. The collaboration started at March 2009 due to the visit of a Master Student to our Group. As a result, we have collaborated in a framework for the evaluation and selection of web services. Joint activities from Oct. 2007: 1 publication [38] and 1 software prototype, WeSSQoS (see 3.7).
- City University, HCI group, UK, responsible Neil Maiden. The collaboration started at 2003 and it is currently active. We have collaborated in the use of *i\** for process reengineering. Joint activities from Oct. 2007: 1 publication [4] and 1 application for the SOCCER workshop going on.
- FBK-irst, Italy, responsible Anna Perini. The collaboration started at 2007 and it is currently very active. This group has a prominent position in *i\** related tools and methodologies. We are currently collaboration in the diffusion of the iStarML interchange format for the *i\** framework. Joint activities from Oct. 2007: 1 publication [10] and 1 technical report currently submitted to a journal [44].
- Grupo GRIAL, Universidad de Salamanca, responsable Francisco J. García. The collaboration started at 2007. We have collaborated in the e-learning projects: Moodle, mobile applications and semantic web. Remarkably we are applying for a coordinated project for the next period 2010-12. Joint activities from Oct. 2007: 4 publications [21][26][27][33].
- Linz University, Austria, responsible Paul Grünbacher. The collaboration started at 2006 with a bilateral project (Acción Integrada). We have collaborated in putting together the *i\** language,

the win-win negotiation approach and variability modelling for representing and monitoring multistakeholder distributed systems. Joint activities from Oct. 2007: 1 publication [5].

- NTNU Center (Trondheim), Norway, responsible Reidar Conradi. The collaboration started at 2006. One member of the group, Claudia Ayala, has gone there for one year with a post-doc. We have collaborated in several issues related to empirical software engineering. Joint activities from Oct. 2007: 2 publications [30], participation in 2 Norwegian projects (Evisoft, Norsk-COSI) and co-advising of several Master thesis.
- Technical University Wien (TUW), Austria, responsible Dimitris Karagiannis. This collaboration is just starting thanks to a bilateral project (Acción Integrada) approved for the period 2010-11. The collaboration will focus on metamodeling issues for the *i\** framework.
- University of Texas at Dallas, responsible Lawrence Chung and Kendra Cooper. The collaboration started at 2005. We have collaborated in the analysis of agile methodologies applied to the product line context. Joint activities from Oct. 2007: 1 journal special issue [16].
- University of Michigan, resp. Charles Severance. We have collaborated in issues of service interoperability and cloud computing. Joint activities from Oct. 2007: 1 publication [33].

### 3.7 Software developed

Name	Description	URL
DesCOTS	Description of COTS components	<a href="http://qualitymodels.blogspot.com/">http://qualitymodels.blogspot.com/</a>
SALMon	Monitoring web services [7][20]	<a href="http://appserv.lsi.upc.es/salmon/">http://appserv.lsi.upc.es/salmon/</a>
WeSSQoS	Evaluation and selection of web services [38]	<a href="http://appserv.lsi.upc.es/wessqos/">http://appserv.lsi.upc.es/wessqos/</a>
QUINST	Metamodeling with induced associations [18]	Currently under renovation
H <sub>2</sub> ME	Editing <i>i*</i> models with inheritance [39]	<a href="http://www.lsi.upc.edu/~llopez/hime/">http://www.lsi.upc.edu/~llopez/hime/</a>
Req-Tool	Requirements pattern management [42]	Pending of IPR analysis
J2MEMicroDB	SQLite-like database engine for J2ME	<a href="http://code.google.com/p/j2memicrodb">http://code.google.com/p/j2memicrodb</a>
Sugar Clic	Player for the Clic open educational contents	<a href="http://clic.xtec.cat/en/jclic/">http://clic.xtec.cat/en/jclic/</a>
Contributions to the Moodle community		
Spellchecker	Moodle Spellchecker feature	<a href="http://cvs.moodle.org">http://cvs.moodle.org</a>
Internalmail	Moodle internal mail system	<a href="http://morfeo.upc.es/crom/course/view.php?id=4">http://morfeo.upc.es/crom/course/view.php?id=4</a>
DFWiki	Alternative wiki for Moodle	<a href="http://morfeo.upc.es/crom/course/view.php?id=4">http://morfeo.upc.es/crom/course/view.php?id=4</a>
Social Bookmarking Activity Module	Implements a Del.icio.us-like activity module for Moodle	<a href="http://code.google.com/p/moodle-social-bookmarking/">http://code.google.com/p/moodle-social-bookmarking/</a>
Moodle-Wave	Integrates the Google Wave platform into a learning activity for Moodle	<a href="http://code.google.com/p/moodle-wave">http://code.google.com/p/moodle-wave</a>
Moodbile	HTML 5.0 + Javascript client for the Moodle Webservices	<a href="http://code.google.com/p/moodbile">http://code.google.com/p/moodbile</a>
Data formats		
iStarML	Interchange format for <i>i*</i> models [10][44]	<a href="http://www.essi.upc.edu/~ccares/index.php?section=iistarml">http://www.essi.upc.edu/~ccares/index.php?section=iistarml</a>
OKI	MIT's Open Knowledge Initiative OSID's for Moodle 1.8	<a href="http://okiproject.org">http://okiproject.org</a>

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