

Interop Master Programme on Interoperability of Enterprise Software and Applications^{*}

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Abstract This paper presents an experience carried out in 2007 in Europe under INTEROP Network of Excellence to develop a curriculum of Master education programme on interoperability of enterprise applications and software (INTEROP Academic Master Programme). The paper presents the content of this master curriculum and the methodology for the implementation. Lessons learned and future perspectives to further develop this master under INTEROP VLab (Virtual Laboratory) are outlined and conclusions are drawn at the end of the paper.

Key words INTEROP Master

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1 Introduction and background

INTEROP (Interoperability Research for Networked Enterprises Applications and Software), a Network of Excellence (NoE) was launched in 2003 under European 6th Framework Programme with the aims to integrate expertise in relevant domains for sustainable structuring of European Research on Interoperability of Enterprise applications (Interop 2003). More than 50 research entities (Universities, Institutes, ...) and up to 150 researchers and 100 Doctorate students from 15 EU countries were involved in INTEROP NoE. At the end of the NoE, INTEROP-VLab (European Virtual Laboratory for Enterprise Interoperability), a sustainable structure under the statute of an AISBL (Association Internationale Sans But Lucratif, an International Association without profitable goals), under the Belgian law, was created on 16 March 2007 assuming and continuing the role of INTEROP NoE. Building on the assets of INTEROP NoE from 42 months of integrating joint research and dissemination activities in the domain of Enterprise Interoperability, INTEROP-VLab is an initiative to develop a large scale networked research community in Europe and beyond (already associating Chinese Partners). It is a virtual, distributed and coordinated research organisation in the enterprise interoperability domain capable of aggregating and integrating existing and future research laboratories to achieve com-

mon goals such as shortening the implementation time cycle of interoperability solutions in industry and developing high education curricula and training e-services. By mid 2008 it is expected that INTEROP-VLab will involve 12 Poles (including one Chinese Pole led by Harbin Institute of Technology), 100 Partners and more than 500 researchers. By joining INTEROP-VLab, the participants access an international community, a work programme and a set of dedicated resources: a collaborative platform, a Knowledge Map, an Interoperability Explicit Knowledge Repository, e-services for Training and Education (Master's programmes).

2 Interop Academic Master Programme

This section presents one of the important INTEROP NoE results: INTEROP Academic Master. This Master has been launched during the last Year of INTEROP in February 2006 (Domeingts 2007) with a call for participation and for the elaboration of the courses. The following 14 universities were interested and gave a positive answer to participate in the Academic Master: University of Bergen (NO), Facultés Universitaires Notre-Dame de la Paix, Institut d'Informatique (BE); New University of Lisbonne/Uninova (PR), University of Geneva (CH), Ecole Centrale de Lille (FR), Universidad Jaime I (ES), Stockholm Univer-

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sity and Royal Institute of Technology (SE), University of Valencia (ES), University Bordeaux 1 (FR), University Henry Poincaré Nancy (FR), Technical University of Berlin / TH (DE), University of Helsinki (FI), Norwegian University of Science and Technology (NO), and Harbin Institute of Technology (CN) in the frame of the cooperation with China.

Finally five universities were selected and participated to the Master: (1) Ecole Centrale de Lille (Jean-Pierre BOUREY), (2) Stockholm University

and Royal Institute of Technology Department of Computer and Systems Sciences (Paul JOHANNESSON), (3) Polytechnic University of Valencia (Raul ROLLER), (4) University Bordeaux 1 (Bruno VALL-ESPR), and (5) Harbin Institute of Technology School for Computer Science and Technology (XU Xiaofei).

The preparation of 11 reference courses for the Master has started. The list of the courses is given below in Figure 1.

Core courses			Orientation	
Course	ECTS	Business	IT	
C01 Enterprise Modelling for Interoperability	5	X	X	
C02 Ontology for Interoperability	5	X	X	
C03 Architectures and Platforms for Interoperability	5	X	X	
C04 Interoperability of Enterprise Software and Applications	5	X	X	
Optional courses			Orientation	
Course	ECTS	Business	IT	
O01 Synchronisation of Different Distributed Enterprise Models	5	X		
O02 Model Driven Interoperability	5	X		
O03 Models Morphisms	5		X	
O04 Semantic Enrichment of Enterprise Models for Interoperability	5		X	
O05 Business / IT alignment	5		X	
O06 Methods, Requirements and Method Engineering for Interoperability	5	X		
O07 Non-functional aspects of interoperability	5		X	

Fig 1 List of Reference Courses

The Reference Courses were structured as a set of Core Courses and a set of Optional Courses:

— Reference Courses are related to the basic knowledge about the Interoperability of Enterprise Software and Applications research domain. This basic knowledge is related with the NTEROP domains: Enterprise Modelling, Ontology, Architectures and Platforms and Interoperability. All these courses are mandatory for students aiming to obtain the Mention.

— Optional Courses are related to the additional knowledge that students may acquire in the Interoperability of Enterprise Software and Applications research domain. This additional knowledge is related with the seven research activities developed in the NTEROP Project. The students can choose some of them to complete the required knowledge in the interoperability domain.

The Optional Courses are oriented to Business or Information Technology profiles; then the students must choose in relation with the profile they want to obtain. Figure 1 shows the list of Core and Optional Courses and their orientation.

2.1 Principle of the Master

The first Principle is not to create a new Master in Enterprise Interoperability (EI) but to be based on the Existing Masters, the closest to the reference courses determined by NTEROP-NoE and to deliver a “MENTION ENTERPRISE NTEROPERABILITY” under

the responsibility of NTEROP-NoE today and NTEROP-VLab tomorrow.

The reference courses in EI are composed of four core modules and seven optional modules. In fact, this programme corresponds to the second year of the Master with two profiles: EIBusiness System Engineering (BSE) and EI Information Communication Technology (ICT).

The strategic plan on the next 5 years is for all Universities listed in the previous section to transform the degree courses of the closest master towards reference courses in EI proposed by NTEROP-NoE. NTEROP-NoE must recognise this “closest Master”. We expect that at the end of the period of 5 years, the programme of this “closest Master” of these Universities will be identical at 80%.

So, for the short term (next three to five years) the EIMaster is based on the “closest Master” in each University. The courses represent 30 ECTS credit. Then a master research or industrial project (leading to a master thesis) finalizes the master training (representing 30 ECTS credit as well).

2.2 Implementation of the Master

The implementation of the Master programme has followed a procedure composed of 6 steps:

Step 1: to launch a call among the students to find candidates.

The responsible person of the Master in each Uni-

versity informed the students of the “closest Master on the possibility to obtain a mention “Enterprise Interoperability” and launched a call for participation. Totally 30 students have answered.

In order to have a first view on the courses, an analysis of the need of courses by student has been performed. The wishes for the optional courses have been collected.

Step 2. to compare the programme of the closest INTEROP Academic Master

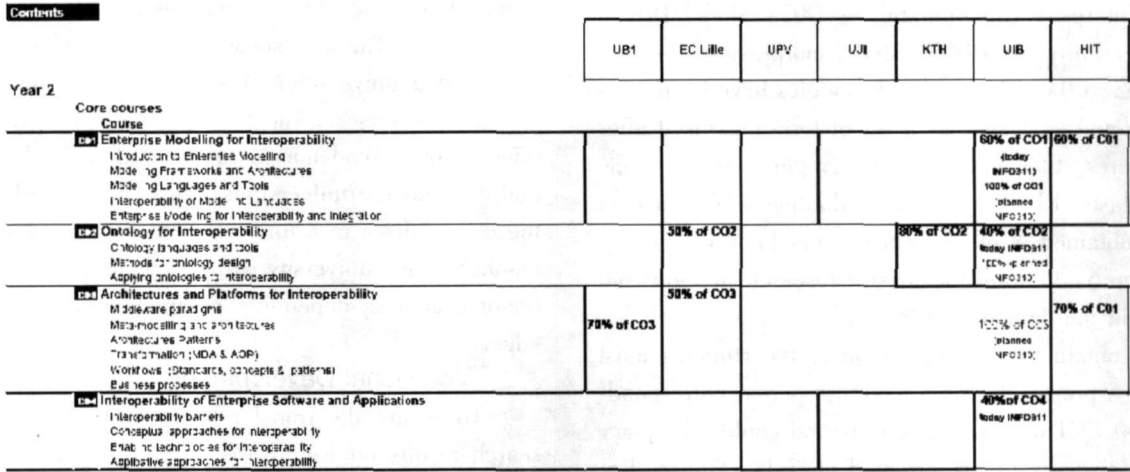


Fig 2 Map of the NTEROP reference “core courses” among universities applying for the Academic Master for Obligatory courses

Step 3. To select the candidates according their results, their knowledge at the end of the first Year of the Master and the number of available places.

Based on the previous results we have found that it is not possible to organise this Year all the courses due to the constraints. After analysing the results of the previous tables, we draw the following conclusion concerning the number of students: the maximum number of students we can support is 20 and we have 30 candidates. We propose to reduce on the following way: Univ. Bxl. 3 students; EC LILLE 5 students; UPV 3 students; KTH 4 students; Bergen 2 students; Harbin 3 students.

At the end of the collect of information, University of Bergen decided to not participate for administrative reasons.

The final number of students accepted at the end of January was 18 (it was necessary to fix this number in order to prepare the conditions of the stay of the students in the Educational Centres). The 18 students have been selected covering the 5 Universities. They are supported by the mobility programme.

Step 4. to organise the complementary courses in an “Educational Centre”.

An Educational Centre is a University which accepts to organise the complementary courses. The next

master of the university with the EI reference programme in order to determine the Courses which are missing in each University.

In fact this analysis is complementary to the collect of information on the need of courses for the students and is a kind of verification. Figure 2 shows the comparison results of the EI reference courses and existing courses at each university.

step was to determine the Educational Centres. Polytechnic University of Valencia and University of Stockholm were candidates.

As the Master programme requires mobility among at least one of the partner institutions, the students will have the opportunity to acquaint themselves with very different aspects of European culture and will have the opportunity to apprehend interoperability requirements.

Based on the proposition received and in order to minimize the travels of the teachers, the first week was organised in Stockholm (week 14 April 2–6); two courses of 20 hours each were given: C02 and C03.

The second week was in Valencia (week 16 April 17–20). Two courses of 16 hours were given: C04 and C02.

The students were coached individually to complete their final degree in Enterprise Interoperability. They will be awarded with the Master of their University plus the mention in Enterprise Interoperability delivered by NTEROP NOE Companies that are also partners of the NOE are already looking for such capabilities.

① Remark: a course lasts normally 40 hours; it means that the students must work alone 20 hours or with the help of the e-learning facilities and with the support of their professors in their University.

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Step 5. Procedure of evaluation

It is proposed to constitute a committee to take the decision with one representative by university participating to the master: B. Vallespir, J.P. Bourey, P. Johansson, R. Poler, R. Poler, X. Xu with the coordination of Guy Doumeingts. Let us recall that the modules of Interop Master are: Q01. Enterprise Modelling for Interoperability, Q02. Ontology for interoperability, Q03. Architectures and platforms for Interoperability, Q04. Enterprise Interoperability, Q02. Model Driven Interoperability and Q03. Model morphisms.

Q02, Q04, Q02 and Q03 modules have been really given and evaluated by a set of tests organised after the lectures. Q01 and Q03 were not taught in the frame of the Master EI. They got an evaluation on the basis of results obtained in other local masters (equivalence).

Step 6. Perform the master research or industrial project in the domain of EI.

To obtain the Master diploma, the students must perform a project during a Training period corresponding to 30 ECTS. This Training period could take place at the University (more oriented towards a Master Research) or in Industry. The subject must have a part related to Enterprise Interoperability.

This first experience of implementing a Master Training programme under NIEROP NoE is a success. After the ending of NIEROP NoE, this Master programme will be continued within the frame of NIEROP VLab created to pursue part of the activities of NIEROP NoE and go beyond, in particular in the area of education and training. The following section will outline future NIEROP VLab education and training activities.

3 Perspective of Future Programme of INTEROP-VLab on Education and Training

One of the important missions of the NIEROP-VLab is the development of Education and Training on the Enterprise Interoperability domain in order to promote and support initiatives for the establishment and the continuous support of European higher education initiatives. The programme of the NIEROP-VLab on education and training comprises three main areas: ① Academic Master, ② Vocational Development, ③ Training material.

3.1 Academic Master

This Master aims at training students on the latest developments in Enterprise Interoperability. The main courses will deal with enterprise modelling for interoper-

ability. Ontologies for Interoperability Architectures and Platforms for Interoperability and Enterprise Interoperability. Optional courses allow defining two profiles: EIBusiness System Engineering (BSE) and EI Information Communication Technology (ICT). The candidate chooses its profile according to its initial education. The Master Dissertation can be a research or industrial project. The courses represent 30 ECTS credit and the Master Dissertation represents 30 ECTS.

Today the Academic Master is organised in the frame of existing Masters proposed by the participant Universities. The next stage is to make evolve the various existing universities Masters Curricula towards the Reference Courses. And the long term objective is to offer a global Academic Master on Enterprise Interoperability in all the universities. This Master will present the core courses in a uniform, consistent and standard manner. Each university will be specialized in different optional courses depending on their skills and knowledge.

3.2 Vocational Development

To ensure the transfer to the industry of the research results on Enterprise Interoperability, it is essential to elaborate a Vocational Development Program that meets the needs of the enterprises. Some examples of courses of the VDP are:

- Methods to elaborate Specifications of Enterprise Interoperability Problems
- Development of Enterprise Interoperability Solutions using MDI approach and SOA techniques
- e-Government Interoperability

New Professional Careers will be defined in the frame of Enterprise Interoperability domain. Some examples are:

- Interoperability Requirements Analyst (RA). An RA is expected to be effective in the activities of understanding interoperability business cases, eliciting interoperability requirements for enterprises, modelling business processes and identifying the appropriate type of ICT solutions.

- Interoperability Infrastructure Designer (ID). An ID is expected to be very effective in identifying requirements for Information Systems based on interoperability and defining models of information flows and business objects in the environment of cooperation within the different enterprises.

3.3 Training Material

The NIEROP-VLab disseminates Web Courses and Tutorials on Enterprise Interoperability through an e-Learning Platform. This training material has the characteristic of being reusable in order to optimize efforts and resources. Reusability is considered not only

from the content point of view but also from the interoperability point of view (the ability of use eLearning contents in different eLearning Platforms). The NTEROP V-Lab will continue and extend the NTEROP NOE joint research training programme through the following training activities:

- Provision of structured training courses (tutorials, reference courses, optional courses) within the framework of a joint training programme; local training programmes between the participants are expected to be coordinated to maximise added value.
- Exchanging knowledge with the members of the NTEROP-VLab universities through undertaking intersectoral visits and secondments.
- Development of network-wide training activities (e.g. workshops, summer schools) that exploit the interdisciplinary aspects of the NTEROP-VLab.
- Organisation of courses to provide complementary training both within and outside the network.
- Invitation of external experts for specialist inputs into the joint research training programme.
- Collaboration with other networks in similar or complementary fields is also encouraged for exchange of best practice and transfer of knowledge.

4 Participation in Future EU Programmes on Education

Specific attention will be paid to the financial support of the NTEROP-VLab educational activities, mainly regarding to the students and teachers mobility. The FP7 PEOPLE Programme^① offers good opportunities for financing such activities. This programme acknowledges that one of the main competitive edges in science and technology is the quantity and quality of its human resources. To support the further development and consolidation of the European Research Area, this Specific Programme's overall strategic objective is to make Europe more attractive for the best researchers.

In particular, the Initial Training action^② will be implemented by supporting competitively selected networks of organisations from different countries engaged in research training. The networks will be built on a joint research training programme, responding to well identified training needs in defined scientific areas, with appropriate reference to interdisciplinary and newly emerging supradisciplinary fields. Support will be provided for: a) Recruitment of researchers (who are still within the first five years of their careers in research) for initial training; b) Recruitment of Senior Visiting Scientists of outstanding stature in international

training and collaborative research to strengthen transfer of knowledge; c) Networking activities, organisation of workshops and conferences, involving the participants own research staff and external researchers.

5 Lesson Learned and Conclusions

This paper reported a success story of experimenting a European-wide Master Programme on Enterprise Interoperability based on the existing Masters in various participating universities and with the support of NTEROP NOE. This experience also aimed at integrating existing education and training activities at European level rather than to create a new one from scratch. The methodological approach followed to implement the master showed its efficiency to quickly set up teaching teams, develop courses and select students. Through this experience we have also discovered the constraints to create a new diploma through Europe, involving more than 4 or 5 Universities due to the National Administrative constraints. Finally we have proposed a long term plan in order to converge toward a European diploma and an organisation for the short term plan to deliver a "mention in Enterprise Interoperability". NTEROP-VLab will have to coordinate the continuation of this programme.

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① http://cordis.europa.eu/fp7/people/home_en.html

② http://cordis.europa.eu/fp7/people/initial_training_en.html