

## Chapter 6

# On the Scientific Foundations of Enterprise Interoperability: The ENSEMBLE Project and Beyond

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### ABSTRACT

*In a rapidly evolving landscape, enterprises face unprecedented challenges and opportunities to become more innovative, competitive, and efficient. Despite the technological readiness and the abundance of solutions, the interoperability issues still afflict enterprises as they remain untackled at design time and without a systemic approach. To this end, the scientific foundations of enterprise interoperability shall structure the knowledge gained through pragmatic research in the domain over the last decades and more in order to avoid repeating research and missing opportunities for application. This chapter aims at outlining the objectives of the Enterprise Interoperability Science Base at its various evolution phases and documenting the key achievements made by the ENSEMBLE project. An overview of the actions to be implemented in this quest for scientific rigour is provided and the perspectives opened up through such an initiative are discussed.*

### INTRODUCTION

Today with the advent of the Future Internet, entrepreneurship has taken new impetus (EC, 2013) and contributes to formulating new societal and business realities. However, enterprises are still

faced with unprecedented challenges at technological and business level, with interoperability among organizations and information systems remaining an insurmountable barrier. Despite the plethora of solutions available to tackle interoperability issues from a research and application perspective,

DOI: 10.4018/978-1-4666-8111-8.ch006

the lack of scientific foundations in the domain seems to hinder unlocking its real value and full potential to all its stakeholders, from researchers to industry and SMEs.

In general, science is an activity of extending perception into new contexts and into new forms, and is viewed as a means of obtaining what may be called reliable knowledge (Bohm, 1977). Typically, an underlying scientific discipline evolves along several decades in incremental stages before being established as a science. Over the 20th century, though, links between science and technology have indeed grown increasingly strong. As Martin Rees (2010) argues, progress in scientific understanding and technology has been synergistic and vital to one another.

In this context, establishing an Enterprise Interoperability Science Base (EISB) has been a long-sought challenge that was originally documented back in 2006 in the 4th version of the EI Research Roadmap (as mentioned in (Charalabidis et al, 2008)). According to the European Commission, such a Science Base comprises a new set of concepts, theories and principles derived from established and emerging sciences, with a view to long-term problem solving as opposed to short-term solution provisioning. The overall objective in establishing an EISB is to formulate and structure the knowledge gained through pragmatic research in the domain over the last decades and more in order to avoid repeating research and missing opportunities for application. Indicatively, the following open research questions have been identified as a priority among those to be answered with the establishment of the EI scientific foundations:

- Why is there so much effort wasted in the development of dedicated technical solutions for interoperability problems? How can it be reduced?
- How can we predict and guarantee the long-term knowledge and behavior of interoperability in engineering systems? In

this vein, can the principles of complexity science, namely systems self-organization, be applied on dynamic business networks, to contribute to a sustainable interoperability?

- Why do certain interoperability problems appear to be very complex at first, but are actually not complex at all once we find a dedicated solution for them? How can these solutions be generalized and formalized to guarantee reusability and repeatability?
- How do we reduce complexity in EI? Can interoperability services be used as “plug-and-play” mechanisms independently of the EI level for which they are designed (higher levels such as business, or lower ones such as technical applications)?

During the past years, an EU-based initiative entitled ENSEMBLE (“Envisioning, Supporting and Promoting Future Internet Enterprise Systems Research through Scientific Collaboration”) was kicked-off in order to contribute towards the establishment of an Enterprise Interoperability Science Base, through defining the concepts, analysing the best practices, synthesising scientific methods and tools from neighbouring domains, defining problem and solution patterns, affecting standardisation, so that enterprises can be systematically assisted in exploiting the benefits of interoperability at strategic, organisational, semantic and technical levels, yielding products and services of unprecedented quality, return on investment and sustainability. Working with expert researchers and practitioners from across Europe, ENSEMBLE has investigated in a systematic manner the scientific foundations of the Enterprise Interoperability (EI) domain and structured its underlying knowledge. To this end, the state of the art has been meticulously analyzed, an action plan calling for coordinated action by diverse stakeholders has been created and the activities towards 3 Waves of evolution have been initiated. Particular care has been taken in order to ensure

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