What Could the Role of Enterprise Modelling be During the 5th Economic Phase?

An Extended Abstract of Keynote Talk

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Enterprise Modelling (EM) has emerged as one of the key techniques in externalising and analysing the factors underpinning the intertwining of Information Technology (IT) systems to their enterprise environment. This intertwining [1] is central to achieving sustainability of IT systems [2, 3]. Sustainability has been studied in strategic management [4] and more recently in Information Systems Engineering (ISE) [5, 6].

In EM there is a large number of languages on offer to assist in capturing and conveying particular information for the understanding of the aforementioned intertwining [7], approaches such as goal modelling [8], business process modelling [9], business rules modelling [10], social modelling [11], to name but a few. In parallel with these initiatives, a number of associated tools has emerged e.g. ADONIS, Archimate, ARIS, GRADE, as well as meta-tools such as ADOxx, MetaEdit + and Metis.

Current EM approaches can deal with facets of modelling that makes requirements traceable to any aspect of the enterprise under study. There is a significant body of empirical evidence that EM approaches and tools have had a positive impact on organizational and information systems development efficiency *c.f.* [12–14].

Research in ISE has attempted to address changing requirements by proposing scalable service delivery platforms such as Services Oriented Architecture (SOA) and cloud computing, or using Model Driven Development (MDD), or analysing large amounts of data [15, 16]. Such engineering approaches more often than not assume a relatively stable enterprise environment, an assumptions that is increasingly being challenged by macroeconomic factors. As enterprises compete in fast-paced changing financial ecosystems they need to constantly adapt their service/product offerings to gain and sustain competitiveness.

The need for dynamically changing software systems has highlighted three challenges. First, in order to develop useful software one must deal with the complexities of the natural world in which the application resides [17–19]. Second, in order to understand the orchestration and configuration of different individual systems one must understand the requirements of different organizations that own the individual systems, the interplay between the collaborating components and the dynamics of the overall system [1, 20]. Third, in order to maintain a high level of quality and utility, software needs to evolve in tandem with the evolution of user requirements [1]. Users, designers and other stakeholders need to be assured that the system will continue to satisfy their emerging goals.

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Could IT be the source of sustainable advantage? There is much debate about it with the prevailing view that IT does not possess uniqueness and inimitability characteristics [21, 22]. Competitive advantage cannot be gained by considering IT as a resource based artifact, but rather by considering the way that IT capabilities are *coupled and aligned* with organizational capabilities [21–23] provides such opportunities.

The paradigm of EM is currently facing a challenge of semantic integration across multiple levels of abstraction and of detail. While traditionally EM emerged from bottom-up approaches, by applying semantic extensions to some core concern (e.g. business process models extended with information about the organizational responsibilities) we are now facing a need to represent enterprise architecture holistically, to support a decomposition of the high level business view down to requirements representation and low level system designs.

Current EM approaches have been used in practice mostly in a reactive mode in the sense that they are deployed a long time after enterprise strategies have been decided upon and adopted. As we enter a new world economic cycle – in the Kondradief sense of analysis of economic lifecycle - the question is whether EM should and could play a more significantly strategic role in this cycle. Could EM play a role over and above the support role it has assumed to date in facilitating IT solutions to solving enterprise problems? Could EM be used for shaping up enterprise strategy and if so what kinds of conceptual frameworks need to be developed so that useful techniques and tools can be of high value? Is it indeed relevant to even ask these questions that after all are driven by macroeconomic considerations when EM is confined to a specific technological paradigm?

The anticipated 5th economic cycle is likely to be dominated by technological innovation [24] and one such innovation of interest to the EM community is the use of information which, because of its increasing social value and use, has the potential of changing the way enterprises react to a new economic era, for example, the opportunities for developing non-market collaborative ventures, the non-formal sharing of information-centric "goods", etc. As Mason argues there is already profound changes in work processes (fuelled by this information-centric view) that is transforming our established notions of work, production and value [25]. This macroeconomic transformation will impact on the way that enterprises need to view a whole new set of key levers affecting their business models and in such a setting the issue is no longer the alignment between an enterprise and its IT system but rather about the opportunities that may arise in an emergent manner.

To address dynamic requirements of today's business environments, one should go beyond static design of services that are aligned to organizational objectives and business requirements. We argue in [26, 27] that we need in EM to begin thinking of conceptual frameworks that can integrate the contextual, service, operational and teleological views and relate these to the enterprise ecosystem. Such a conceptual framework will need to deal with the different but intertwined perspectives of *description*, *relation*, *and evaluation* that will empower designers – business as well as IT designers – to come up with solutions that will fit this new macroeconomic landscape.

The *design requirements* problem clearly articulated by Brooks [28] poses the challenge of "What is the emergent behaviour and dynamics of the software artifact and its

environment in their evolutionary trajectory?" Users, designers and other stakeholders need to ask "will the system continue to satisfy our emergent goals, and what are these goals be expected to be during the artifact's lifetime?", in contrast to the older question of "what are the (fixed) goals of the system and what is it expected to do in relation to these goals?".

The *predictability problem* of designs raises the question of "how does the artifact and its behaviour change the environment as to make our predictions of system behaviours faithful?" In other words, now designers need to attend more closely to the continuous dynamic composition of the system and its environment, and how they together differ from the environment in separation. Designers need to predict faithfully the impact of the system on the environment, and vice versa. This is a different problem from those faced earlier where the system was assumed to not affect the environment, or the environment the system, with rare exceptions.

These research challenges can only be satisfactorily addressed through multidisciplinary approaches that, in addition to the traditional ISE disciplines exploited in EM (conceptual modelling, development methods etc.) consider also the possibilities offered by for example, socio-economic analysis, systems thinking, architectural impact analysis, design rationale, etc.

EM should strive to offer enterprises the opportunity of developing meta-capabilities, that is routines and mechanisms that bring about changes to enterprise capabilities and depict different abstraction levels. The significance of meta-capabilities is that by modelling and analysing meta-capabilities, their needs and relations to other capabilities, processes and services, will facilitate identification of potential social and technical inflexibilities towards change and hence play a significant role in sustainability of competitive advantages. Developing these meta-capabilities will require enterprises to engage in a continuous knowledge enhancement cycle and in this the EM research and practice community could play a significant role.

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