FutureEnterprise, A Roadmap for Sensing Enterprise

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Abstract

The circumstances for shifting to new kinds of economies and to new ways of doing business are compelling, with the concept of the sharing and circular economies opening up novel ways to reconcile the quest for growth and business value with the environmental prudence perspective: "doing more with less". The evolution of Sensing Enterprises is expected to capture new business value across supply chains and drive digital business innovation to undiscovered pathways in product design, development of product-to-service approaches, customer engagement and internal structure and performance. In this paper, a glimpse of the business models innovations that are relevant for Sensing Enterprises is provided, leading to the elaboration of the research challenges to accelerate new forms of enterprises, mainly along the following dimensions: (a) Collaborative, Real-time, Proactive Business Analytics-as-a-Service, and (b) Innovative, Web-based Business Models for New Kinds of Economies.

1. Introduction

Currently the Internet is influenced by multiple forces whose actual impact in everyday business has not been yet

apprehended. In this constantly changing and challenging environment, successful companies of the future will be characterized by open and blurry boundaries and will compete by outreaching to harness external knowledge, resources and capabilities, and becoming hubs for innovation and magnets for uniquely qualified minds (Tapscott & Williams, 2014). Stimulating break-through innovation for added value products and services is in fact well acknowledged at policy level and embedded in the mind-sets of leading enterprises, successful entrepreneurs, and forward-looking researchers, yet recognized philosophies of doing business 'better' are still not integrated in the strategies and approaches of many companies, especially in Europe which has traditionally struggled to convert its scientific excellence into successful market products (EC, 2012). As a consequence, the European industry, in general, lags behind its global rivals with respect to digital business innovation, factors that will become more and more crucial as the global economy recovers.

To fully exploit the potentiality inherent to the future IoT (Internet of Things) and smart objects, there is a need to decentralise intelligence, moving to a scenario where the enterprise is seen as a smart complex entity capable of sensing and reacting to (business) stimuli (EC, 2013). The 'Sensing Enterprise' is characterized as an enterprise making use of the sensing possibilities provided by interconnected 'environments', anticipating future decisions by using multi-dimensional information captured through physical and virtual objects, and providing added value information to enhance its global context awareness (Santucci et al, 2013). Among the implications of the Sensing Enterprise are (EC, 2013): context awareness, dynamic configurability, information requirement and processing, multi-identity enterprises and enterprise entities, and relationships between humans and objects.

In the context of our work in the EC-funded FutureEnterprise project, the term "new forms of enterprises" has been adopted to reflect the next evolutionary step of a Digital / Sensing Enterprise, along the following definition: New forms of enterprises are "Enterprises of the Future, driven by constant business model transformation and innovation, acting as multi-sided platforms built on -as well as emerging from- digital innovations at the global, as well as local level, to produce shared value including that beyond monetisation".

Along these lines, the present paper aims at discussing a number of instrumental research challenges that need to be tackled by researchers and practitioners in order for new forms of enterprises to evolve and flourish. In section 2, the methodological approach is presented, leading to sections 3 and 4 that summarize the business models innovations and the identified research challenges related to the sensing enterprise. Section 5 concludes this work and presents next steps along this approach.

2. Methodology

In order to pave the research path towards future developments that accelerate new forms of enterprises, a brainstorming methodology featuring 5 steps was followed:
1. Multiple sustainable business model innovations, based on bibliography (Amit & Zott, 2012), (Keeley et al, 2013), (Model Behavior, 2014), (Osterwalder & Pigneur, 2010) and experts input, were collected.
2. Common or directly related business model innovations were circulated internally, discussed and merged. In total 30 business-model-innovations were identified and reported, but upon merging, 21 business-model-innovations remained.
3. Various business models were studied in detail to enable brainstorming under different perspectives about what research directions should be put forward. In detail, the analysis of the business model innovation was done for the following aspects:
- Existing technologies that enable specific business model innovations nowadays.
- Dependency with innovation diffusion (Rogers, 2003) / acceptance factors (Chesbrough, 2010), analysed under both the current situation in Europe and the future desirable scenario: Possible changes in the way business is done, as described in Porter's Value Chain; Ethical issued that may arise; Technological obstacles or difficulties; Societal characteristics that might favour or prevent the adoption; Political situations that might arise; Industry opportunities and threats (i.e. as identified in Porter's five forces); Economic issues that might affect a business model innovation.
- Changes in existing business models that such business innovations could bring, accordingly to the business model canvas elements (Osterwalder & Pigneur, 2010), i.e. value proposition, channels, customer relationships, customer segments, key resources, key activities, partnerships, cost structure and revenue structure.

- Key research directions needed to enable or boost every business model innovation as described, characterised with the expected impact on enterprises, SMEs and startups (i.e. web entrepreneurs).

4. The results were iteratively circulated to a number of experts to validate, refine and update the analysis.

5. The key research directions from various business model innovations, were classified under four (4) Grand Challenges that provide the necessary focus for research activities for the upcoming years in order to come as close as possible to a Desirable Scenario of the future that promotes prosperity, social caring and equal opportunities.
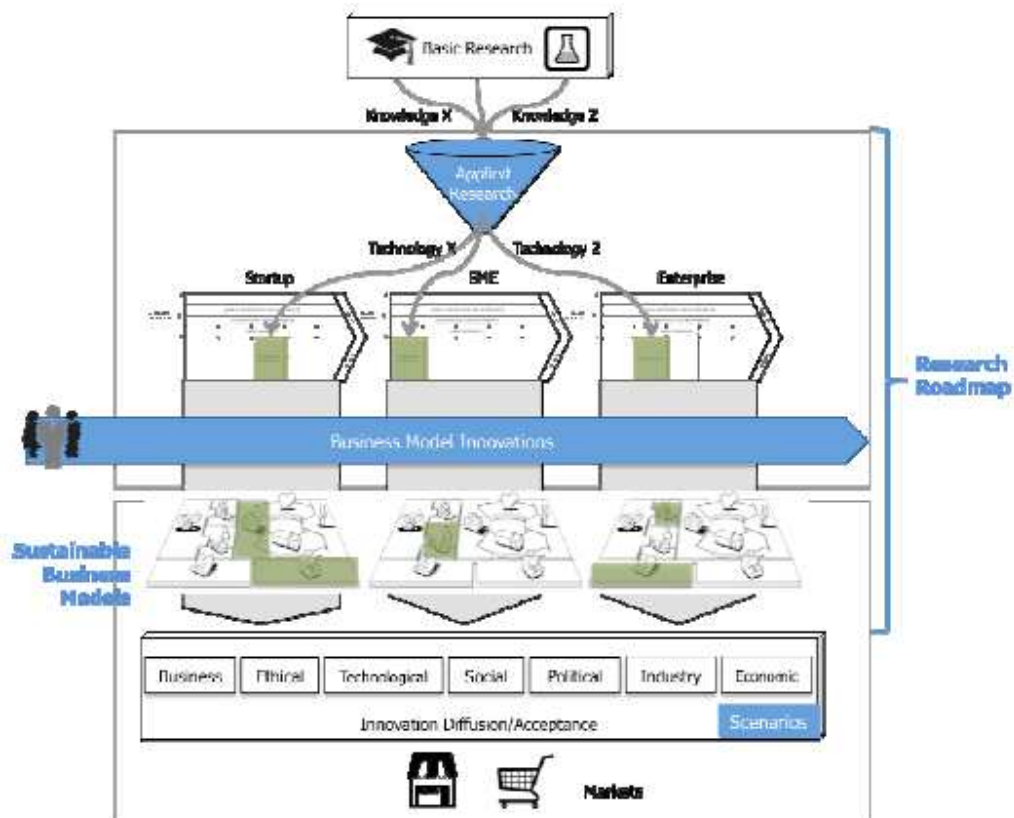

Figure 1: Roadmapping Methodology

It needs to be noted that in the following sections, the parts of our work that are relevant for Sensing Enterprises will be presented.

3. Business Models Innovations related to the Sensing Enterprise

According to Chesbrough (2010), while companies may have extensive investments and processes for exploring new ideas and technologies, they often have little if any ability to innovate the business models through which these inputs will pass. This matters - the same idea or technology taken to market through two different business models will yield two different economic outcomes.

In our work, a number of business models innovations along their research directions have been identified for sensing enterprises that want develop the capability to innovate their business models.

Table 1: List of BMIs and Research Directions

ID	Research Direction Title
BMI#1 - Closed-Loop Production	
CLP.01	Real-time, big data analytics in sensing enterprises
CLP.02	Social, behavioural changing platforms
BMI#2 - Physical to Virtual	
PtV.01	Mobile enabled shopping
PtV.02	Digital Ecosystems of Virtual Products
BMI#3 - Produce on Demand	
PoD.01	Interactive, Personalised and Responsive Marketplace platforms
PoD.02	Demand driven production through Gamification Systems
PoD.03	Interoperable and collaborative enterprise-wide platforms
BMI5 - Sell One, Give One	
S1G1.01	Smart Prescriptive Business Analytics
S1G1.02	Configurable Products through 3D printing systems
S1G1.03	Crowdsourcing platforms for service/product creation and access
BMI#7 - Supply Chain Integration	
SCI.01	Supply Chain Business Intelligence
SCI.02	Sensor-based, open, supply chain environments
SCI.03	Workforce support and safety through ICTs
SCI.04	Knowledge based platforms
SCI.05	Smart Supply Chain Support Agents
BMI#12 - Bait & Hook (Subscription model)	
BaH.01	Flexible IPR management platforms
BaH.02	Crowd-sensing and smart feedback ICT infrastructures
BaH.03	Real-Time Prescriptive and Predictive Market Analytics:
BMI#13 - Differential Pricing & Customisation	
DIP.01	Market Insights and Business Analytics through Big Data powered Social Platforms
DIP.02	Smart, Differential Charging Platforms
BMI#15 - Micro-Franchise	
MFR.01	Big Data for Micro Franchising
MFR.02	Compact business-intelligence solutions
BMI#16 - Behaviour Change	
BHC.01	Game-based Customer and Employee Behavioural Change Systems
BHC.02	Open-standard, social-impact measuring platforms
BMI#19 - Transparency	
TRA.01	Open Enterprise-wide APIs
TRA.02	Intuitive and Responsive Visual Analytics
BMI#20 - Unbundling	
UBL.01	Collaborative, lean-startup oriented project management platforms
UBL.02	Real-time, prescriptive analytics platforms for shop floor processes
BMI#21 - Multisided platform	
MSP.01	Product and Service Coupling Collaborative Hub platforms

MSP.02	Big Data Analytics for Multisided Marketplaces
MSP.03	Decentralised community platforms
MSP.04	Virtual Currency Enablers

4. Research Challenges for the Sensing Enterprise

With a perspective towards 2030, a radically different context for business analytics and their provision of them to enterprise personnel, whether these are highlevel executives or shop floor workers, is anticipated. Thanks to smart devices, and to the unparalleled deployment of sensor grids and the progress in IoT technology, enterprises will be in a position to collect enormous amounts of data, exceeding the current classification of Big Data and will possess raw business knowledge that could be turned into intelligence. Enterprise data will be delivered in real-time and in huge amounts, and new novel approaches for extracting the meaningful part of it would be necessary, while also transportation of this data would require next generation network infrastructures.

Radically different business realities in which prosperity and wellbeing of humans prevail against the backdrop of pure shareholder's value at any cost will also emerge. Disruptive and creative technologies, like the Internet of Things, Big Data, Social Media, Mobile and Cloud Computing, have been put in place to be used as a means to an end: how to generate value from more efficient resource use and conduct business in a sustainable manner that benefits all stakeholders and the overall society. The design of products and services, as well as the overall business operation, shall abide by the principles of flexibility, durability, restoration and prosumption.

In total, the draft release of the roadmap includes four (4) Grand Challenges that collectively contain 25 research challenges:
- Grand Challenge 1: Collaborative, Real-time, Proactive Business Analytics-as-a-Service, dealing with a radically different context for business analytics for the enterprise personnel, either high-level executives or shop floor workers.
- Grand Challenge 2: Innovative, web-based business models for new kinds of economies, exploring the definition, experimentation and constant evolution of novel business models that challenge traditional operating models, follow the paradigms of the Sharing Economy and the Circular Economy, and capitalize on novel technologies and Future Internet assets in business environments in order to introduce unique innovation propositions at multiple levels, ranging from the innermost configuration and the core offerings of an enterprise, to the customer-facing, networking elements of its business system (user experience).
- Grand Challenge 3: Distributed, Innovation-driven Enterprise Platforms, embodying a radically different context for business innovation and collaboration among organisations, where platforms promote collaboration among enterprises and web entrepreneurs, boost productivity and enable business innovation in consistent lifecycles; from invention to production, from supply chain management to ERP systems, and from customers' adoption to collaboration with internal business functions or external partners.
- Grand Challenge 4: Dynamic discovery and negotiation of the intellectual property rights' flow, addressing effective management, monitoring, identification and creation of IPRs and knowledge generation and handling, through the use of innovative ICT tools and platforms that will exploit the collaborative features of existing platforms and the power of analytics. As depicted in Figure 2, the proposed Grand Challenges follow the logical pattern in value creation, where one starts with creating or maximising its current intelligence operations and then, based on the material collected, he starts experimenting and simulating different alternatives, until he decides to implement a chosen pathway to innovation. In accordance, GC#1 aims to tackle research issues that will maximise the efficiency and the effectiveness of enterprises based on assets they currently possess, or that they can easily generate as they already possess the raw material (e.g. data, processes and people), while GC#2 works on the intelligence generated from the GC#1 outcomes to experiment and simulate alternative business models which can be used to drive the enterprise and an entrepreneur forward, allowing its transformation to a more sustainable, collaborative and value generating entity. GC#3 and GC#4 pick-up from that exact point, as they are formulated around research questions that will help an enterprise deploy the desirable business model innovations, offering the baseline tools and platforms for the actual establishment and management of collaborations, the introduction of new ways of working and the definition of rules for securing and managing each party's work, such as the intellectual properties to be created (or to be used).
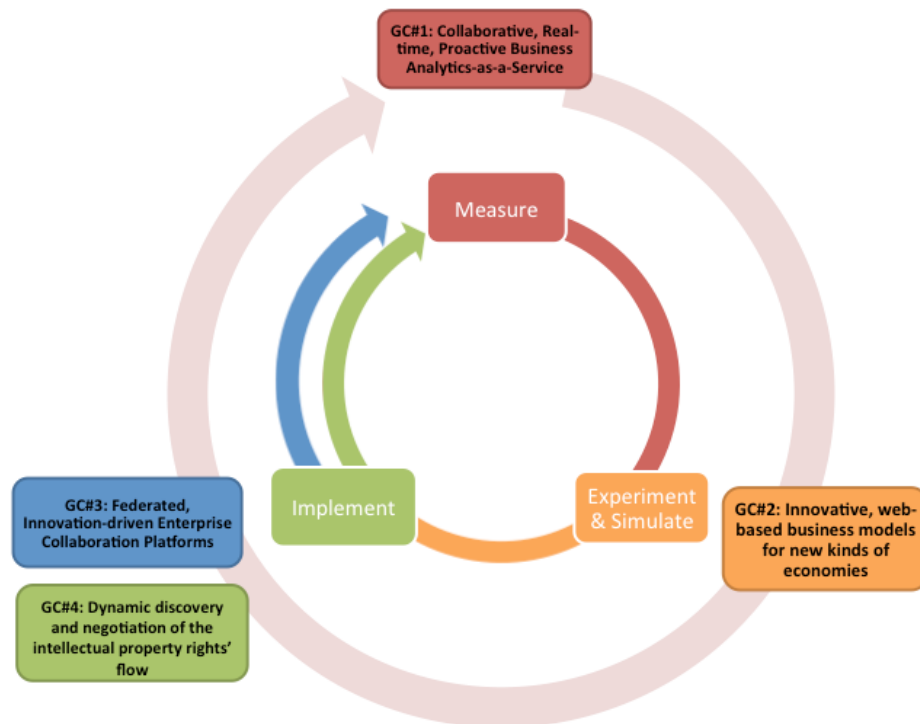
Figure 2: Interrelation of Grand Challenges and the flow of Business Model Transformation

In the case of Sensing Enterprises, GC#1 and GC#2 are more relevant. In particular, the following challenges need to be met in the next 3-5 years

- RC1.1: Multi-source Data Analytics Services for Real-Time Business Critical Decisions
- RC1.2: Predictive and Prescriptive Crowd-based Analytics powering Business Innovations
- RC1.5: Generation and Exposure of SMEs Analytics over federated cloud-based platforms
- RC2.4: Instant, crowd market validation of Business Innovations
- RC2.6: Innovation Diffusion & Adaptation Patterns and Techniques

In the next 5-10 Years:
- RC1.4: Enterprise-wide smart, personalised intelligence and delivery systems
- RC1.8: Proactive safety and security safeguarding recommendation and notification systems using real-time data analysis
- RC1.6: Smart and Collaborative APIs for cognisant business processes
- RC1.7: Responsive and Dynamic Visualisation and Augmented Reality Services for Business Functions
- RC2.1: Circular Supply Chain Management
- RC2.3: Collective Ideas Flow on ever-evolving and interactive Business Plan Lifecycles

In the next 10-15 years:
RC1.3: Business Transformation Platforms combining Human Knowledge with Information Flows

5. Conclusions

In the aftermath of the recent financial crisis and in light of the emergence of disruptive technological paradigms, how to conduct business in an ever-changing environment appears more challenging than ever. The surging app economy, manifested within a platform-oriented, mobile-driven and collaboration-rooted era, has already paved new paths for digital business innovation.

In the present paper, a number of research challenges to be tackled in the years to come in order for enterprises to evolve towards new forms of enterprises have been elaborated. Next, iterative steps along our approach include: (a) further elaboration of the research challenges based on case studies along the Digital Business Innovation aspects and (b) recommendations on how to maintain a "live" roadmap, with contributions by any interested stakeholder.

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