Accelerating Web-Entrepreneurship in Local Incubation Environments

Carlos Agostinho[1(✉)], Fenareti Lampathaki[2],
Ricardo Jardim-Goncalves[1,3], and Oscar Lazaro[4]

[1] Centre of Technology and Systems, CTS, UNINOVA,
2829-516 Caparica, Portugal
{ca, rg}@uninova.pt
[2] National Technical University of Athens,
15780 Athens, Greece
flamp@epu.ntua.gr
[3] FCT, Universidade NOVA de Lisboa,
2829-516 Caparica, Portugal
[4] Innovalia Association,
48008 Bilbao, Spain
olazaro@innovalia.org

Abstract. This paper explores novel forms of technological and digital societal innovation putting the full potential of the Future of Internet into Web-based innovation, web-Entrepreneurship and Internationalization (IEI) of businesses. It introduces an approach to extend and complement existing incubation environments, which are no longer sufficient to deal with the dynamicity of the Web-Entrepreneur. Based on personal and professional relations, and new business models empowered by social media and the Web 2.0, together with a set of interoperable ICT services supporting virtual or agile enterprises, the authors propose a federation of open-source platforms for the to-be born and existing enterprise life-cycle management, instantiating the Unified Digital Enterprise concept. The novel approach ensures full reuse of existing solutions, developing targeted research to support web-entrepreneurship with cooperation between people, businesses, and assets, namely focusing on innovative methods and architectures for competitive intelligence; crowd-based market sensing; idea incubation and simulation; knowledge intensive team building; as well as interoperability to enable internal federation and external platform integration.

Keywords: Web-Entrepreneurship · Open innovation platforms and services · Unified Digital Enterprise · Future Internet

1 Introduction

Innovation, Entrepreneurship and Internationalization (IEI) are essential processes of an interlinked chain to fight-off an economic and financial crisis that has been considered the World's worst since the U.S. depression in the 1930's. As our world becomes increasingly interconnected, Future Internet (FI) technologies are the tools for change [1, 2] since they enable cultures, industries, and people to collaborate and

partner in new ways, stimulating businesses, and capitalizing existing assets, such as individuals, technology, data, knowledge, or physical resources. Entrepreneurship, with its emphasis on Web-based innovation and growth, can provide the spark that's needed to ignite new economic and societal vibrancy [3–5].

Jerome Engel [6], claims there is no better timing to kick-start innovative projects of what in periods of decline. However, to be entrepreneur in recessions is not easy, nor can derive only from a logic of survival. He defends it is important to invest in new business models and innovative technology-based ideas that can create an imprint in the digital society of the future. Also, the potential entrepreneur must be prepared for the fact that the capital investment will be much harder to find and the filters for evaluating ideas will become tighter. New forms of business models supporting extended, virtual or agile enterprises in the FI will have the advantage. Thus to maximize that creativity, relationships with universities and research are requested.

For startups that are part of global networks of clusters of innovation, opportunities are increasingly not only a competitive challenge but also a business imperative. Indeed, building upon the ideas of Engel in global clusters of innovation, the emergence of new technology and digital enterprise innovation can be achieved and attributed to the leverage of multi-national, multi-cultural knowledge, people, and other resources around the world. Whereas in the past, this collaboration phenomenon could be related to human physical migrations and the consequent "brain circulation", nowadays it is expected that the FI and the Social-Web can provide new forms of business relations and enhance cooperative networking in the innovative entrepreneurship process.

However, European entrepreneurs fear the possibility of bankruptcy, and the risk of irregular income and unemployment still remains an issue. Among the young, numbers are even more disturbing. In February 2014, 5.392M (under 25 years) were unemployed in the EU-28[1]. Hence, to face these issues, the EC Entrepreneurship 2020 Action Plan ([5]) defines three main actions to encourage the appearance of new entrepreneurs: (1) Entrepreneurial education and training to support growth and business creation; (2) Creating the right business environment and; (3) Role models and reaching out to specific groups.

This paper proposes an approach to extend and complement existing incubation environments for the needs of the Web-Entrepreneur. It specifies an ICT open innovation platform to be deployed at local entrepreneurship clusters, to support an agile enterprise IEI. Section 2 analyses the UDE concept in face of to the to-be born enterprise. Together with advanced modelling and engineering strategies it supports of not only the start-up creation but also its entire lifecycle. Section 3 specifies WEnOIP, a Web-Entrepreneur Open Innovation Platform and its services, while Sect. 4 depicts a possible scenario that highlights the platform's advantages. Finally Sect. 5 concludes the paper, drawing some considerations on the work developed and to-be developed.

1.1   Future Internet and Business Innovation: The Gap to Cover

It is widely acknowledged that the advantage of one company over another stems from the way it manages its process of innovation. However, if the enterprise information

systems used are not efficient experiencing communication and automation issues, innovation might not be realized [7]. Hence, Future Internet Enterprise Information Systems (FInES) has been in the past an important area of research to ensure the competitiveness and growth of enterprises [8, 9]. Specific solutions and research is being developed and supported by the EC, and the 2025 Research Roadmap ([10]) has so far addressed existing enterprises, indicating the socio-economic spaces where they prosper, the qualities of being they aim to achieve, the enterprise applications they need to innovate, and the basic FI technologies for a Universal Business System.

In summary, a Web-Entrepreneur is capable of using the social media and the apps "world" for creating concepts for web start-ups and stimulating web-based innovation in existing businesses.

Nevertheless, considering the economical perspective and entrepreneurship vision addressed before, the roadmap attends some issues related to innovation of existing enterprises into digital enterprises, but others remain unattended, e.g.:

- How to accelerate innovation of the to-be-born enterprise?
- How can Internationalization of businesses be better achieved?

To cover the gap, it is required to provide support for web entrepreneurship and Internet businesses, engaging new stakeholders in visions of web-based innovation, enabling and demonstrating innovative services for businesses and citizens which build upon the most advanced technologies.
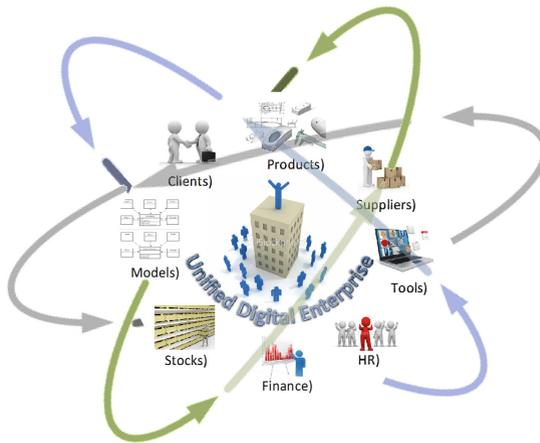
2   The Unified Digital Enterprise (UDE)

The UDE, as defined in the 2025 FInES Roadmap consists in a full digital image of the enterprise, representing various aspects, such as conceptual and factual (data), behavioural and structural aspects, at various levels of detail. A Unified Digital Enterprise is a complex structure that emerges from the collection of several knowledge resources logically and geographically distributed, inside and outside of the enterprise, e.g. products, clients, human resources, tools, etc. [11]. Figure 1 illustrates a view on the UDE, which addresses enterprise related knowledge in a holistic way, contributing to overcome the current fragmentation, where data of the same enterprise entity is frequently stored in different databases, managed by different departments, and using different tools without interoperability concerns [12].

In the context of UDE, no satisfactory techniques and modelling languages have been developed that can adequately describe in a holistic form all enterprise knowledge components and their inherently complex interactions, including human behaviour. Similar concepts are being explored commercially with management platforms that gather both business and IT information in a common single platform. Nevertheless this is neither a solution focused to starting entrepreneurs nor it is interoperable with many of the legacy system applications in use by a large majority of organizations.

In this work, the authors propose to use and instantiate the UDE components envisaging a holistic view over existing applications to enable innovation, as well as to implement these components in the web-entrepreneur eco-system in which they must be delivered. The idea is to proceed towards a totally integrated approach from the

functional point of view, providing a sustainable model constantly aligned with the reality, along the to-be born and innovative enterprise life cycle, supporting the IEI processes. This poses a research challenge that requires significant progress beyond state of the art in highly dynamic scenarios that require constant monitoring of the internal and external events, and quick responses to changes, maintaining the UDE model aligned [13]. Along this line, the notion of Enterprise Architecture (EA) and Enterprise Modelling (EM), as well as methodologies, such as Model-Driven Architecture (MDA - www.omg.org/mda/) are important.

Fig. 1. View on the Unified Digital Enterprise Concept

Following some of the most relevant works in these domains (e.g. [14–18]), methodologies such as MDA/MDI or semantic annotation can provide a valuable addition to more traditional EA/EM frameworks, allowing complementary technologies to be identified and put together, while enabling the recompilation of a full digital representation of the enterprise assets and components at any point in time of the UDE lifecycle.

3   Novel Approach to Supporting Local Clusters of Innovation

So far, the Future Internet (FI) research has provided a plethora of technical solutions addressing the development of better products, services and devices that can improve significantly the enterprises' and industries' performance, but there is a need for complementary support, linking potential web entrepreneurs with key actors at international level. In fact, organizations and institutions from all three major institutional sectors that make up a society (i.e. civil, state, and businesses) are working constantly to resolve the challenges ahead. Facing our common wisdom, they reveal promising new perspectives that meet and need to be met by ICT developments.

Traditionally, local innovation clusters facilitate the connection of entrepreneurs with talent networks, investors and mentors regionally. However, many times they lack the technological support for the web-entrepreneur, and the internationalization potential. Indeed, major difficulties are frequently posed, whether it is in the creation of something new or the innovation of the existing, there is the need to strengthen the environment for web entrepreneurs to grasp the new opportunities offered by the web and the app economy.

Apart from the classic financial difficulties and risk associated with any entrepreneurship project, there is a panoply of other issues that need to be attended, such as:

- The e-conceptualization of the idea;
- The elaboration of e-business/expansion plans;
- The analysis of e-market requirements and e-market monitoring;
- Finding the right team for the job;
- Product support;
- E-Branding, e-marketing and finding customers;

Hence, the authors propose an ICT platform to support local innovation clusters overcome their problems. The proposal is based on a federated concept of innovation platforms interlinked among each other via interoperable services. Together, they create a network capable to capitalize on all the FI technology being developed to provide the above services, and facilitate internationalization. Besides enabling the innovation ecosystem itself through capacity building and stakeholder engagement activities, it has the ability to connect with existing platforms for funding or mentoring.

3.1 Web-Entrepreneur Open Innovation Platform (WEnOIP) Specification

WEnOIP complements that need, setting the ICT framework conditions for web-entrepreneurs to start-up and develop business ideas, bringing them to a worldwide market. It introduces a federation of open source platforms to support the web-innovation, web-entrepreneurship and web-internationalization, as well as the integrated to-be born enterprise life-cycle management, covering the issues identified and enabling the instantiation of the Unified Digital Enterprise (UDE) challenge, as well as establishing synergies and building up existing innovation frameworks.

To realize the vision, the proposed platform explores and pioneers novel forms of technological and digital business innovation, progressing beyond the state of the art by using the full potential of the network effect to support the IEI processes. As illustrated in Fig. 2, the platform to support the web entrepreneur open innovation cluster relies on a next generation model for the web-based digital enterprise set-up, and a set of interoperable ICT services supporting extended, virtual or agile enterprises in the Future Internet. Making an analogy with the Human incubation process, it envisages at modelling the 9-months gestation of the new idea, including tests and ultrasound scans, i.e. identifying what phases to go through, which methods-tools-ICT support are needed in each of the phases, and providing intelligent interconnected services, crowd-mining ideas, crowd-funding or competitive intelligence to deliver the best web-based incubation environment for the UDE.
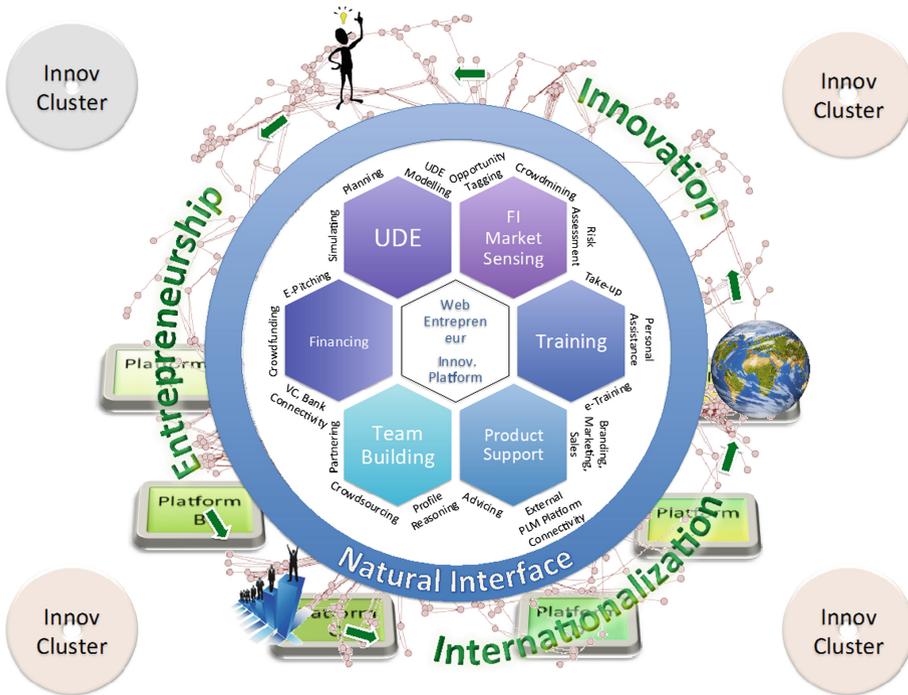
Fig. 2. Platform to support the web entrepreneur open innovation cluster

In detail, six modules are envisaged and accessible through natural-style user interfaces, reflecting advances in conceptual foundations, new models and methodologies, and aggregating services for the web-entrepreneur: (1) "FI Market Sensing" with services made available for the analysis of market requirements and market monitoring, where the proposed crowd mining concept (based on social media and the Web) leads to the identification of short or long term business opportunities; (2) "UDE", with ICT support to planning and conceptualization of the idea (e.g. business plan elaboration), applying modelling technologies to support UDE and build a digital image of the enterprise, overcoming the current fragmentation of concepts and achieving a holistic vision of the enterprise (to-be born or not) which is dynamically aligned with the business reality along its entire lifecycle; (3) "Financing", enabling interconnectivity with traditional systems such as banking platforms (including financial simulators), but envisaging at novel strategies (e.g. crowdfunding and web-based pitch presentations); (4) "Team Building", fostering dynamic alliances/partnering among enterprises with complementary objectives, and intelligent selection of human resources (e.g. semantic capabilities for profile reasoning through the social web); (5) "Product Support", enabling interoperability with existing ICT platforms that can complement the design/development of the Enterprise product/prototype; (6) "Mentoring", providing digital support to the IEI chain, while enabling remote personal assistance.

Ensuring generalization and full reuse/take-up of existing methods and tools, WEnOIP is specified and described exploiting existing frameworks (e.g. OpenIdeo) as

well as the Enterprise Interoperability (EI) Science Base (EISB) [9], thus supporting that initiative and sustaining external future developments.

3.2   Open Innovation & Business Innovation Platforms

There are various platforms on open innovation that can be connected and allow companies to use crowd wisdom and diverse capabilities around the world in order to speed up innovations and open the innovation funnel. In that direction OpenIDEO (openideo.com), IdeaConnection (www.ideaconnection.com) and InnoCentive (www.innocentive.com) open the innovation process and assign tasks to teams that get awards to solve specific problems, coming from really industrial needs. Moreover, various platforms try to cultivate a community and ecosystem around their products or services, exporting APIs and SDKs to the community; Facebook and Twitter APIs are some of the most successful examples in that direction, but the FIWARE catalogue (catalogue.fi-ware.org/), DARPA open catalog (www.darpa.mil/opencatalog/) move a step further and try to allow companies use code and services coming from research. There are also many platforms running idea competitions, like IDEA (www.ideacompetition.org), IDSA Idea (www.idsa.org/idea) and Big Ideas @Berkeley (bigideas.berkeley.edu). Other platforms create a network of people and teams, trying to bring them together in order to solve specific problems; P&G was one of the first companies to open its R&D labs, exporting knowledge while trying to boost innovation as never imagined before, with the P&G Connect+Develop platform (www.pgconnectdevelop.com).

There are platforms that support finding a co-founder to run a startup, like FounderDating (founderdating.com), and CoFoundersLab (www.cofounderslab.com). Groups that support team building and startup launching, like Meetup (www.meetup.com), Women 2.0 (women2.com) and Lean Startup Machine (www.leanstartupmachine.com), or platforms that facilitate hiring for Startups, like F6S (www.f6s.com). Additionally, there are many tools that can support business modelling and visual collaboration, like Mural.ly (mural.ly) and Business Model Canvas (www.businessmodelgeneration.com/canvas), or can support customer development process and business model validation, like Business Model Alchemist [19], or FounderSuite (www.foundersuite.com). As entrepreneurs start validating their business model and look funding to expand, there are platforms that enable pitching and advising from distance, e.g. Startup pitching night (www.startuppitchnight.com/startuppitchnight).

Finally, there are also many early-stage networking and idea-sharing platforms, without focusing on the business planning, market fit and business development of an innovative idea or solution. Proven methodologies such as Lean Startup or Customer Development Methodology, and various individual software solutions and visual tools support them [20, 21]. What is really missing is the real online support, the experienced contribution of advisors and investors who will support and drive entrepreneurs out of the "valley of death" of an entrepreneurial idea. The proposed approach meets this need with a platform (i.e. of software and networking solutions) that allows web entrepreneurs to combine existing tools, methodologies and networks coming from successful platforms, with a network of investors and advisors who will support them across Europe through newly developed e-Advising and e-Pitching platforms and events.

4 Scenario

Actors Involved: (1) A web-entrepreneur (John) wishes to set-up a new business and (2) A Capital fund agency (Cap) is willing to support the development of an innovative product in the creative industry market at the start-up stage.

Baseline: John has just finished his engineering studies at university and is a programmer fond of building innovative mobile games. He is willing to sell them to the public so he plans to set-up a company of mobile games. He now has his idea in mind and wants to materialize it into a real product. In order to set-up his own start-up John has to think about the different problems that he will face:

1. It is necessary to explore who are going to be the potential customers and which are their problems and needs. A major reason why start-ups are unable to succeed is that there is little or no market for the product or service that they want to build. Many start-ups find it really difficult to know exactly the size of the market accessible for them;
2. It is essential to develop a game that fits the market needs. Too many start-ups begin with an idea of a product that they think people want and spend months, even years, optimizing it without ever showing the product to the prospective customer. When they fail to reach broad uptake from customers, it is often because they never spoke to them and determined whether the product was interesting for them. This normally ends up in the start-up failing, which is a failure to achieve Product/Market fit.
3. Lack of funding. John will need to demonstrate as soon as possible that his idea is feasible to materialize so as to being able to obtain funding.
4. It is essential to incorporate social media into the marketing strategy. It is essential to know how to monitor the impact on the target audience. Monitoring the customers' questions is a great way to understand what is on their mind, their problems and how we could help.
5. Look for an experienced team, with technical and management skills.

All these issues should be solved in a reduced period of time while spending the least possible amount of money, as it is really important to create a product as soon as possible that provides added value to the customer. However, John, who has no previous experience in business making and has no sustainable cash-flow yet, finds really difficult to deal with all these problems without external help (external business consultant) and of course, he does not have the economic capacity to enjoy the full-time support of external consultants.

4.1 How WEnOIP Will Help This Creative IT Industry Start-up to Succeed?

From the Start-up Point of View: WEnOIP provides John different services that will help him cover all the aspects needed to set up his own start-up. First, in order to find the potential customers for John's product, WEnOIP will gather data from social media correlating them with gender, age, education, demographic or seasonal information so

as to identify temporary or constant trends in consumers' behaviour, thus detecting short or long term business opportunities.

WEnOIP supports the lean start-up methodology and its "build-measure-learn feedback loop". The first step is figuring out the problem that needs to be solved and then developing a minimum viable product (MVP) to begin the process of learning as quickly as possible. Once the MVP is established, a start-up can work on adapting it to the target public needs. This will involve measurement and learning and must include actionable metrics that can demonstrate cause and effect question. In our use case, and by means of WEnOIP platform the process will be as follows:

1. John selects one of his game ideas as an innovative initiative.
2. Some key indicators are chosen so as to check that the product can work (number of downloads, number of requests for information, number of positive and negative comments in Social Networks, number of likes, number of recommendations to friends, etc.).
3. A prototype or minimum viable product of the game is developed (just a local game with no capabilities to play online yet with friends).
4. Based on users' feedback (e.g. users want to play online with their Facebook friends) and the key indicators chosen, the result of this first launch is analysed.
5. Based on these results, John may decide whether to opt for a different game or to begin again the cycle so as to improve and adapt the game to users' needs. (e.g. John may want to introduce the capability of playing online with online friends).

Enabling this Lean Start-Up methodology, WEnOIP will find it easier to get funding as the feasibility of the product will be demonstrated in a short period of time. As the product will be evolved progressively according to user needs, the funding agency (Cap) may be interested in providing even more funding to the creative start-up. Moreover, WEnOIP will serve also as a human-resources support system as it will help John to find the right team for the job, by looking for CVs in appropriate web locations (such as LinkedIn) and by selecting the best candidates by means of reasoning services. WEnOIP will also help John to find alliances and partnerships with other companies with complementary interests that may be interested in working in a project together. During the whole process, remote assistance will also be facilitated. As it can be seen, the WEnOIP environment will help to set up a digital start-up from the beginning covering all the aspects that should be taken into account so as to be a successful start-up. It will afterwards cover the whole cycle of product optimization, collaboration and even internationalization.

4.2   How WEnOIP Will Help the Funding Company?

From the Funding Company Point of View: Cap is looking for innovative business ideas and projects so as to provide funding and promote the creation of new start-ups in the creative industry. Cap is contacted by WEnOIP so as to provide funding to John and help him develop his idea. After a quick and first market analysis, WEnOIP demonstrates to Cap the business opportunity that has been identified. It decides to provide a certain quantity of money to John so that he can start developing his idea.

As a first prototype of the mobile game is soon in the market, Cap is able to see the results of its investment and as they notice the success of this project, they decide to increase the funding so that John can follow optimizing and adapting his product according to customers' demands.

5   Conclusions and Future Work

As the Flash Eurobarometer 354 reflects in the report "Entrepreneurship in the EU and beyond" [22], entrepreneurs and start-ups are often faced with important barriers to their flourishing and market access. The lack of capital is seen as a barrier to self-employment by a relatively high number of citizens. However, in the case of Europe, people see the current economic climate not being suitable for starting a new business as an important obstacle. Apart from that, not having enough skills to be self-employed and having little or no business ideas are significant restrictions, which discourage potential entrepreneurs to set up new enterprises. Thus, the generation of favourable business ecosystem conditions are critical to both scale and success of start-ups, and is essential to create the right framework to foster entrepreneurs.

The motivation for the presented work is to promote web-entrepreneurship along the IEI chain of processes, while enhancing the full potential of the Future of the Internet and Web 2.0 into Web-based Innovation. The WEnOIP platform and the proposed approach empowers cooperative networking, supporting entrepreneurs to develop their innovative ideas into real business while also supporting funding agencies and business angels to find new potential innovative business to whom provide funding always being based on evidence-based funding policies. This work is targeted to convince SMEs and entrepreneurs willing to set-up their start-ups that innovation is the key in order to be competitive, not just in their set-up but also in their later lifecycle. Indeed, as about 50 % of companies fail in their first five years, it is fundamental to support the whole cycle of product optimization, collaboration and networking with peers, R&D coaching and mentoring, and even internationalization.

Based on the federation of localized innovation clusters, it is possible to maintain proximity with the entrepreneurs, and at the same time, promote interaction between entrepreneurs across countries and support crosslinks that might develop complementary business between start-ups and SME's. Also, besides the advantages for the web-entrepreneur, nowadays, companies such as funding agencies find difficult, if not impossible, to set-up evidence based funding policies. This is particularly true for the implementation of micro-credit allocations. WEnOIP could help to increase their impact, which is a very useful instrument in the start-up phase. It would also allow a more intelligent, dynamic and evidence-based use of the funding resources and will leverage the implementation of incremental funding schemes based on various iterations of MVP development.

For future work the authors intend to validate the proposed approach in a set of local innovation clusters, providing WEnOIP services for market sensing, UDE modelling, financing, team building and interoperability among the platforms, as the MVP to demonstrate the concept in a real life scenario. It is absolutely necessary to delineate at an early stage of its development: the appropriate methodology for

intelligent team crowd-building, indicating the information necessary, the decision-making steps, the criteria for a successful team building process and the mitigation plan for possible risks; and the appropriate methodology for social media consulting in each cluster. UDE modelling, trend analysis and market sensing are already developed [23–25] as separate tools, so the remaining services are to-be tested in longer-term perspective.

References

1. Pan, J., Paul, S., Jain, R.: A survey of the research on future internet architectures. IEEE Commun. Mag. **49**(7), 26–36 (2011)
2. Moreno-Vozmediano, R., Montero, R.S., Llorente, I.M.: Key challenges in cloud computing: enabling the future internet of services. IEEE Internet Comput. **17**, 18–25 (2013)
3. Spiegel, O., Abbassi, P.: Going it all alone in web entrepreneurship?: a comparison of single founders vs. co-founders. In: Proceedings of the 2013 Annual Conference on Computers and People Research, pp. 21–31 (2013)
4. Harada, H., Yagi, R., Sashida, N.: Machibata.net — innovation hub for community development. FUJITSU sci. Tech. J. **49**, 440–447 (2013)
5. European Commission: Startup Europe. ec.europa.eu/digital-agenda/en/startup-europe
6. Engel, J.S., Del-Palacio, I.: Global networks of clusters of innovation: accelerating the innovation process. Bus. Horiz. **52**, 493–503 (2009)
7. Jardim-Goncalves, R., Agostinho, C., Malo, P., Steiger-garcao, A.: Harmonising technologies in conceptual models representation. Int. J. Prod. Lifecycle Manag. **2**, 187–205 (2007)
8. FInES Cluster: Future Internet Enterprise Systems (FInES) Position Paper on Orientations for FP8 "A European Innovation Partnership" for European Enterprises: V3.0 (2011)
9. Lampathaki, F., Koussouris, S., Agostinho, C., Jardim-Goncalves, R., Charalabidis, Y., Psarras, J.: Infusing scientific foundations into enterprise interoperability. Comput. Ind. **63**, 858–866 (2012)
10. FInES Research Roadmap Task Force: FInESResearch Roadmap 2025: version 3.0 (2012)
11. Missikoff, M.: The future of enterprise systems in a fully networked society. In: Ralyté, J., Franch, X., Brinkkemper, S., Wrycza, S. (eds.) CAiSE 2012. LNCS, vol. 7328, pp. 1–18. Springer, Heidelberg (2012)
12. Münch, T., Hladik, J., Salmen, A., Altmann, W., Buchmann, R., Karagiannis, D., Ziegler, J., Pfeffer, J., Urbas, L., Lazaro, O., Ortiz, P., Lopez, O., Sanchez, E., Haferkorn, F.: Collaboration and interoperability within a virtual enterprise applied in a mobile maintenance scenario. In: Charalabidis, Y., Lampathaki, F., and Jardim-Goncalves, R. (eds.) Revolutionizing Enterprise Interoperability through Scientific Foundations, vol. 7 (2014)
13. Jardim-Goncalves, R., Agostinho, C., Steiger-Garcao, A.: A reference model for sustainable interoperability in networked enterprises: towards the foundation of EI science base. Int. J. Comput. Integr. Manuf. **25**, 855–873 (2012)
14. Chalmeta, R., Campos, C., Grangel, R.: References architectures for enterprise integration. J. Syst. Softw. **57**, 175–191 (2001)
15. Boudjlida, N., Panetto, H.: Enterprise semantic modelling for interoperability. In: Proceedings of 12th IEEE Conference on Emerging Technologies and Factory Automation (ETFA 2007), pp. 847–854, Patras, Greece (2007)
16. Chen, D., Doumeings, G., Vernadat, F.: Architectures for enterprise integration and interoperability: past, present and future. Comput. Ind. **59**, 647–659 (2008)

17. Agostinho, C., Černý, J., Jardim-Goncalves, R.: MDA-based interoperability establishment using language independent information models. In: van Sinderen, M., Johnson, P., Xu, X., Doumeingts, G. (eds.) IWEI 2012. LNBIP, vol. 122, pp. 146–160. Springer, Heidelberg (2012)

18. Frankel, D.: Model Driven Architecture – Applying MDA to Enterprise Computing. OMG Press, Wheat Ridge (2003)

19. Osterwalder, A.: Test your value proposition: superchargeable lean startup and custdev principles. http://businessmodelalchemist.com/2012/09/test-your-value-proposition-supercharge-lean-startup-and-custdev-principles.html

20. Blank, S.: The Four Steps to the Epiphany: Successful Strategies for Products that Win. Lulu Enterprises, Pascadero (2006)

21. Blank, S.: Why the lean start-up changes everything. enterprisersproject.com/article/hbr-article-why-lean-start-changes-everything(2014)

22. TNS Opinion & Social: Flash Eurobarometer 354: Entrepreneurship in the EU and beyond (2012)

23. Agostinho, C., Sesana, M., Jardim-Goncalves, R., Gusmeroli, S.: Model-driven service engineering towards the manufacturing liquid-sensing enterprise. In: Proceedings of the 3rd International Conference on Model-Driven Engineering and Software Development (ModelsWard 2015)., Angers, France (2015)

24. Marques-Lucena, C., Sarraipa, J., Fonseca, J., Grilo, A., Jardim-Gonçalves, R.: Framework for customers' sentiment analysis. In: Angelov, P., Atanassov, K.T., Doukovska, L., Hadjiski, M., Jotsov, V., Kacprzyk, J., Kasabov, N., Sotirov, S., Szmidt, E., Zadrożny, S. (eds.) Proceedings of the 7th IEEE International Conference Intelligent Systems IS'2014. AISC, vol. 322, pp. 849–860. Springer, Heidelberg (2015)

25. Biliri, E., Petychakis, M., Alvertis, I., Lampathaki, F., Koussouris, S., Askounis, D.: Infusing social data analytics into future internet applications for manufacturing. In: Proceedings of the 11th ACS/IEEE International Conference on Computer Systems and Applications (AICCSA 2014)