New concepts used in a Digital Business EcoSystem

Ph.D. Lecturer MIHAIL DUMITRU SACALA  
The Bucharest Academy of Economic Studies  
Ph.D. Assistant IOAN STEFAN SACALA  
University “Politehnica” Bucharest

Abstract: - The research and development of a Digital Business Ecosystem is one of the priorities of the European Union Information Technology research agenda. Recent achievements in the new DBE multidisciplinary research domain have revealed a strong convergence, with respect to various fundamental sciences (mathematics, physics, genetics, biology, a.s.o.). This approach has created the necessary "pressures" as to positively become a push for innovative technical approaches. The paper is focused on providing a base for the development of regional Digital Business Ecosystems by assessing the probability methods for the development of business connections capable of sustaining both organizational and economical growth.

Key-Words: Digital Business Ecosystem, Probability of Appearance, Interoperability

1 Introduction
During the Lisbon European Council [March, 2000], the European Union representatives set the goal of making Europe the world's most dynamic and competitive Knowledge-based Economy (KBE) with the need to promote "the Information Society for all"! According to this mission to be completed next decade The "Networked Enterprise and Radio Frequency Identification (RFID & EN)" unit of the European Commission's "Information Society" (IS) and Media aims at facilitating the emergence of future innovative business models within Global Economy and "e-market" based platforms.

Everybody could recognize that: "Businesses require new technologies, applications and services to enable them to work as Networked, Knowledge-based, Enterprises"

In this context two important messages are to be sent towards target audience:
1. Taking into consideration the three categories of "EcoSystems" (1996) Digital ICT EcoSystems, Business EcoSystems, Innovation EcoSystems, living and to working within a "Blue Ocean" is concerned with both dissemination and successful stories implementation of Collaborative Network Organization for global e-economy supporting e-democracy;
2. A convergent innovative effort should be necessary to harmonize various new trends as to be able to overcome the Global economic crisis: microeconomics & macroeconomics e-business, social networks, e-services sciences, a.s.o.

The concerns and aims of this paper are related with the Digital Business Ecosystem foundation:
1. DBE analysis (global & local performance evaluation)
2. DBE formal tools to prove the stability of such evolving, self-organizing, complex systems within the Internet of the Future (Web 3.0, Internet of Things)
3. DBE synthesis methods and techniques for e-business
4. DBE-ICT-tools development and their integration e-Collaborative platform
5. Compatibility, Interoperability and Collaborative new methodologies

2 From Business Ecosystem, Towards the Development of a Digital Business Ecosystem

In order to discuss the advantages, opportunity and formation of a DBE we will first have to discuss the principles which led to the development of this new business approach.

Taking into consideration the genuine concept of ECOSYSTEM an we will first define the ecosystem as a meta system comprising of the following macrosystems:
(i) E-BIO -> living organisms (BIOTA),
(ii) E-ABIO -> nonliving environment (ABIOTIC factors)
Φeco : {E-BIO; E-ABIO; R, G}
Where: R -> set of relationships (in the metasystem)
G -> goal of a certain sustainable ecosystem

The analogy between business environment and the biological ecosystems has been proposed as the basis of solving the difficult problem of understanding the effects of company’s decisions on the surrounding business environment.

One of the first definitions of the business ecosystem has been proposed by More [2]. This definition states that a business ecosystem can be regarded as “an economic community supported by a foundation of interacting organizations and individuals. “This economic community produces goods and services of value to customers, who are themselves members of the ecosystem”. The organizations forming the ecosystem “also include suppliers, lead producers, competitors, and other stakeholders.” The main characteristic of the ecosystem is inherited by the business environment model “a system that can sustain itself without outside interventions”.

The Digital Business Ecosystem (DBE) positions itself research on the 'digital' aspect of the business cooperation. The focus is to “provide an open source distributed environment, where software components, services, applications and also business models are regarded as ‘digital species’ that can interact with each other, reproduce and evolve according to laws of market selection.” [3]

In this context some requirements regarding the DBE environment are pointed out [4]:

In the following section we will discuss the most important systemic concepts providing the foundation for the DBS.

**Complex systems** can be defined in a number of ways depending on the different scientific domains approaches.
First of all a system is viewed as a group of interacting, interrelated, or interdependent elements forming a complex whole. A system may have boundary and may interact with the surrounding environment by exchanging energy and/or matter.

One way to describe complex systems is as a dissipative structure that imports free energy and exports entropy so as to be able to achieve a level of self-organization.

From the information science point of view a complex adaptive system is a system that absorbs information from the environment and creates stores of knowledge.

In order to describe complexity we have selected the a few basic basic principles. In order to bring the approaches together we have to consider 2 of the most important approaches: one considers that complex systems function far-from equilibrium, exploring the space of possibilities as a path dependent process, using their history and timeline and the second considers that complex systems are dissipative and function as local knowledge based agents involved in self-catalytic reactions and characterized as non-linear and evolutionary.

Based on these principles we can provide a classification of the complex systems:

- **First order complex systems** as the imposed energy transformation
- **Second order complex systems** as control over the acquired energy through the translation of the absorbed information into a connectional knowledge structure
Third order complex systems as feedback and feed-forward model driven acquired and imposed knowledge. Fourth order complex systems as interactive knowledge generated as interconnected models and knowledge sets.

Self-organization can be defined as the ability of complex systems to create new order and coherence. The events that lead to self-organization occur spontaneously as a result of interactions so as a regular structure or pattern can be defined without the function of a central controller.

Digital Business Ecosystems can be considered as self-organizing systems as the partners participate in the ecosystem voluntarily without the directions of external or internal leaders.

Another self-organizing component of the DBE is the goal driven evolution of the ecosystem. Companies act on behalf of their own interest and therefore can negotiate connections in order to adapt to the new “turbulent market”.

The ecosystem is in this manner changing continuously, dissolving and creating new connections, as the market offers new opportunities and challenges.

Adaptation is one of the first identified phenomenon linked to intelligence and it can be viewed as a common factor in different approaches of intelligence definitions. The adjustment of behavioural patterns is one of the clearest acts of adaptation. This correction is the result of applying different methodologies, concepts, approaches, logical schemes, etc. that finally represent the ability of reasoning and logical deduction.

At the level of abstract systems, adaptation is a concept easy to understand: a system that adapts well can minimize perturbations in its interaction with the environment and behaves successfully. As a simple case study, this adaptation can be done by a system that reacts to external stimuli by appropriately enacting different predefined processes. If the system has not a sufficient capacity of discerning between external events or it has no appropriate process to trigger as a response to a given stimulus, it is unable to adapt anymore. This is the reason for the learning capacity is one of the most important factors for adaptation and thus for intelligence. There is a wide set of applications that involve system adaptation, such as communication systems, banking, energy management, transportation, manufacturing, intelligent enterprise a.s.o. Besides the necessity to have an adaptive behaviour, all those systems have in common, in different degrees, other similarities, like the high dynamics, multiple solutions to a given problem, high heterogeneity.

Another important aspect is related with the position of DBE within the scientific research areas. In this context an investigation has been proposed in order to populate the meta level, as well as meta-meta-level of multiple scientific disciplines with emerging new sciences as represented in fig 4.
3 The Development of a Regional Oriented Framework for the Digital Business Ecosystem.

The information environment management framework that supports the development of the DBE is organized in 7 functional layers:

1. Producers/Consumers (Users/Applications)
2. Decision Management
3. Knowledge Management
4. Information Management
5. Data Management
6. Dissemination Management
7. Communication Management

The following basic requirements, but not limited to this list, have to be taken into account for the development of a DBS system of systems syntheses within the Information Systems framework:

- **System robustness**: to preserve the structural proprieties of Discrete Event Systems (e.g. viability, boundness, reversibility) in the presence of internal disturbances. The qualitative supervisory theory is, generally speaking, the theoretical background.

- **System adaptivity**: to deal with changes so robustness is supplemented with the ability to freely adapt to external changes. An internal market-bid model should undertake the task to fulfill this requirement.

- **Decision-support system autonomy**: to improve the role of co-operative multi-agent systems within a synergetic framework of discrete event dynamical system platform.

- **Contextual metasystem representation completeness**: to support the multi-view approach for system of systems consisting of heterogeneous resources and a mosaic of activities.

- **Multi-modeling system connectivity**: to facilitate interoperability between the underlying models required.

- **Governance / Public Administration Interoperability**: The interoperability is, first of all, a problem of communication and e-collaboration oriented within Digital Global World.

- **Functional modules reusability**: to develop reusable software to adequately respond to the need for frequent changes. [6]
4 The Probability of the Development of Collaborative Connections inside a Digital Business EcoSystem

We took into account the possibility of possible sources of bias in this type of work arising and found some relevant variables:

- Smaller SMEs grow faster than larger SMEs (Factor 1 – SMEs dimension - D).
- Younger firms grow faster than the older ones (Factor 2 – SMEs age - A).
- Informal management structure and chief executive’s (CE) personal control of strategic and operating decisions hinder SMEs’ output growth significantly. (Factor 3 – Informal Management - IM).
- Owner-managed firms and firms with concentrated ownership appear to experience faster productivity growth than the others. (Factor 4 – Owner Implication- OI).
- Innovation and training contribute significantly to SME output growth. SMEs who innovate and train grow significantly faster than those who do not (Factor 5 – Innovation - I).
- The impact of external business advice on SME growth. (Factor 6 – External Advice - EA)

The probability of appearance and development of connections inside a Digital Business EcoSystem, considering the interconnections between factors, is given by:

\[ P = \frac{\lg (5^{PD*PA} + 3^{PIM*POI} + 2^{PI*PEA}) - 0.5^{PD*PIM*PEA}}{0.75} \]

This is an empiric method, where PD, PA, PIM, POI, PI, PEA are given by the factor’s value divided by the maximum value for each factor. Quality variables are transformed in numeric variables by giving values on the same scale for all 6 factors. Individual probabilities (PD, PA etc) ∈ [0,1].

Management and governance characteristics of SMEs: factor analysis Data

In order to simplify and efficiently investigate the impact on growth of the management and governance characteristics of SMEs, we first employ factor analysis to the underlying variables measuring management and governance factors. The aim of this analysis is to identify some combinations of variables which capture the principal features of the dataset.

Using correlation we can identify several management and governance variables which are closely correlated. We treat them as the inputs of the factor analysis. These variables can be classified into 4 groups as follows.

Factor analysis Factor analysis attempts to identify a small number of underlying variables, or factors, that explain most of the variance observed in a set of observed variables. There are four factors which explain 64 per cent of the
variance across all the underlying variables. These four factors are retained and extracted, and the estimated ‘factor loadings’ which represent the weights attached to each underlying variable in the factor.

Based on the proportion of the variance they accounted for and their factors’ economic meaning, we decided to retain the first three, which together explain more than 54 per cent of the variance. These three factors are: ownership structure (A); management competence (B), and management style (C).

A Formal Model of SME Growth
An integrated framework of SMEs growth, which combines the relevant industrial economics, the new growth theory and the managerial economics in one model, can be set out as follows,

\[ G = \beta_0 + \beta_1 G_1 + \beta_2 G_2 + \beta_3 G_3 + \beta_4 G_4 + \beta_5 G_5 \]

where: \( G \) = total growth;

\( G_i \) = growth provided by group factor i, obtained by an econometric model from all variables included in the group.

5 Conclusion
This probability is bigger from year to year as an evolution of the Business EcoSystem and, as a result of our research, this is happening mostly because SME’s need for growth develop strong connections inside a Digital Business EcoSystem especially based on the same interest area. In the future, we established that in no more than 3 years, the connections in one business area will become so strong that we’ll look at the SMEs acting in this field like a big corporation with subsidiaries all over the world. Another aspect is that connections made between countries are even stronger than the ones made in a certain country. Future will tell but we should be prepared.

References: