# Methodology Of Business Ecosystems Network Analysis: A Field Study In Telecom Italia Future Centre

*Cinzia Battistella, Katia Colucci, and Fabio Nonino*

**Abstract** The scope of this paper is the analysis of the business ecosystems, as reticular structures interacting one with each other. The aim is to propose a methodology for analyzing and modeling the ecosystems and to illustrate its application via a field study conducted inside the Telecom Italia Future Centre, and in particular the digital imaging ecosystem. The methodology is called *methodology of business ecosystem network analysis (MOBENA).*

## 1. Introduction

Today's dynamic and complex environment requires a higher level, network view of inter-organizational exchanges at both the conceptual and practical level. The Value Chain and the Value Network models (Porter, 1985; Allee, 2002) are concepts focused on the value creation process of the firm, instead the Business Ecosystem (Moore, 1993; Iansiti and Levien, 2004) concept is useful to understand complex inter-firms relationships which form the background of the value creation process. In fact, the success of a business ecosystem lies in the combination of efforts from business, government, education, and all segments of the *community*. The cultural and two-sided interactions between actors of a community sharing the same values and especially the same interests have the implicit objective of long-term sustainability of the whole community. While value chains are based on volatile supplier/buyer relationships, the business ecosystems are based on a network of multi-directional relationships with firms with shared values and interests. The relationships are both monetary and not monetary, and the winners are those actors who can leverage *network externalities*. Whereas value chains are essentially defined by the accumulated value generated by monetary relationships, business ecosystems are also defined by the non-monetary advantages derived by firms participating in them. Therefore, a business ecosystems growth depends also on the quality of the non-monetary, qualitative interactions between stakeholders. These interactions create something intangible that is shared by all participants, the *social capital* (see Durlauf and Fafchamps, 2004; De Toni and Nonino, 2010). Networks, common norms, shared values and trust, comparable expectations, brought forth in cooperation and business relationships, create a web of social relations that have productive benefits by facilitating coordinated actions. While value

chains create value, business ecosystems generate value and social capital, resulting in a long-term and sustainable relationships.

If a company would like to know the complex dynamics intercepting it and/or if it would like to enter and act in an ecosystem, it has to rely on a deep knowledge and analysis of the ecosystem itself. It is a matter of identifying and describing the ecosystem components, the relationships between them and the balance of power that guarantees their existence. All these elements together define the shape and behaviour pattern: how the ecosystem "lives". Moreover, also the time variable is fundamental: the relationships between the constituent elements may change the ecosystem structure. So, understanding the ecosystem means not only drawing the shape and relationships among the constituent elements in a certain moment in time, but understanding how it can evolve by monitoring the evolutionary trends with all the variables involved. It is thus important that companies establish monitoring processes for their ecosystem from a static and dynamic point of view, and that they analyse business ecosystems and investigate how it can potentially impact their businesses. Clearly, these analyzes need to be supported by appropriate tools and methodologies to work on. But, despite the importance of the practical application of the business ecosystem concept as a representation of the real situation, literature on methodologies for business ecosystems is still in its infancy, while the majority of the contributions are focused on the discussion of business ecosystems per se (i.e. comparisons between natural ecosystems and business ecosystems, differences between value chain and business ecosystem, business ecosystems properties, their strategies, etc.). The scope of this paper is the analysis of the business ecosystems, as reticular structures interacting one with each other. The aim is to propose a methodology for analyzing and modeling the ecosystems and to illustrate its application in a field study conducted inside the Telecom Italia Future Centre. The methodology is called *methodology of business ecosystem network analysis (MOBENA)*.

The paper, after a discussion of the current literature on business ecosystems (section 2), presents the field study methodological strategy (section 3) and introduces the MOBENA and its application in a peculiar business ecosystem in Telecom Italia, the digital photography ecosystem (section 4). Finally, it discusses the findings and draws conclusions (section 5).

## 2. Modeling approaches of networks and ecosystems

Various approaches have been proposed to create a modeling language for firm interactions. In the view of Value Network, different modelling approaches have been proposed, as the e3-value model (Gordijn *et al*., 2000), the c3-value (Weigand *et al*., 2007) and the value network's model of intangibles (Allee, 2002). In the view of business ecosystems analysis, we found some first works all based on agent-based modeling, such as the Business Ecosystem Analysis Methodology (BEAM - Tian *et al*., 2009).

The following table (Table 1) shows a synthetic description of such methodologies, their main characteristics and compares them to our methodology. The methodologies for business ecosystems are very few. The main problems that we highlighted are that these methodologies are strongly interconnected to an agent-based modeling, therefore they over-simplify the problem. Moreover, they limit potential for strategic analysis.

**Table 1.** Modeling approaches of value networks and business ecosystems

| **Model or methodology**<br>**Investigated object** | **Critiques** |
|---|---|
| **e3-value modeling** (Gordijn *et al*., 2000)<br>Value network (theoretical basis: industrial view) | Based on agent modeling; Lack of a clear strategic focus in the model weakens its ability for prescriptive strategic insights |
| **c3-value model** (Weigand *et al*., 2007)<br>Value network (theoretical basis: resource-based view) | Based on agent modeling; It focuses on the direct competitor and the direct customer; It neglects the inter-dependencies and the potential given by the network perspective |
| **Value network model of intangibles** (Alee, 2002)<br>Value network | Analysis is mostly visual; It assumes that value is created through exchanges; It is focused on intangibles exchanges; It does not assign a purpose to the network; It assumes that the network is not manageable; It limits potential for strategic analysis |
| **Agent based methodology** (Marin *et al.*, 2007)<br>Business ecosystem | Based on agent modeling; Focused only on tangible exchanges. |
| **BEAM: business ecosystem analysis and modeling** (Tian *et al.*, 2009)<br>Business ecosystem | Based on agent modeling; Lacks of a strategic focus |

## 3. Research strategy

The present work is meant to help widen the knowledge basis on management of ecosystems and proposes a methodology based on network analysis and foresight. This paper attempts to answer to the following research questions: **How is it possible to systematically study the structure and fluxes of a business ecosystem?**

Increasingly, the technological innovations headed by ICT and TLC go beyond the value chain where they have been originated to attract the interest of other value chains which are so far remote, with different actors, interests and market objectives. Therefore actors interact now in a business ecosystem. In this new context, previous business models can change and latent or even not existing markets (and consequent business models) can emerge. That is why we decided to focus our research on the TLC industry. Moreover, we took an exemplar case: the most important TLC company in Italy, Telecom Italia (and in particular its unit focused on economical studies and investigation of the future, the Telecom Italia Future Centre). Among the ecosystems studied by the Future Centre, we chose to focus on the digital imaging ecosystem. The research methodology includes an analysis of literature on Strategic Management, Network Analysis and Foresight, from whence the theoretical proposal of the *methodology of business ecosystem network*

*analysis (MOBENA)* was born. The case study design is opportune for presenting a relevant overview of the importance and applicability of the methodology (Eisenhardt, 1989; McCutcheon and Meredith, 1993; Meredith, 1998). *The object of the case study is the test of the proposed methodology of business ecosystem network analysis.* As described by Yin (2003), the case study research design can be used to describe an intervention and its context. Some authors refer to this as a "field experiment". In the test in this study, the intervention is the application of the proposed methodology, and the context is the company studied and in particular one of its ecosystems (the digital image ecosystem).

## 4. A proposal of a methodology for business ecosystems analysis

The methodology aims to provide a theoretical and operational framework for analyzing the business ecosystems. It is designed to support the identification and understanding of the business ecosystems by providing the criteria to define its structure and analyze and evaluate the relevant behaviour. The methodology is based on five steps. Table 2. MOBENA phases

| PHASE and OBJECTIVES | CONTENT | DELIVERABLE |
|---|---|---|
| **ECOSYSTEM PERIMETER, ELEMENTS AND RELATIONSHIPS**<br>• Define the meaning of the ecosystem, decide what identifies it and identify what defines its boundaries.<br>• Detail the information to be collected as regards the constitutive elements and their relationships. | • Identify the seed – the actors' attractor and the leverage for business.<br>▪ Identify the elements and their connections. Elements: players, technologies, products/services and environment (market, constraints and regulation forces)<br>Players: (1) revenues, employees, EBITDA, investments, cash flow, (stock, trend, cagr, expected trends) (2) share trends, market capitalization (3) geographical presence (4) current market positioning and strategy (5) research strategy<br>Technologies<br>Products/services: (1) service concept (2) biz model (3) economics: users, revenues, margins, Cagr, ARPU<br>Environment<br>Relationships among actors - different kind of flows through the ecosystem: exchanged information<br>Transactions<br>▪ connection matrix: per each couple of variable it will be indicated: 0 - no relationship is on 1 - if a link already exists and is intangible, 2 – if a link already exists and is tangible, 3 – if a possible relation can be formed in a near future | *1. TECHNOLOGY WORKBOOK*<br>*2. PLAYERS INFORMATIONS*<br>*3. CONNECTION MATRIX* |
| **ECOSYSTEM MODEL REPRESENTATION**<br>• Develop a representation model | Translate in a graphical way the connection matrix: oriented graph; links and nodes characterized in a quantitative way; weight to each kind of relationship | *4. ECOSYSTEM REPRESENTATION MODEL* |
| **DATA VALIDATION**<br>• Obtain criteria to validate the | ▪ Brainstorming; existing literature; research conducted by specialists from reference markets; offi- | *5. ECOSYSTEM REPRESENTATI* |

| | | |
|---|---|---|
| model | cial documents (budgets, communication to the financial community, business plans, etc.); direct contact with the actors that belong to the potential ecosystem; consulting experts in modeling complex systems | *ON MODEL VALIDATED* |
| **ECOSYSTEM ANALYSIS**<br>• Evaluation of the ecosystem's behaviours (last, current, future) and relevant key indicators. | Ecosystem value analysis<br>▪ revenues: quantify the economic dimension of the ecosystem<br>▪ economic structure: understand how this value is shared among the various players: physical structure, revenues attraction, attractivity, relationship, assets & technologies<br>Ecosystem control point analysis<br>▪ identification of control points ("points at which management can be applied" - business strategy, regulation, and/or technology); control points constellation: put control points in a logical sequence, represent integrated control points as joined together; check for lock-in; show multiple offering outcomes if applicable | *6. ECOSYSTEM ANALYSIS* |
| **ECOSYSTEM EVOLUTION**<br>• Simulation of different scenarios aimed to perform what-if analysis, trend analysis, classification, forecasts. | ▪ list of trends and uncertainties; early signs; scenarios graph; scenarios narrative; definition of possible scenarios; list of implications and options of responses | *7. ECOSYSTEM SCENARIOS ANALYSIS* |

1. ECOSYSTEM PERIMETER, ELEMENTS AND RELATIONSHIPS The objective of this first step is to identify the perimeter and constituent parts of the ecosystem. In the digital imaging ecosystem, the seed is the service, based on the psychology of the "management of the memories" and the "digital translation" of the reality, that permit new possibilities and functionalities for the personal sphere of the individual. Another important point for the decision about the borders of the object of observation are the constitutive elements of the ecosystem and the relationships among them. For the digital imaging ecosystem, the team preliminarily identified two macro-classes of actors in the ecosystem and for each one listed the component actors and the main players:

- Manufacturers: class of actors connected to the consumer-electronics production, in other words the hardware part of the ecosystem; they are typically constrained to obtain cost-efficiency through scale-economies and realize high production-volumes. They are: *camera and camcorders manufacturers*, *storage manufacturers*, *printers manufacturers*, *cameraphone manufacturers*
- Service Providers: their offer is connected to services and not-tangible functionalities for users. They are: *on line storage providers*; *photoalbum providers; social network providers; on-line printing providers*; *mobile applications providers*; *software vendors providers*; *telco operators providers*; *retailers providers*

As regards the enabling technologies of the Digital Imaging Ecosystem, we identified these categories: *Computational photography, Sensors resolution and*

*quality*, *Still/motion convergence, Barcode / QR Code, RFID / NFC, GPS*, *Wireless / Mobile, Metadata Exif, 3D, Digital pictures and video playback.*

The next step is the construction of the *Connections Matrix* which has the purpose to highlight the links between the constituent parts of the ecosystem. The connection matrix of the Digital Imaging Ecosystem is in Table 3.

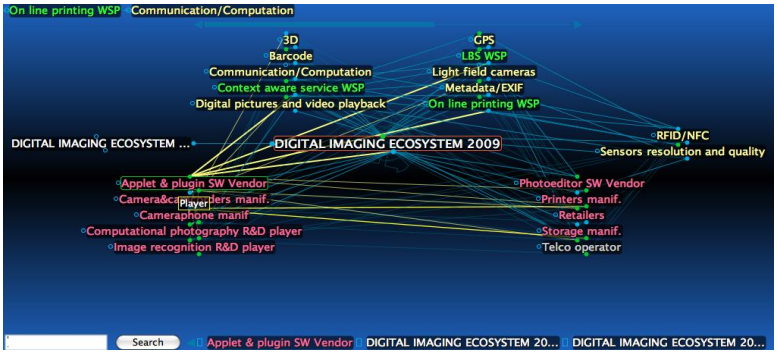


**Fig. 1.** Digital Imaging Ecosystem model representation [screenshot]

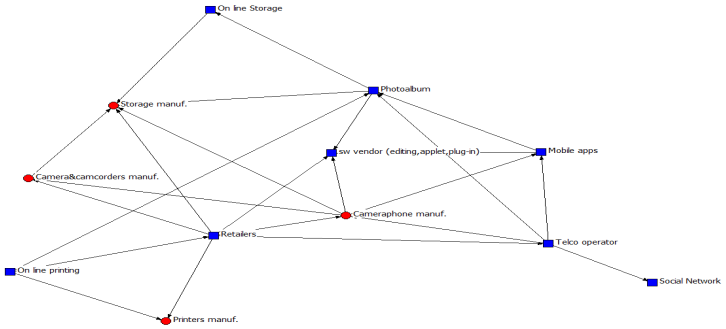


**Fig. 2.** Digital Imaging Ecosystem relationship structure

2-3. ECOSYSTEM MODEL REPRESENTATION and DATA VALIDATION

The objective of this step is to develop a representative model of the ecosystem. For *nodes,* a color code is used to differentiate players who have a different role, and a code volume to differentiate the weight of each actor. A parameter for the weight factor could be the size (turnover, number of employees) where applicable. For *links*, it is necessary to classify the different types of relationships with the criteria used in the connection matrix. See Figure 1.

**Table 3.** Digital Imaging Ecosystem connection matrix

| | MANUFACTURER | | | | SERVICE PROVIDER | | | | | | | | TECHNOLOGY | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Camera&camcorders manuf. | Storage manuf. | Printers manuf. | Cameraphone man | On line Storage | Photoalbum | Social Network | On line printing | Mobile apps | sw vendor (editing,applet,plug-in) | Telco operator | Retailers | Computational photography R&D player | Image recognition R&D player | Sensors resolution and quality | Still/motion convergence | Barcode / QR Code | RFID/NFC | GPS | Wireless/Mobile | Metadata/EXIF | 3D | Digital pictures and video playback |
| Camera&camcorders manuf. | - | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 3 | 1 | 3 | 2 | 3 | 3 | 2 | 2 | 0 | 0 | 2 | 3 | 1 | 1 | 3 |
| Storage manuf. | 1 | - | 1 | 1 | 2 | 2 | 1 | 1 | 0 | 0 | 3 | 2 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 2 |
| Printers manuf. | 2 | 1 | - | 3 | 0 | 1 | 0 | 2 | 0 | 1 | 3 | 2 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 3 | 1 |
| Cameraphone manuf. | 2 | 1 | 3 | - | 1 | 1 | 1 | 3 | 2 | 2 | 2 | 2 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 0 | 3 |
| On line Storage | 1 | 2 | 0 | 1 | - | 2 | 1 | 1 | 1 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 2 |
| Photoalbum | 1 | 2 | 1 | 1 | 2 | - | 2 | 2 | 2 | 2 | 2 | 0 | 0 | 2 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 3 | 1 |
| Social Network | 1 | 1 | 0 | 1 | 1 | 2 | - | 1 | 1 | 3 | 2 | 0 | 0 | 1 | 0 | 3 | 0 | 0 | 1 | 1 | 1 | 3 | 3 |
| On line printing | 1 | 1 | 2 | 3 | 1 | 2 | 1 | - | 3 | 1 | 3 | 2 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 |
| Mobile apps | 3 | 0 | 0 | 2 | 1 | 2 | 1 | 3 | - | 2 | 2 | 0 | 1 | 2 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 3 | 1 |
| Sw vendor | 1 | 0 | 1 | 2 | 0 | 2 | 3 | 1 | 2 | - | 0 | 2 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 |
| Telco operator | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | 2 | 0 | - | 2 | 3 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 1 | 1 |
| Retailers | 2 | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | - | 0 | 0 | 1 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 0 |
| Computational photography R&D player | 3 | 0 | 1 | 3 | 0 | 0 | 0 | 0 | 1 | 1 | 3 | 0 | - | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 1 | 3 | 1 |
| Image recognition R&D player | 3 | 0 | 0 | 3 | 0 | 2 | 1 | 0 | 2 | 1 | 1 | 0 | 2 | - | 1 | 1 | 2 | 3 | 2 | 2 | 1 | 1 | 1 |
| Sensors resolution and quality | 2 | 1 | 1 | 2 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 2 | 1 | - | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 2 |
| Still/motion convergence | 2 | 0 | 0 | 2 | 0 | 1 | 3 | 0 | 0 | 0 | 1 | 0 | 2 | 1 | 1 | - | 0 | 0 | 0 | 0 | 0 | 3 | 2 |
| Barcode / QR Code | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 2 | 0 | 2 | 1 | 0 | - | 1 | 0 | 0 | 0 | 0 | 0 |
| RFID/NFC | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 2 | 0 | 3 | 0 | 0 | 1 | - | 1 | 1 | 1 | 3 | 3 |
| GPS | 2 | 0 | 0 | 2 | 0 | 1 | 1 | 0 | 1 | 1 | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 1 | - | 2 | 2 | 2 | 1 |
| Wireless/Mobile | 3 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 0 | 2 | 0 | 0 | 3 | 0 | 0 | 0 | 1 | 2 | - | 0 | 0 | 2 |
| Metadata/EXIF | 1 | 1 | 0 | 2 | 0 | 1 | 1 | 1 | 1 | 1 | 2 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 2 | 0 | - | 3 | 1 |
| 3D | 1 | 0 | 3 | 0 | 0 | 3 | 3 | 0 | 3 | 1 | 1 | 0 | 3 | 1 | 0 | 3 | 0 | 3 | 2 | 0 | 3 | - | 1 |
| Digital pictures and video playback | 3 | 2 | 1 | 3 | 2 | 1 | 3 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 2 | 2 | 0 | 3 | 1 | 2 | 1 | 1 | - |

4 ECOSYSTEM ANALYSIS The aim of this step is to analyze the behavior of the ecosystem in the past and in the present. This involves understanding how the value is distributed in each ecosystem and the best places to target the positioning strategy to capture part of this available value. This requires two separate steps: *Business Ecosystem Value Analysis* and *Business Ecosystem Control Point Analysis*. See figure 2. The control point analysis identified the pc and the smartphones and mobile applications as control points of the digital imaging ecosystem. They connect and control the ecosystem in two levels of connection: one between creation and storage/modification and one between storage/modification and services (online printing and online storage).

5 ECOSYSTEM EVOLUTION In this step the possible evolutionary scenarios are studied. For the digital imaging ecosystem we built a scenario analysis and a roadmap for future evolution (Battistella and De Toni, 2011).

## 5. Conclusions

As businesses become more and more modularized, characterizing entity relationships and understanding how business decisions or actions taken by one entity impact all of the interrelated entities, both within and among enterprises, become a key challenge. Ignoring these interactions can lead to unexpected and potentially undesirable outcomes. Tools that help to systematically characterize the business ecosystem (or network) and analyze the potential impact of different business decisions on each entity in the network are essential for improving business design.

The knowledge of a phenomenon is the basis of its evolution. The methodology of business ecosystem network analysis (MOBENA) is a first step to build a tool that can facilitate the knowledge about the business ecosystems, with a first improvement toward the standardization of the procedure for different contexts and the reusability of data and information.

## References

synthesises the five phases, giving a brief description of objectives, contents and deliverables.

**Table 2.** MOBENA phases

| PHASE and OBJECTIVES | CONTENT | DELIVERABLE |
|---|---|---|
| **ECOSYSTEM PERIMETER, ELEMENTS AND RELATIONSHIPS**<br>• Define the meaning of the ecosystem, decide what identifies it and identify what defines its boundaries.<br>• Detail the information to be collected as regards the constitutive elements and their relationships. | • Identify the seed – the actors' attractor and the leverage for business.<br>▪ Identify the elements and their connections. Elements: players, technologies, products/services and environment (market, constraints and regulation forces)<br>Players: (1) revenues, employees, EBITDA, investments, cash flow, (stock, trend, cagr, expected trends) (2) share trends, market capitalization (3) geographical presence (4) current market positioning and strategy (5) research strategy<br>Technologies<br>Products/services: (1) service concept (2) biz model (3) economics: users, revenues, margins, Cagr, ARPU<br>Environment<br>Relationships among actors - different kind of flows through the ecosystem: exchanged information<br>Transactions<br>▪ connection matrix: per each couple of variable | *8. TECHNOLOGY WORKBOOK*<br>*9. PLAYERS INFORMATIONS*<br>*10. CONNECTION MATRIX* |

| | | |
|---|---|---|
| | it will be indicated: 0 - no relationship is on 1 - if a link already exists and is intangible, 2 – if a link already exists and is tangible, 3 – if a possible relation can be formed in a near future | |
| **ECOSYSTEM MODEL REPRESENTATION**<br>• Develop a representation model | Translate in a graphical way the connection matrix: oriented graph; links and nodes characterized in a quantitative way; weight to each kind of relationship | *11. ECOSYSTEM REPRESENTATION MODEL* |
| **DATA VALIDATION**<br>• Obtain criteria to validate the model | ▪ Brainstorming; existing literature; research conducted by specialists from reference markets; official documents (budgets, communication to the financial community, business plans, etc.); direct contact with the actors that belong to the potential ecosystem; consulting experts in modeling complex systems | *12. ECOSYSTEM REPRESENTATION MODEL VALIDATED* |
| **ECOSYSTEM ANALYSIS**<br>• Evaluation of the ecosystem's behaviours (last, current, future) and relevant key indicators. | Ecosystem value analysis<br>▪ revenues: quantify the economic dimension of the ecosystem<br>▪ economic structure: understand how this value is shared among the various players: physical structure, revenues attraction, attractivity, relationship, assets & technologies<br>Ecosystem control point analysis<br>▪ identification of control points ("points at which management can be applied" - business strategy, regulation, and/or technology); control points constellation: put control points in a logical sequence, represent integrated control points as joined together; check for lock-in; show multiple offering outcomes if applicable | *13. ECOSYSTEM ANALYSIS* |
| **ECOSYSTEM EVOLUTION**<br>• Simulation of different scenarios aimed to perform what-if analysis, trend analysis, classification, forecasts. | ▪ list of trends and uncertainties; early signs; scenarios graph; scenarios narrative; definition of possible scenarios; list of implications and options of responses | *14. ECOSYSTEM SCENARIOS ANALYSIS* |

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high production-volumes. They are: *camera and camcorders manufacturers*, *storage manufacturers*, *printers manufacturers*, *cameraphone manufacturers*

- Service Providers: their offer is connected to services and not-tangible functionalities for users. They are: *on line storage providers*; *photoalbum providers; social network providers; on-line printing providers*; *mobile applications providers*; *software vendors providers*; *telco operators providers*; *retailers providers*

As regards the enabling technologies of the Digital Imaging Ecosystem, we identified these categories: *Computational photography, Sensors resolution and quality*, *Still/motion convergence, Barcode / QR Code, RFID / NFC, GPS*, *Wireless / Mobile, Metadata Exif, 3D, Digital pictures and video playback.*

The next step is the construction of the *Connections Matrix* which has the purpose to highlight the links between the constituent parts of the ecosystem. The connection matrix of the Digital Imaging Ecosystem is in Table 3.

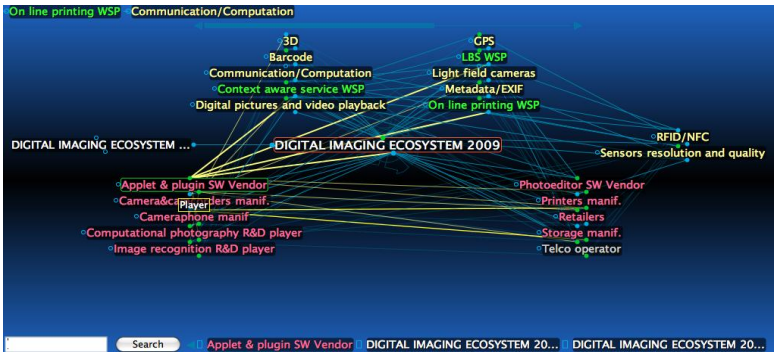


**Fig. 1.** Digital Imaging Ecosystem model representation [screenshot]

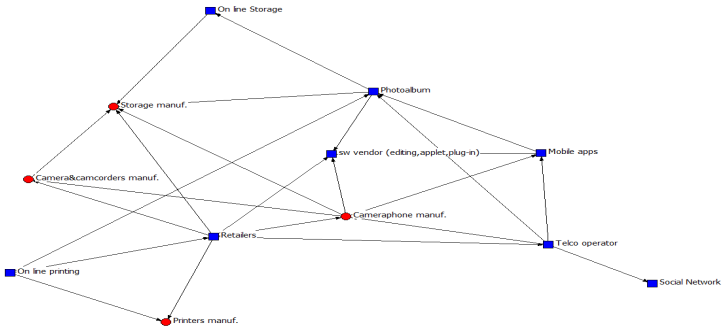


**Fig. 2.** Digital Imaging Ecosystem relationship structure

2-3. ECOSYSTEM MODEL REPRESENTATION and DATA VALIDATION

The objective of this step is to develop a representative model of the ecosystem. For *nodes,* a color code is used to differentiate players who have a different role, and a code volume to differentiate the weight of each actor. A parameter for the weight factor could be the size (turnover, number of employees) where applicable.

For *links*, it is necessary to classify the different types of relationships with the criteria used in the connection matrix. See Figure 1.

**Table 3.** Digital Imaging Ecosystem connection matrix

| | MANUFACTURER | | | | SERVICE PROVIDER | | | | | | | | TECHNOLOGY | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Camera&camcorders manuf. | Storage manuf. | Printers manuf. | Cameraphone man | On line Storage | Photoalbum | Social Network | On line printing | Mobile apps | sw vendor (editing,applet,plug-in) | Telco operator | Retailers | Computational photography R&D player | Image recognition R&D player | Sensors resolution and quality | Still/motion convergence | Barcode / QR Code | RFID/NFC | GPS | Wireless/Mobile | Metadata/EXIF | 3D | Digital pictures and video playback |
| Camera&camcorders manuf. | - | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 3 | 1 | 3 | 2 | 3 | 3 | 2 | 2 | 0 | 0 | 2 | 3 | 1 | 1 | 3 |
| Storage manuf. | 1 | - | 1 | 1 | 2 | 2 | 1 | 1 | 0 | 0 | 3 | 2 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 2 |
| Printers manuf. | 2 | 1 | - | 3 | 0 | 1 | 0 | 2 | 0 | 1 | 3 | 2 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 3 | 1 |
| Cameraphone manuf. | 2 | 1 | 3 | - | 1 | 1 | 1 | 3 | 2 | 2 | 2 | 2 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 0 | 3 |
| On line Storage | 1 | 2 | 0 | 1 | - | 2 | 1 | 1 | 1 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 2 |
| Photoalbum | 1 | 2 | 1 | 1 | 2 | - | 2 | 2 | 2 | 2 | 2 | 0 | 0 | 2 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 3 | 1 |
| Social Network | 1 | 1 | 0 | 1 | 1 | 2 | - | 1 | 1 | 3 | 2 | 0 | 0 | 1 | 0 | 3 | 0 | 0 | 1 | 1 | 1 | 3 | 3 |
| On line printing | 1 | 1 | 2 | 3 | 1 | 2 | 1 | - | 3 | 1 | 3 | 2 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 |
| Mobile apps | 3 | 0 | 0 | 2 | 1 | 2 | 1 | 3 | - | 2 | 2 | 0 | 1 | 2 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 3 | 1 |
| Sw vendor | 1 | 0 | 1 | 2 | 0 | 2 | 3 | 1 | 2 | - | 0 | 2 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 |
| Telco operator | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | 2 | 0 | - | 2 | 3 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 1 | 1 |
| Retailers | 2 | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | - | 0 | 0 | 1 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 0 |
| Computational photography R&D player | 3 | 0 | 1 | 3 | 0 | 0 | 0 | 0 | 1 | 1 | 3 | 0 | - | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 1 | 3 | 1 |
| Image recognition R&D player | 3 | 0 | 0 | 3 | 0 | 2 | 1 | 0 | 2 | 1 | 1 | 0 | 2 | - | 1 | 1 | 2 | 3 | 2 | 2 | 1 | 1 | 1 |
| Sensors resolution and quality | 2 | 1 | 1 | 2 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 2 | 1 | - | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 2 |
| Still/motion convergence | 2 | 0 | 0 | 2 | 0 | 1 | 3 | 0 | 0 | 0 | 1 | 0 | 2 | 1 | 1 | - | 0 | 0 | 0 | 0 | 0 | 3 | 2 |
| Barcode / QR Code | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 2 | 0 | 2 | 1 | 0 | - | 1 | 0 | 0 | 0 | 0 | 0 |
| RFID/NFC | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 2 | 0 | 3 | 0 | 0 | 1 | - | 1 | 1 | 1 | 3 | 3 |
| GPS | 2 | 0 | 0 | 2 | 0 | 1 | 1 | 0 | 1 | 1 | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 1 | - | 2 | 2 | 2 | 1 |
| Wireless/Mobile | 3 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 0 | 2 | 0 | 0 | 3 | 0 | 0 | 0 | 1 | 2 | - | 0 | 0 | 2 |
| Metadata/EXIF | 1 | 1 | 0 | 2 | 0 | 1 | 1 | 1 | 1 | 1 | 2 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 2 | 0 | - | 3 | 1 |
| 3D | 1 | 0 | 3 | 0 | 0 | 3 | 3 | 0 | 3 | 1 | 1 | 0 | 3 | 1 | 0 | 3 | 0 | 3 | 2 | 0 | 3 | - | 1 |
| Digital pictures and video playback | 3 | 2 | 1 | 3 | 2 | 1 | 3 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 2 | 2 | 0 | 3 | 1 | 2 | 1 | 1 | - |

4 ECOSYSTEM ANALYSIS The aim of this step is to analyze the behavior of the ecosystem in the past and in the present. This involves understanding how the value is distributed in each ecosystem and the best places to target the positioning strategy to capture part of this available value. This requires two separate steps: *Business Ecosystem Value Analysis* and *Business Ecosystem Control Point Analysis.* See figure 2. The control point analysis identified the pc and the smartphones

and mobile applications as control points of the digital imaging ecosystem. They connect and control the ecosystem in two levels of connection: one between creation and storage/modification and one between storage/modification and services (online printing and online storage).
5 ECOSYSTEM EVOLUTION In this step the possible evolutionary scenarios are studied. For the digital imaging ecosystem we built a scenario analysis and a roadmap for future evolution (Battistella and De Toni, 2011).

## 5. Conclusions

As businesses become more and more modularized, characterizing entity relationships and understanding how business decisions or actions taken by one entity impact all of the interrelated entities, both within and among enterprises, become a key challenge. Ignoring these interactions can lead to unexpected and potentially undesirable outcomes. Tools that help to systematically characterize the business ecosystem (or network) and analyze the potential impact of different business decisions on each entity in the network are essential for improving business design.

The knowledge of a phenomenon is the basis of its evolution. The methodology of business ecosystem network analysis (MOBENA) is a first step to build a tool that can facilitate the knowledge about the business ecosystems, with a first improvement toward the standardization of the procedure for different contexts and the reusability of data and information.

## References

Examples of Digital Imaging ecosystem are taken from an other workgroup in Telecom Italia Future Centre led by G. Piersantelli, http://www.telecomfuturecentre.it/ecosistemi/foto_digitale.shtml

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