Insights and Challenges about the use of VNA on Airport/Hinterland Linkages

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Abstract: Airport operators, planners and regulatory agencies to measure the economic contribution of an airport to its local and regional surroundings, frequently use economic impact studies. The most common methods to measure airport economic impacts have been the Input-Output method, the Collection of Benefits method and most recently the Catalytic method. The most used measured variables include employment, wages, local and regional spending and air traffic levels. This paper is a new approach to these impact studies in which is used a new tool to identify the added values generated within airports and surrounding community interactions to better catch real socio-economic impacts. The VNA – Value Network Analysis, is used as an integrated methodology to identify these interactions and added values generated (tangibles and intangibles) in the business system of landside airports. To define the system it is used the matrix key airport performance benchmarking areas of ACI (Airport Council International) that are in the range of landside of the airport.

Key words: Social Networks, Airport Landside, Value Network Analysis, Key Performance Indicators, Business System.

1. Introduction

In the context of the AIRDEV[2] project it's under discussion how the airport's interactions with the surroundings generates value, in order to determine the real socio-economic impacts and identify new business opportunities.

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As we know, air transport sector has been undergoing profound changes over the recent decades. Terrorism, political instability, price of oil, worldwide financial crises among others, drive the sector to turmoil. The airport business system has not been left untouched by these changing waves: many airport infrastructures have been privatised, while others remain under public control that have commercial purposes, either by specialization either by diversifying their different business models. These different business models have reviled quite profitable but only for those airports that are above certain annual traffic threshold; for the small airports the public funding supports is needed in order to survive.

The profits of airlines have been in a continua's degradation and many airports are trying to find an alternative sources of revenue areas like retail centres, logistics areas, business centres, etc., becoming truly multi-business, multi-activities and converging towards the concept of Airport City. In some cases the airline revenue count as low as 30% on total revenues.

According to several studies it is possible to benchmark an airport through the movements, passenger and cargo, which are the most known and shared key performance indicators. In line with those studies, Braz *et al.* (2011) create a ranking between the airports (Iberian Airports Case Study), applying a new method of MCDA – Macbeth. But this kind of key performance indicators and rankings arise some questions: can it be said that with this ranking it's possible to associate the biggest creation of value? The first in the ranking is the one that generates the biggest value generation in the hinterland? Is the number one in the ranking the one that creates the biggest economic impact? How far the dimension of an airport determines the kinds of business? How an airport develops the networks with the hinterland to create value? These are the major questions to be answered by the AIRDEV project.

On the context of this paper, the aim is to use the existing key performance indicators proposed by ACI (2006) but grouping them accordingly to a model we propose which intends to understand and access the dynamics of the airport landside with the hinterland. The model proposed is the BSALA (Business Systems for Airport Landside Areas) and the methodology

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used to understand and access the dynamics of the airport landside with the hinterland is the Value Network Analysis (VNA).

This paper is structured as followed, first we will define the concepts of network in chapter 2, by explaining the advantages and disadvantages for the social network concept and the new approach to overcome the limitations in the social network analysis with the value network analysis methodology. We will analyse, in chapter 3 the VNA with the Airport Landside Areas and create the business system for airport landside areas. The challenges and the insights of the VNA tool are discussed in chapter 4, and in chapter 5 are pointed some conclusions and references to future work.

2. Some theoretical and methodological approaches: from SNA to VNA.

2.1. SNA – Social Network Analysis

The concept of network is being used in scientific literature in two directions (Romeiro, 2007), particularly relevant in the context of this paper. As a 1) fundamental architecture for the economic, social and institutional organization: in this context a network represents an organizational structure comprised of independent elements that establish relations between them for medium-long term, based on the will of the elements to work together around common objectives, which could not be achieved in the same way through individual work (Vernon, 2005); and as a 2) explanatory principle of complex realities structure: in this sense the concept of network refers to a set of actors (individuals, institutions or organizations) bound by a set of social relations of a certain type (friendship, business or other), (Gulati, 1998). Therefore, the social network can be viewed as a series of links that are established between a defined set of social actors (Requena, 1989; Powell and Smith-Doer, 1994).

Both perspectives of analysis are important for this research. While organizational structure the concept of network is understood as a structure between the market and the hierarchy, formed by more than two organizations (corporate, public organization, association, university, among others) who decide, formally or informally, initiate cooperation in the medium term involving the exchange of resources (material or immaterial). The network is established under the premise that all organizations within a network are interdependent, meaning that the behaviour of one organization affects and is affected by the behaviour of the others organizations. This design points out explicitly the components of a network - a set of

actors and a set of relations, whose structure can be systematized and analyzed through the Social Networks Analysis (SNA).

One of the fundamental goals of SNA is to identify the players that, in some way, stand out or are prominent in the social structure (network). This appeals for two aspects: power and prestige of those players, which can be evaluated through the property of centrality of the network (power) and through the concept of indegree among others (prestige). The degree is one of the most basic measures of centrality and power of a node: the greater the number of relationships it establishes or others establish with it, the more power it accumulates and gets over the other nodes, in relative terms. Similarly, the more relationships it has with others nodes, more alternatives have to choose their relations, thus providing for more autonomy.

In short, the SNA approach as well the set of indicators and techniques nowadays at our disposal allows to analyse the patterns of relations, which occur among distinct elements (nodes). Through the SNA is possible to analyse the relations established among the distinct actors in order to identify the structured patterns of the network as an whole and also to interpret the differences among actors in terms of opportunities or constraints which derive from their position in the network.

Thus, applications of Social Network Analysis (SNA), have increasingly been expanding to the business world, whether at the level of organizational performance and/or strategic alliances (Cross and Parker, 2003; Dawson 2003; Iansiti and Levien, 2004; Anklam 2007; Basol and Rouse 2008; all cited by Allee (2009). However some inherent limitations of SNA have been limited that progress (Allee, 2009):

- Although SNA provides a structural analysis of the network linkages does not directly address economic or social value creation and outputs;
- Remains to be demonstrated adequately the empirical link between organizational structure and performance of companies;
- The links defined in a social network are of the same nature and only one link is represented among actors. When there are multiple variables and unique features, it becomes necessary to build separate networks for each different type of social or economic exchanges between players, which turns the analysis very weighty;

- Due to the high level of technical expertise needed to analyze and interpret the patterns of the network, the use of SNA as a management tool is limited.

2.2.VNA – Value Network Analysis

To overcome these limitations Allee (2008) proposed a network methodology that allows measuring the value creation of networks. According to this author (op.cit., 2008:2) *(...) because the network is the primary economic mechanism for value conversion, network analysis can be used to describe the value creation dynamics of work groups, organizations, business webs, and purposeful networks engaging in both tangible and intangible value exchanges to support the achievement of specific outcomes and to generate economic and social good (MacCauley, 1963; Granovetter and Swedberg, 2001; Allee, 2002, 2003).*

The term value network is being adopted in general business practice, primarily in regard to industry value networks, but also in regard to business webs. According to Allee (2008) value network is any set of roles and interactions in which people engage in both tangible and intangible exchanges to achieve economic or social good. It comprises, a) internal value networks focused on the sets of relationships between individuals, within and among work groups and between and among the various work groups that make up the organization; and b) external-facing value networks, which comprise those between the organization and its suppliers, its investors, its strategic business partners, and its customers.

Another related concept is value conversion, which refers to the act of converting or transforming financial to non-financial value or transforming an intangible input or asset into a financial value or asset. When considering value conversion, it is necessary to assess the inputs and outputs for each role in the network to determine whether value conversion opportunities are being overlooked. Also the network is a value conversion mechanism that achieves not only positive goods and outcomes, but nefarious and negatives ones as well, according to the values and intent of those who serve the network. Based on these concepts, Allee (2008) proposed a methodology called Value Network Analysis (VNA) which provides a network ecosystem perspective into how processes and people create value.

This methodology presents several advantages in comparison with the traditional SNA Allee (2008):

- It shows both structured relationships and the informal yet essential flow paths of knowledge sharing and support;
- Provides a perspective for understanding value creating roles and relationships, both internal and external, upon which an organization depends;
- Offers dynamic views of how both financial and non-financial assets can be converted into negotiable forms of value that have a positive impact on those relationships;
- Explains how to more effectively realize value for each role and how to utilize tangible and intangible assets for value creation;
- Provides a systematic analysis of how one type of value is converted into another.

Value Network Analysis includes a set of indicators developed along four dimensions: business performance, value optimization, network vitality and brand relationships, as shown in Figure 1.

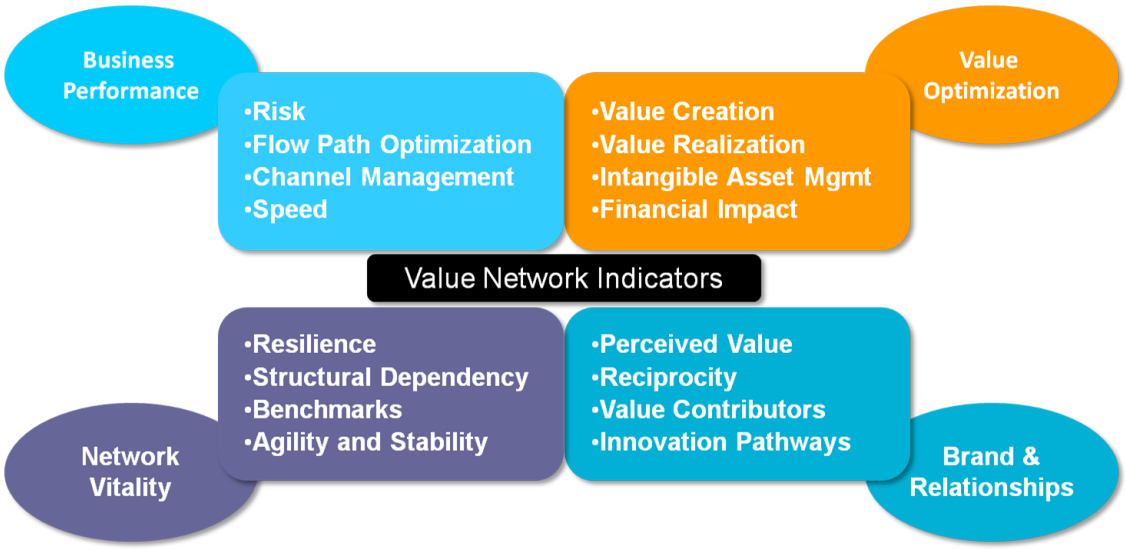

Figure 1. Value Network Indicators (ValueNetworks.com, 2009)

These value network indicators refer to the main characteristics of relationships and to the (positive or negative) value resulting from them, and include:

- Resilience, which requires the right balance of formal structure to informal knowledge sharing;

- Value Creation indicators, that show the capacity for each role to generate both tangible and intangible value;
- Perceived Value (Brand), that assesses the level of value roles.
- Asset Impact indicators, used to consider which assets are most affected by the network behaviour as a whole and by the actions of specific roles;
- Reciprocity indicators, which can point to a more hierarchical structure or show instability;
- Structural Dependency and Risk indicators, include role centrality. In VNA high centrality for any one role may actually be a risk factor for the network – or certain patterns of clustering may serve the overall value creation dynamics in unique ways;
- Structure and Value relationships revealed by incoming and outgoing deliverables for each role;
- Agility depends which on how quickly information can move around the network and how easy it is for any individual to reach the person who might be able to solve a specific problem;
- Stability, revealed by measures of network Density, the overall connectedness of the network.

3. Value Network Analysis and Airport Landside Areas

3.1. Introduction

Airports clearly recognise the value of benchmarking. In a globally competitive environment, benchmarking is a widely accepted mean to analyse business performance against objectives and to evaluate achievements relative to peer performance. Airports worldwide have adopted financial and quality of service benchmarking as a management tool to enhance efficiency, improve service and drive down costs. ACI (2006), provides background on airport benchmarking, including results of a recent questionnaire completed by ACI members, and describes a number of initiatives underway in ACI's regions. At the same time, airport operators recognise that benchmarking is not an exact science, as differing physical characteristics of airports, varying ownership and regulatory frameworks and disparate business models can all distort comparisons. ACI encourages its members to participate in benchmarking studies, yet points out the potential pitfalls that can occur either through flawed methodology or the difficulty of comparing some parameters across airports. For example,

many attempts to calculate productivity of airport company employees have been rendered inaccurate because of the failure to take into account the impact of outsourcing of key airport functions (ACI, 2006).

3.2. Benchmarking

There are in principle three quantitative methods that can be applied in the productivity and efficiency analysis among government enterprises, which are: Non-parametric index number approaches to measure the total factor productivity (TFP); Parametric (econometric) analyses such as Stochastic Frontier Analysis (SFA); and Non-parametric linear programming approaches as Data Envelopment Analysis (DEA). All methodologies are substantially different in its model specification and data requirements and might consequently lead to different results.

To better understand how an infrastructure like an airport it's behaving the methods most common to benchmark its key performance indicators, are Data Envelopment Analysis (DEA) to benchmark the operating efficiency; Data Envelopment Analysis (DEA) that is a nonparametric method in operations research and economics for the estimation of production frontiers. It is used to empirically measure productive efficiency of decision-making units (or DMUs). Non-parametric approaches have the benefit of not assuming a particular functional form/shape for the frontier; however they do not provide a general relationship (equation) relating output and input. There are also parametric approaches, which are used for the estimation of production frontiers (see Lovell & Schmidt 1988 for an early survey)[3]*. These require that the shape of the frontier be guessed beforehand by specifying a particular function relating output to input. One can also combine the relative strengths from each of these approaches in a hybrid method (Tofallis, 2001)*[3] *where the frontier units are first identified by DEA and then a smooth surface is fitted to these. This allows a best-practice relationship between multiple outputs and multiple inputs to be estimated.*

Another method is Multi-Criteria Decision Analysis (MCDA) unlike methods that assume the availability of measurements; measurements in MCDA are derived or interpreted subjectively as indicators of the strength of various preferences. Preferences differ from decision maker to

[3] In: http://en.wikipedia.org/wiki/Data_envelopment_analysis.

decision maker, so the outcome depends on who is taking the decision and what are their goals and preferences (Saaty, 2005). A different ranking is obtained by attribution of levels of importance by the decision maker in the key performance indicators (Braz *et al.*, 2011).

This kind of analysis ranks the airports by its key performance indicators but doesn't tell us what are the economic impacts of one or another airport; and can we say that if we want a hub we just build a big airport exactly like the one that ranks first in the benchmark? It is necessary evaluating all the surrounding of the airport and see how it links to the hinterland to have a perception of the economic impact that some kind of airport will have in a region.

In the 1990's, with evolving business management theories and approaches (management-by objectives, total quality management, re-engineering, and performance management) and heightened market competition, came the need for businesses and organisations to be more strategically driven and efficient. Since corporate culture and performance are inextricably linked, management teams were driven to reform their organisation's culture and practices to meet these new challenges. Benchmarking became a powerful management tool to assist in identifying new approaches for increasing efficiency and for continuously monitoring on-going strategic success. Applied properly, benchmarking can help reinforce an organisation's vision, mission, and strategies, as well as help create a new corporate *esprit de corps* by building employee focus, competencies and morale. Airport benchmarking is a component of an airport's strategic planning process. It is a statistical and accounting process that is used to monitor and compare airport economic, operational and service performance. Benchmarking assesses the implementation of an airport's strategic planning objectives to measure the performance of discrete airport functions and identifies best practices for possible incorporation into the organisation's procedures to increase efficiency, quality and customer satisfaction. Thus benchmarking links day-to-day operations and management with an airport's short and long-term strategic initiatives and action plans (ACI, 2006).

3.3. Key Performance Indicators

The starting point for efficiency measurement is the definition of the appropriate key performance indicators (KPIs) or metrics.

Using productivity as an example, in a human resource intensive operation or process the input is a measure of the staff deployed, e.g. the number of air traffic controllers or security agents on duty each hour. This is particularly dependent on the fostering process.

The definition of the system is taken using the Matrix of Key Airport Performance Benchmarking Areas (ACI, 2006) thus, this matrix groups measurable parameters according to the area of airport activity: physical facilities; airfield, aircraft, terminal passenger and landside transportation processing efficiency; airfield aeronautical charges; terminal aeronautical related charges; terminal non-aeronautical concession revenues; landside non-aeronautical revenues; operating and maintenance costs; other financial including liquidity, debt, profits, asset and capital expenditures; quality of community airline service; and quality of airport facility and services as measured by passenger satisfaction.

If it's considered the landside of the airport to structure the BSALA model for the business system that we propose in Figure 2, we have these groups of parameters:

- **Aeronautical Related Charges – Terminal**
  Ticket counter space, boarding gates and loading bridges, administrative office space, flight kitchens and services, baggage processing/handling, passenger lounges, FIS, BIDS and CUTE fees;

- **Revenues – Terminal**
  Retail/specialty retail, food/beverage, news/gifts, duty free/tax free, advertising, hotels;

- **Non-Aeronautical Concession Revenues – Landside**
  Parking, rental cars, taxis, buses, limos, rail and train stations, other commercial vehicles, hotels, conference centres, office buildings, shopping centres;

- **Operating and Maintenance Costs**
  Personnel costs (salaries and benefits), soft costs/outsourcing, supplies and materials, repairs and maintenance, communications and utilities costs, law enforcement and fire fighting costs, other operating costs;

- **Other Financial**

  Other non-operating revenues, cash flow and liquidity, debt (bonds and loans), return on equity and assets, EBITA and net profit, capital expenditures and costs (actual and projected).

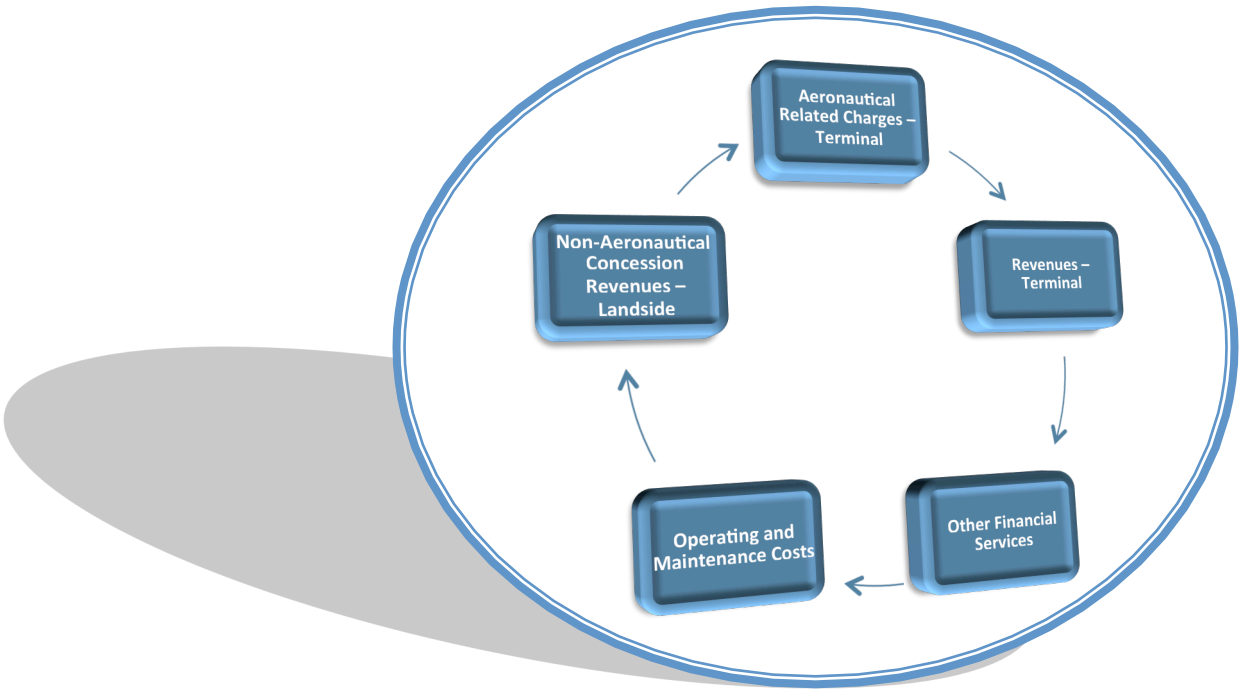

Figure 2. BSALA - Business Systems for Airport Landside Areas (Authors)

3.4. VNA vs Airport Landside

The adequacy of any method (traditional or not) to measure impacts depends on the understanding of the complex roles and spatial interactions actually associated with a given system. The same is true when the goal is not the metric of the impacts but instead majoring the opportunities associated with that system. Some studies applied value network analysis to several areas but none concerning the application of this methodology to BSALA - Business Systems for Airport Landside Areas, (Figure 2) as far as we know. Since we argue along this paper that networks are fundamental instruments for the development of this domain of activity, in this section we explore how this methodology can be adopted in order to achieve *(...) a more economically efficient, aesthetically pleasing, and socially and environmentally sustainable (...)* development (Kasarda, 2010). Considering, as we argued before, that Business Systems for Airport Landside Areas has to be considered in a global base, we agree with Stevens *et al.* (2007) that the list of system impacts further than the system boundaries

has grown through time, but treatments have remained highly specialized and contained within disciplinary paradigms. Even the empirical analysis has been generally limited to the evaluation of the isolated components of a complex system.

These facts call for refreshed conceptual frameworks for better understanding Business Systems for Airport Landside Areas opportunities and constrains and at the same time for integrative models that allow recognizing and understanding the nature and importance of international, national, regional and local drivers for the airport industry growth and the need for sustainable balanced development.

Thus, based in Stevens *et al.* (2007) model we propose one model (Figure 3) which draws on the meta-concept of interfaces of *Business Systems for Airport Landside Areas* as an organizing tool for better understand the complexity and planning aspects of airport activities.

The model defines four interrelated interface domains, which we assume that strengthen the long-term sustainability airport business activities in a territory:

- Economic Development of the territory as a result of airport activities. For all stakeholders it is important to be acquainted with and understand the sort of financial and social economic impacts of their activities and ensure that opportunities for regional, national and international benefit are maximized;
- Land Use, is related with the geographical/geophysical resources of the region, and has both social and biophysical environmental impacts. These impacts can be best managed if the planning schemes and strategies incorporate development trends, existing land use patterns, land characteristics, identified human and physical characteristics of the land, and desired and possible future uses. The compatibility between individual intentions of land use and collective land use planning beyond is a fundamental must;
- Infrastructure includes large-scale installations that connect and service commercial, industrial, residential and cultural nodes of the region. Typical elements are roads, railways, utilities, ports, other airports, freight and service interchanges, and information and communication technology (ICT). They are fundamental for the airport systems efficiency and development capacity, but must be balanced ensuring that regional connections are not made at the expense of local connectivity;

- Governance refers to the legislative arrangements and institutionalized processes that have been designed or have evolved to guide the social structures and behaviours of individuals and organizations. Governance may also be recognized as the function or administering of policy and actions of all kinds, often relating to decisions made.

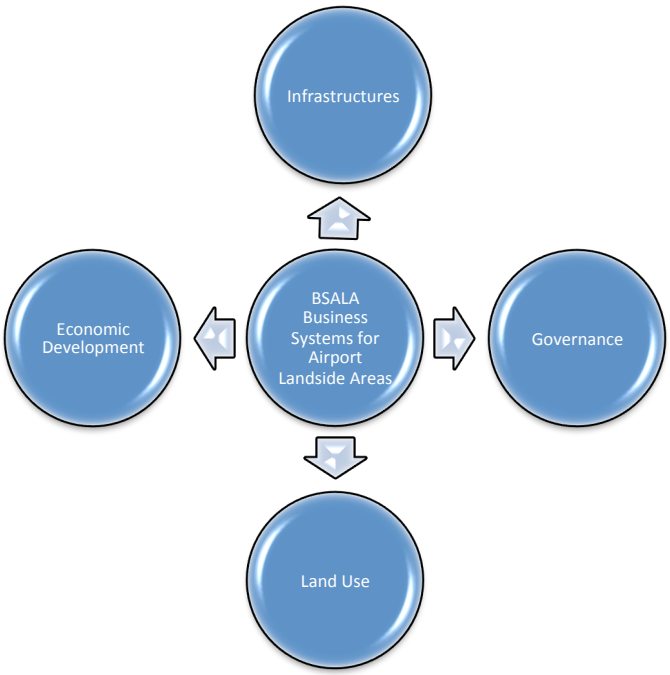

Figure 3. Business Systems of Landside Areas of an Airport Interface Model (Stevens *et al.,* 2007)

This model is essentially an organizing tool that allows identifying key policy areas for improved integrated decision-making and is a conceptual framework for future research. The application of VNA methodology also allows the recognition and examination of the relationships between, and impacts of, multiple systems, thus avoiding continuing the ad-hoc compartmentalized analysis of issues. This means that to understand the role that Business Systems of Airport Landside Areas plays in the regional development, not only a variety of relationships need to be recognized, but also how do they create or may create value.

4. VNA: Insights and Challenges

Applying the Value Network Analysis (VNA) to this interface model turns possible:

- Identifying organizations that would benefit from a tighter integration into the all system and at each sub-system (dimensions);
- Identifying *white spaces* in the system that will give rise to new offerings that compete with or complement their own organization's products and/or services;
- Gaining insights into market dynamics;
- Identifying business development opportunities;
- Extending the penetration of products and services into horizontal and vertical supply chains;
- Developing explicit sales and branding strategies;
- Understanding what alliances (potentially) exist in an ecosystem.

Three final perspectives of importance emerge from specifically applying value network indicators and metrics to airports business systems as value network indicators provide the ability to:

- Benchmark airports over time to understand network behaviour's and cycles;
- Predict the impact of outlying influencers such as regulators on the network; and
- Justify the development of unique value propositions for business and territory development that are centred around *integration* of the ecosystem based on a whole systems view.

The value networks for business development managers it's a tool in VNA that makes possible finding new opportunities in a business ecosystem. Business environments can be best understood as ecosystems consisting of interacting roles and exchanges focused on an industry segment.

The key challenge for business development managers from an ecosystem perspective are: identifying a) organizations that would benefit from a tighter integration into the system, and b) *white spaces* in the system that will give rise to new offerings that compete with or complement their own organization´s products and/or services. In both cases the VNA methodology supports identifying and leveraging such opportunities, when combined with web crawl technologies and organizational information available in online databases. (ValueNetworks.com, 2009).

5. Conclusions

Throughout this work we showed how we could define the network for airports business systems and suggested a model with which we could apply VNA analysis. Following (Allee, 2008) it is the only network analysis method that can link directly to financial and non-financial scorecards, including industry, society, and the environment, which are embedded in the value network data model.

Provides a powerful network ecosystem perspective into how processes and people create value and it shows both structured relationships and the informal yet essential flow paths of knowledge sharing and support. Also it fills the analytical and managerial gap between other business tools and it complements more traditional social network analysis; further more it contributes to tangible and intangible asset management and helps to optimize resources.

Using benchmarks and the appropriated key performance indicators a model of the interface business systems of airport landside to its hinterland is suggested to apply to the value networks analysis methodology.

Further work is needed to understand the role that Business Systems of Airport Landside Areas play in the regional development. To achieve that, not only a variety of relationships need to be recognized, but also how they do create or may create value.

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