



E-STRATEGY FORMULATION: A NEW APPROACH BASED ON A LAYERED MODEL

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ABSTRACT

E-Strategy is the process used to evaluate and develop the Information and Communication Technologies (ICT) integration in a country. This process is composed of three phases: the diagnostic phase named e-Readiness is used to evaluate the ICT infrastructure and its use in a country, e-Strategy formulation phase carries out the definition of how to develop the e-Readiness of the country, the implementation of this e-Strategy is the third phase of the process. Several approaches are used for e-Readiness but the lack of indicators measures (data) limits its development. Also, there is a lack of e-Strategy formulation approaches. We propose in this paper: 1) a new classification of the e-Readiness indicators inspired from the IS (Information Systems) urbanization model; 2) a mathematical model based on this new classification with the aim to cover some of standard approaches limits. This model should lead to a framework for the formulation of the e-Strategy and present a state model that can use the data analysis tools for dynamic systems like filtering mechanisms to cover the lack of data problem.

Keywords: *E-Readiness – E-Strategy – Urbanization – Impactability – State model.*

1. INTRODUCTION

The new revolution that is ICT's one is an opportunity for all countries to achieve rapid social-economic and human development and adjust their world development ranking. The 21st century is driven by the available and accessible information. Thus, for the coming decades, importance and prosperity of countries will be very correlated to its « digital » level: the ICT use in common citizen life (human and companies). In fact, every country have to adopt an e-Strategy as its specific strategy for ICT development.

On another hand, further to the increasing complexity of the components of IS (Information Systems) and its involvement in all business units and processes, it became imperative to adopt a strategy to ensure the continuity and evolution of the IS in the context of the overall strategy of the company.

Thus, the e-Strategy concept is born alongside the IS urbanization concept development.

The aim of the present paper is to present new concepts that can cover two main limits of the actual e-Strategy approaches: How to make e-Readiness assessment follow up easier and how to build up an e-strategy based on the e-Readiness assessment. Thus, continuing our work on the analogy between IS urbanization concepts and e-Strategy's ones, we propose to exploit the urbanization approaches based on IS layers to introduce a new approach for e-Readiness indicators treatment and classification. The first chapter is a brief state of the art of e-Readiness and e-Strategy focusing on some limits of the actual approaches; then, we present the use of layers in IS urbanization; in the third chapter, we present our new approach for the e-Strategy: first we propose a new indicators classification based on a layered

model and then we propose a state model of the indicators vector.

2. E-STRATEGY: STATE OF THE ART

Since the end of last century, developed countries have realized the importance of establishing a coherent and integrated strategy for developing and integrating new technologies in all areas of civil and economic life. "The digital revolution" had to be harnessed and exploited to consolidate the economic power and human development of countries.

Thus, these countries have adopted a process of integration of e-Strategy through three phases [1]:

1. E-Readiness assessment,
2. E-Strategy: the definition of strategic axes in light of the e-Readiness assessment,
3. Implementation: implementation of the strategy adopted by the various stakeholders (government, major NGOs, major economic institutions ...).

We present below a brief state of the art of the two first phases that are in the scope of this paper.

2.1. E-Readiness

Several definitions of the e-Readiness emerged since the late 90s. All these definitions tend to consider and measure aspects of Availability - Use of new information technologies and communications (ICT) [2].

Thus, the e-Readiness definition we retain is that of the Economist Intelligence Unit, which conducts one of the main initiatives published of annual e-Readiness rankings.

Definition: "The e-Readiness is the measure of the quality of ICT infrastructure of a country and the capacity of civilian actors, economic actors and government to use the ICT to their benefit." [9].

During the last decade, several approaches for measuring the e-Readiness were born. For these approaches, the calculation of the e-Readiness index is the application of a model (set of defined mathematical functions) on a set of indicators measured. Each indicator is a quantitative or qualitative aspect that may impact the use of ICT in the country [2],[8],[9],[20],[21],[22],[23].

Indeed, the set of indicators is structured on a sectoral basis through major axes that include

categories and sub-categories and so on (Figure 1). The number of levels of the sectoral tree differs from an approach to another.

The value of each element of the indicators tree is calculated using a weighted average of its children nodes. Gradually, the e-Readiness index is the weighted average of the axes values.

A list of the main used approaches is in Appendix 1. Appendix 2 contains the set of indicators used in the context of the i2010 initiative of the European Union [20].

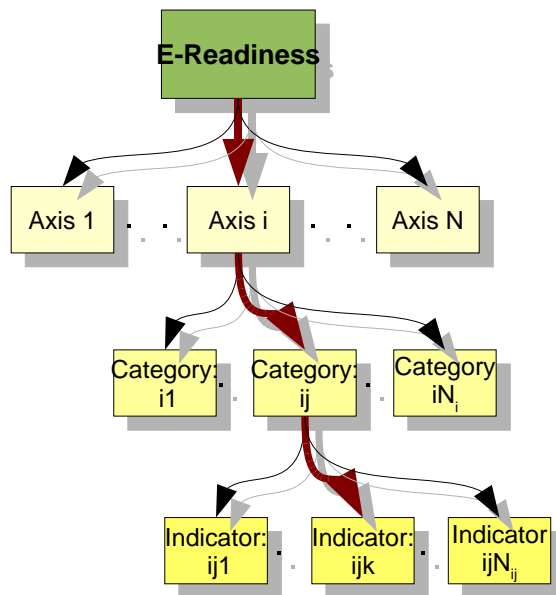


Figure 1 : E-Readiness indicators classification

A state of the art based on the references cited in this article lead us to cite the following weaknesses in existing approaches:

- These approaches are static and do not adapt to the specificity of each country.
- No assistance is available for the adoption of best fit APPROACH - COUNTRY STUDIED regarding the choice of indicators of different axes and their weight. For non-developed countries, the choice of the approach is often based on availability and ease of access to models.
- Finally, the calculation of the e-Readiness index is based on the availability of statistical information and measures of used indicators. These statistics and measures are

cruelly lacking in the undeveloped countries. Getting these statistics periodically and synchronized is unrealistic for these countries. Even developed countries have difficulties to collect this data. [2],[3],[7],[8],[20],[21],[22].

Thus, it is very important to provide mechanisms to help countries taking advantage of e-Readiness and e-Strategy by exploiting the minimum available data and using a practical approach for the definition of the e-Strategy according to their own specificity.

2.2. E-Strategy formulation

The definition phase of the e-Strategy is the stage of drafting the strategy and programs based upon concrete action plans for improving the various indicators.

Indeed, the growth objectives are defined in the light of the analysis of the current e-Readiness and goals and general strategies of major stakeholders in the studied country (Exp: government, civil society, ...).Also, the strategy for achieving these objectives will be defined as part of the overall strategy of the different stakeholders.

We note the lack of an assistance module for the definition of the e-Strategy in the light of the readiness assessment analysis. [1], [2], [3], [10], [11],[25],[35].

As a first step in addressing this limitation, a new general conception of the e-Strategy inspired from the general conception of the IS urbanization was proposed in [3] (figure 2):

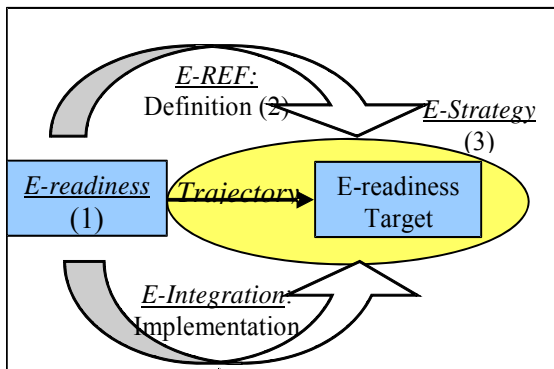


Figure 2: e-Strategy : General concept
The E-REF is a set of rules to observe for the construction of the e-Strategy. It includes, inter-alia, the guide lines of the country's overall strategy, standards, best practices, etc.

Thus, in this paper, we propose an approach to support the definition of e-Strategy. This approach is inspired by approaches used in the definition and implementation of the architecture and urbanization of information system ("Master Plan").

3. MASTER PLAN OF INFORMATION SYSTEMS: LAYERS APPROACHES

The 21st century Companies' development is based on the ability of their information systems to adapt to changes and growth of their scope of products and markets. In fact, the last global crisis has shown that radical changes can be abrupt and flexibility of the IS is essential for the support of management in their decisions to adapt the corporate strategy in response to these changes.

In this context, we adopt the following proposal: "The urbanization of IS is to develop a general plan and construction rules for simplifying and guiding the change management" [4]. This makes the IS more able to serve the corporate strategy.

To this end, according to [4], the urbanization of IS is based on two major principles:

1. IS layers model,
2. Approaches for the definition of the master plan,

The model bellow (Figure 3) decomposes the IS into four layers driven by three major factors: Company's strategy, the company standards, repositories and management rules and technological innovations [4].

With this layered model, the urbanization of IS adopts a multi-phase approach to specify the master plan (Target and path). In fact, two approaches are identified:

Top-down approach : this approach identifies the target layer, then, find out the operations to be conducted on the layer below, and repeat the process to find the layer that needs no change to support the previous layers.

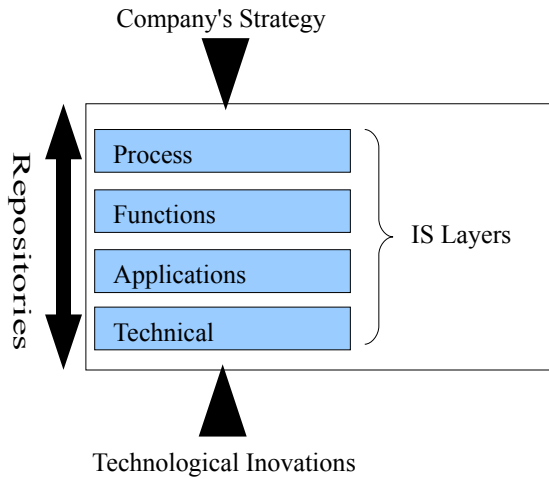


Figure 3: IS Urbanization: Layers Model

Bottom-Up approach : This approach represents the opposite of the top-down approach. This approach can be based on the strengths of IS to provide new targets that may produce an important added value without significant investment. This approach makes the IS creating added value and impacting the company's strategy.

Using these two approaches, we can extract the layered dashboard of necessary urbanization acts. The dashboard can be declined as below (Figure4 – [4]):

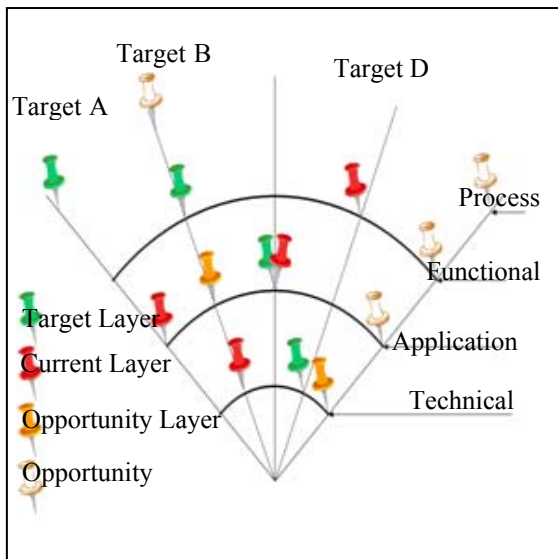


Figure 4: Dashboard for IS urbanization operations

Thus, for the target A, the target layer is the business layer (or process layer) and the layer "Application" is the first invariant layer or the one that needs no change to support the goal achievement.

For the target B, the target layer is the "functional" one which corresponds to a functional change in a same business role. The invariant layer is the "technical" one. Thus, operations on the Applications layer are needed. After review, it is found that the new application component represents an opportunity that can bring something new in the business layer (a new added value like a new distribution channel ...). To this effect, the business layer becomes an opportunity layer.

This example leads to the recommendation to use both approaches, top-down and bottom-up, with the best match to get an efficient urbanization dashboard.

These concepts of the IS architecture guided our reflection about the new e-Strategy approach we propose in the following section.

4. E-STRATEGY: A STATE MODEL BASED ON THE IMPACT CONCEPT

In this section, we propose a layered model of the e-Strategy inspired from the layered model of the urbanization of IS. Then, we propose a state model of the indicators vector.

4.1. E-Strategy: A new Layered Model

Inspired from the layered model of the IS urbanization, we propose to introduce a second classification of the indicators by adopting three interrelated layers (Figure 5):

Basic Layer: featuring the basic indicators that can be of two types: basic indicators on which it is possible to act by decision (example: GSM coverage or the rate of R&D budget to GDP can be directly impacted by government decision) or general prerequisite indicator part of a wider area than that studied (Example: illiteracy rates).

Target layer: featuring indicators that represent a development goal. Example: rate of e-business GDP to GDP.

Intermediate layer: having Intermediate indicators that are neither basic indicators nor target

ones. These indicators generally represent milestones that help ensure the smooth progress of projects but are not final goals in themselves. Example: percentage of the population using the Internet.

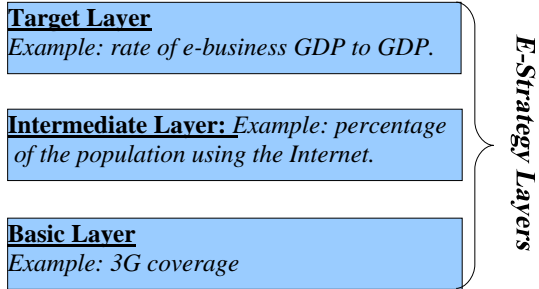


Figure 5 : E-strategy Layers

Adopting this classification, we can adopt a model of indicators interdependence driven by the e-Strategy layers. Indeed, we connect each target indicator to the intermediate indicators that influence it, then, we connect each intermediate indicator to the basic indicators that most influence it. This model leads to a hierarchy of indicators. We denote this tree by the "Impact tree"

To illustrate this approach, we have applied it on the set of indicators adopted by the European Union for the project I2010 (FC Appendix 2).

To do this, we adopted the following steps:

1. Assign the indicators to the three layers,
2. Re-index the indicators,
3. Creation of a square matrix M of order N whose elements are 0 (N = total number of indicators),
4. For each target indicator number i, identify the list of intermediate indicators that influence or impact it. For each indicator j of this list, $m_{ij} = 1$.
5. For each intermediate indicator number i, identify the list of basic indicators that influence or impact it. For each indicator j of this list, $m_{ij} = 1$.
6. Using a mathematical tool, the matrix M is converted into a tree which is the « Impact tree ».

After the first two steps, we have proposed the following classification (based on our opinion and just for illustration):

| INDICATOR | Index | Layer |
|---|-------|-------|
| Take up of internet services (as % of population) | 1 | T |
| e-Commerce as % of total turnover of enterprises | 2 | T |
| ICT sector share of total GDP | 3 | T |
| ICT sector share of total employment | 4 | T |
| % of ICT exports on total exports | 5 | T |
| ICT sector growth (constant prices). | 6 | T |
| looking for information about goods and services | 7 | I |
| % of population using e-Government services | 8 | I |
| % of population using e-Government services for returning filled in forms | 9 | I |
| % of enterprises using e-Government services | 10 | I |
| % of enterprises using e-Government services for returning filled in forms (including e-procurement) | 11 | I |
| % pop. who are regular internet users (using the internet at least once a week) | 12 | I |
| sending emails | 13 | I |
| Internet telephoning or videoconferencing | 14 | I |
| downloading computer or video games or their updates | 15 | I |
| listening to the web radio/watching web tv | 16 | I |
| reading online newspapers/magazines | 17 | I |
| internet banking | 18 | I |
| % of GPS using electronic networks for transfer of patient | 19 | I |

| | | |
|--|----|---|
| data | | |
| % enterprises selling online | 20 | I |
| % enterprises purchasing online | 21 | I |
| % enterprises using ERP systems | 22 | I |
| % enterprises using analytical CRM | 23 | I |
| % of persons employed with ICT specialist skills | 24 | I |
| % enterprises sending/receiving e-invoices | 25 | I |
| % enterprises using digital signatures | 26 | I |
| % basic public services for citizens fully available online | 27 | B |
| % basic public services for enterprises fully available online | 28 | B |
| Total DSL coverage (as % of total population) | 29 | B |
| DSL coverage in rural areas (as % of total population) | 30 | B |
| Broadband penetration (as % of population) | 31 | B |
| DSL penetration (as % of population) | 32 | B |
| % of households with an internet connection | 33 | B |
| % of households with a broadband connection | 34 | B |
| % of enterprises with a (fixed) broadband access | 35 | B |
| % of GPs with Broadband connection | 36 | B |
| % of GPs with secondary care connection | 37 | B |
| % enterprises with integrated internal business processes | 38 | B |
| % enterprises with integrated external business processes | 39 | B |
| % enterprises using secure protocols for internet orders | 40 | B |

| | | |
|--|----|---|
| % enterprises using open sources operating systems | 41 | B |
| % of the population with no internet skills | 42 | B |
| % of the population with low internet skills | 43 | B |
| % of the population with medium internet skills | 44 | B |
| % of the population with high internet skills | 45 | B |
| % of persons employed with ICT user skills. | 46 | B |
| ICT R&D expenditure by the business sector, as % of GDP | 47 | B |
| ICT R&D expenditure by the business sector, as % of global R&D expenditure | 48 | B |

T: Target Layer, I: Intermediate, B: Basic Layer
 Table 1: i2010 set of indicators classification into E-strategy layers

To simplify plots, we used a parameterized function to return only the tree of a requested target indicator. At the end of the other steps, we get the tree below which relates to the target indicator No. 4: ICT sector share of total employment:

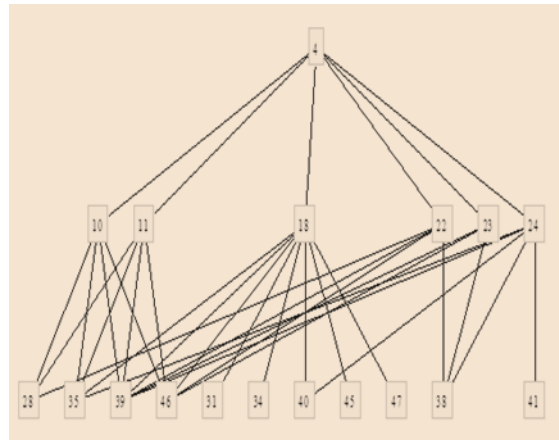


Figure 6 : e-Strategy Impact Tree

Thus, we can exploit this representation to help formulating the e-Strategy (e-Readiness target and trajectory) using the two approaches used to define the master plan of IS urbanization:

Top-Down Approach:

For each target indicator, we identify the basic indicators of its impact tree. The e-Strategy should act on indicators that are less developed in this list to improve the target indicator.

Bottom-Up Approach:

If a basic indicator or intermediate indicator is well developed, we identify the associated indicators that enable a better development of target indicators.

This new indicators classification is a conceptual method for the assistance to the e-Strategy formulation. The quantification of the impact concept of this approach is the basis of the indicators vector state model proposed below.

4.2. E-Strategy state model based on the Impact Tree:

The new classification of the e-Readiness indicators is based on the interdependence of indicators relative to each other and not by sectoral clustering. Thus, the two vertical approaches, top-down and bottom-up, will help formulating the e-Strategy addressing its two components: e-Readiness target and trajectory to reach it.

In this context of target and trajectory, we propose two axes to reflect our new concept in mathematical form:

1. Calculate the impact of an indicator on the other indicators and on the e-Readiness index,
2. Use the equations of dynamic systems to determine the trajectory to achieve the target e-Readiness,

Indicators impact:

We can notice that the impact of an indicator « l » on the e-Readiness index is composed of the impact related to changes in the measure of the indicator itself and the impact related to changes in measures of the other indicators that are impacted by « l ». Thus, we introduce the concepts of relative impact and marginal impact. The marginal impact is composed of a vertical marginal impact and transverse marginal impact (Figure 7).

Relative Impact (RI): The Relative Impact of the indicator I_l on the indicator I_r is the I_r measure variation due to a unit variation of I_l :

$$RI(I_l/I_r) = I_r(I_l + 1) - I_r(I_l) \quad (1)$$

Where we define $RI(I_l/I_l) = 0$

Marginal Impact (MI): The Marginal Impact of the indicator I_l on the e-Readiness Index is its variation, during a period of measurement, due to a unit variation of I_l . It is clear that MI is composed of two parts: 1) The impact due to the change of I_l in the intrinsic functions calculating e-Readiness (weighted averages), 2) The impact due to the changes in the indicators impacted by Relative Impact of I_l . The first one is called Vertical Marginal Impact VMI (MI_v) and the second is called Transverse Marginal Impact TMI (MI_t) (Figure 7 below). This gives us:

$$MI(I_l) = MI_v(I_l) + MI_t(I_l) \quad (2)$$

$$MI_v(I_l) = \left(\frac{\partial E}{\partial I_l} \right)_{t_{next}} = E(I_l + 1) - E(I_l)$$

$$MI_t(I_l) = \sum_{k=1, k \neq l}^{Nb} \{ RI(I_l/I_k) * (MI)_r(I_k) \}$$

where Nb is the indicators set cardinal.

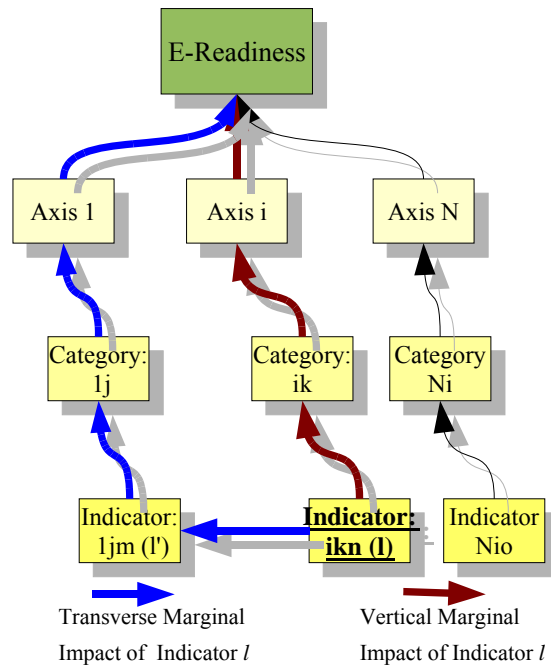


Figure 7: Vertical and Transverse Marginal Impact

In the purpose to calculate VMI as function of the weightings of the sectoral indicators tree, in the following section we adopt the notations below:

A= The set of “e-Readiness sectoral tree” axis = {A_i, i=1 .. N= number of axis}

R_i = The set of categories of the axis A_i in the e-Readiness sectoral tree= {R_{ij}, j=1 .. N_i = number of categories of A_i}

I_{ij}= The set of indicators of the category R_{ij} of the axis A_i in the e-Readiness sectoral tree= {I_{ijk}, k=1 .. N_{ij} = Number of indicators of R_{ij}}

U_{ijk} is the unit of the indicator I_{ijk}

α_i = weight of the axis A_i in the set of axes A ; ∑α_i=1

β_{ij} = weight of the category R_{ij} in the set of categories R_i of the axis A_i; ∑β_{ij}=1

γ_{ijk} = weight of the indicator I_{ijk} in the set of indicators I_{ij} of the category R_{ij}; ∑γ_{ijk}=1

E= E-Readiness Index

E(I_{ijk}) = e-Readiness as function of the indicator I_{ijk}

We have by construction:

$$R_{ij} = \sum_{k=1}^{N_{ij}} \gamma_{ijk} (I_{ijk}) \cdot A_i = \sum_{j=1}^{N_i} \beta_{ij} R_{ij} \cdot E = \sum_{i=1}^N \alpha_i A_i$$

Then: $E = \sum_{i=1}^N \alpha_i \sum_{j=1}^{N_i} \beta_{ij} \sum_{k=1}^{N_{ij}} \gamma_{ijk} (I_{ijk})$ (3)

We define a bijective function F from the set of triplets (i,j,k) to the set {1 .. Nb= Cardinal of the set of indicators}: $F(i, j, k) = l$ and by extension $F(\alpha_i, \beta_{ij}, \gamma_{ijk}) = l$

$$MI_l(I_j) = \left(\frac{\partial E}{\partial I_j} \right)_{I_{j \neq l}} = E(I_j + U_j) - E(I_j) = \alpha_i \cdot \beta_{ij} \cdot \gamma_{ijk} = \omega_l$$

$$MI(I_j) = \omega_l + \sum_{i=1, i \neq j}^{Nb} \{RI(I_i/I_j) \cdot \omega_{i_j}\}$$

To generalize the equation to all the indicators, we consider:

- The vector MI composed of the marginal impacts of all the indicators.
- The square matrix of order [NbnNb] constructed from relative impacts. We denote that matrix RIM (Relative Impacts Matrix) and have: $RIM_{ij}=RI(I_i/I_j)$.

$$RIM = \begin{bmatrix} 0 & \dots & RI(I_1/I_Nb) \\ \vdots & \ddots & \vdots \\ RI(I_{Nnb}/I_1) & \dots & 0 \end{bmatrix}$$

We get:

$$MI = (RIM + Id) \cdot \Omega ; Id = \text{identity matrix (4)}$$

It should be noted that the marginal impact is calculated as a direct impact for one period of measurement and do not include the spread of transverse impact on several periods. This spread will be elucidated through the equation of state proposed in the following section.

E-Strategy state model

In the context of estimating the trajectory to achieve the targeted e-Readiness, we would get an equation of state with the form as below:

$$M_{k+1} = A_k \cdot M_k + C_k$$

- M_{k+1} is the indicators measures vector at the period K+1,
- M_k is the indicators measures vector at the period K,
- A_k is square matrix of order [NbnNb] at the period K,
- C_k is a vector of order Nb, constant at the period K,

Denote by G the set of basic indicators and G* its complement in the set of indicators. G, in general, represents the set of indicators that are responsible of the dynamic of the system and could be likened to a generating set.

For indicators of the set G*: the measure at a period refers to the measure in the previous period increased by the transverse impact of the variation of indicators at the previous period: system inertia (the noises are canceled at this stage).

For indicators of the set G: These indicators may be impacted by a decision; their measure at a period depends upon the system inertia plus the decision of change (additional force injected in the system).

$$M_{(k+1)l} = \begin{cases} M_{(k+1)l} + \sum_{i=1}^{N_b} (M_{(k+1)i} - M_{ki}) \cdot RI(I_i/I_l) & l \in G^* \\ M_{(k+1)l} + \sum_{i=1}^{N_b} (M_{(k+1)i} - M_{ki}) \cdot RI(I_i/I_l) + c & l \in G \end{cases}$$



c is a constant corresponding to the decision of change of the basic indicator.

$$\begin{cases} M_{(k+1)t} = M_{kt} + \sum_{i=1}^{NE} (M_{(k+1)t} - M_{kt})_i * RIM_{it} + C_{(k+1)t} \\ C \text{ is a vector of constants and } (C_{(k+1)t} = 0 \text{ if } t \notin G) \end{cases}$$

If M, vector of indicators measures, is used in its row form or column form depending on its position in the equation, we get (5):

$$M_{k+1} - M_k = (M_{k+1} - M_k) * (RIM)^T + C_{k+1} \quad (5)$$

Using “Transpose” function on both sides of the equation:

$$M_{k+1} - M_k = (RIM)^T * (M_{k+1} - M_k) + C_{k+1}$$

If we denote $EV_k = M_k - M_{k-1}$ for all $k > 0$, EV_k represents the evolution or the speed of M, we get the equation of state below:

$$EV_{k+1} = (RIM)^T * EV_k + C_k \quad (6)$$

This state model (equation 6), through the filtering function of the dynamic systems statistical tools, is a solution for the estimation of missing measures in the database. The predictive function of these tools is a solution for the simulation of the evolution of the indicators vector in response to basic indicators manipulations. These simulations will help decision makers to define the e-Strategy.

5. CONCLUSION

We have presented the process of e-Strategy for which we have identified a need for e-Strategy formulation approaches and the monitoring of e-Readiness over the time axis using a minimum of data.

We targeted to develop a new approach for the assistance for the formulation of e-Strategy exploiting and adapting the approaches used for the architecture of information systems.

Thus, we proposed a new model of the e-Readiness that allows us to use "top-down" and "bottom-up" approaches for the formulation of the e-Strategy. In this new model, we have introduced:

- A new classification of indicators into three layers: Target indicators, Intermediate indicators and basic indicators,

- An impact tree to describe the interdependence of indicators of different layers
- A mathematical model describing the impact concept including:
 - An impact function to calculate the marginal impact of any indicator on the e-Readiness index over the next period.
 - A state equation to describe a trajectory of indicators. This equation would simulate the evolution of the system in response to a change in the measure of a basic indicator.

The generalization of the model to a larger number of layers of the impact tree and the sectoral ontology is a matter of notations.

This approach is, through its state model, a response to the two issues set out in the state of the art chapter: the lack of indicators measures is addressed through the filtering function of the state model and the lack of an approach for the e-Strategy formulation is addressed through the predictive function.

Appendix 1: List of some e-readiness approaches

- **APEC:** Asian Pacific Economic Cooperation (APEC) E-Commerce Assessment (tool and report).
- **CID:** The Guide to "Readiness for the Networked World" by the Center for International Development (CID) at Harvard and IBM.
- **CSPP:** Computer Systems Policy Project (CSPP).
- **McConnell:** McConnell International's E-Readiness Reports.
- **WITSA:** The World Information Technology and Services Alliance.
- **Mosaic:** Mosaic Group's Questionnaire for tracking the global diffusion of the Internet.
- **CIDCM:** University of Maryland, Center for International Development and Conflict Management (CIDCM)'s.

Other institutions and international organizations have developed their own approach in terms of set of indicators and their sectoral ontology (EU, The Economist Intelligence Unit, ITU ...).

Appendix 2: Indicators of the European i2010 initiative at midterm review. [20]

| | |
|--|--|
| Broadband | % of GPs using electronic networks for transfer of patient data |
| Total DSL coverage (as % of total population) | e-Commerce |
| DSL coverage in rural areas (as % of total population) | e-Commerce as % of total turnover of enterprises |
| Broadband penetration (as % of population) | % enterprises selling online |
| DSL penetration (as % of population) | % enterprises purchasing online |
| % of households with an internet connection | e-Business: % of enterprises |
| % of households with a broadband connection | with integrated internal business processes |
| % of enterprises with a (fixed) broadband access | with integrated external business processes |
| Internet Usage | using ERP systems |
| % pop. who are regular internet users (using the internet at least once a week) | using analytical CRM |
| Take up of internet services (as % of population) | sending/receiving e-invoices |
| sending emails | using digital signatures |
| looking for information about goods and services | using secure protocols for internet orders |
| Internet telephoning or videoconferencing | using open sources operating systems |
| downloading computer or video games or their updates | Employment and Skills |
| listening to the web radio/watching web tv | % of the population with no internet skills |
| reading online newspapers/magazines | % of the population with low internet skills |
| internet banking | % of the population with medium internet skills |
| e-Government Indicators | % of the population with high internet skills |
| % basic public services for citizens fully available online | % of persons employed with ICT user skills. |
| % basic public services for enterprises fully available online | % of persons employed with ICT specialist skills |
| % of population using e-Government services | Indicators on growth of ICT sector and R&D |
| % of population using e-Government services for returning filled in forms | ICT sector share of total GDP |
| % of enterprises using e-Government services | ICT sector share of total employment |
| % of enterprises using e-Government services for returning filled in forms (including e-procurement) | ICT sector growth (constant prices). |
| e-Health | ICT R&D expenditure by the business sector, as % of GDP |
| % of GPs with Broadband connection | ICT R&D expenditure by the business sector, as % of global R&D expenditure |
| % of GPs with secondary care connection | % of ICT exports on total exports |

Table 2: i2010 set of indicators grouped by sector



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