e-CADASTRE = e-PROCESSES + Business Rules: The Lessons of Lebanon Cadastre Automation Project

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ABSTRACT

The 1999 UN-FIG Bathurst Declaration advocates designing and building land administration systems which are service-oriented and based on the careful analysis and cadastral information flow. The Lebanese Cadastre Automation project (a $20 M World Bank endeavor) has attempted to build such systems. The target systems have been designed to integrate three distinct but inter-related aspects of Cadastre work: workflow (business processes), cadastral functions, and handling of citizen transactions. This integrated approach implies moving from existing business processes to e-Processes. The e-Processes in turn require that constraints and procedural guidelines which are usually referred to as business rules and govern the conduct of the underlying processes be embedded in the software supporting the citizen transactions. Transactions include items like issuing map abstracts, doing land subdivisions and land annexations. This paper will describe the design principles behind the Lebanese system and highlight the lessons learned based on the initial implementation of the system—this is a an attempt at building e-Cadastre using e-Processes and business rules.

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e-CADASTRE = e-PROCESSES + Business Rules: The Lessons of Lebanon Cadastre Automation Project

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1. INTRODUCTION: ELEMENTS OF E-CADASTRE

1.1 e-Cadastre: Coordination of Tasks and Maps by Software and Databases

At its most basic, Cadastre work rests on transactions (interactions between the citizens and employees of Cadastre organizations) and involves an exchange—a Cadastre product or service (e.g., processing of a subdivision update) is provided by the Government for a fee by the citizens (e.g., requesting the subdivision update). In the manual environment, the employees of the Cadastre organization perform a series of tasks, and activities involving a variety of documents and other information. These are coordinated through a manual interface. That interface usually involves direct handling, drawing, writing, etc. through documents (maps, plats, surveys, index maps, etc.). Quite simply, in e-Cadastre this interface becomes the software that drives the flow of information and processes required to turn citizen requests into Cadastre organization responses.

In simplified form the Cadastre organization performs a process in the sense that it is responsible for transforming the input (request) into the output (response). Viewing processes as workflows, the link between input and output is a set of tasks and activities that constitute a linear flow of steps. For e-Cadastre, the process becomes e-Process, and the links are the business rules that become the software, (in the near future or immediately, an electronic link to a web site). Thus, “input-process-output” changes to “request-transform-respond.” The Cadastre organization makes this transformation by using its capabilities: survey knowledge base, business processes and information contained in variety of forms. So, in e-Cadastre, it is the business rules that govern the transformation of request to response by the business processes.

1.2 e-Cadastre Means e-Processes and Business Rules

The core of e-Process is our concept of “business rules.” One of the reasons many Cadastre organization appear to be process-blind is that they overlook the importance of business processes in their automation plans. That is, a typical mistake made, which is separating their computerization projects (as buying hardware boxes and software products) from their business (administration of Cadastre transactions for the citizens by the employees) and vice versa. From their perspective, computerization is all about goods and services they buy, and Cadastre work is all about administrative/technical procedures. They do not see that with the proper design the software and databases themselves can become business process “coordinators”. This common view estranges business processes of Cadastre work from information technology. It positions application software as a thing that is used by surveyors or employees in general in conducting the Cadastre work rather than the e-Cadastre coordination engine it can be. A piece of Cadastre software and the associated databases are

not just a system. They are more (or can be more). If properly designed and implemented, there can be many processes behind the click on the screen—subdivision, annexation, map abstract, invoice generation, and so on. However, this view of software systems is novel if not strange for most Cadastre organizations. So for many Cadastre automation projects "e-Process" is not a well-understood goal, and automation continues to be viewed as procurement of geomatics goods and services. This is a pity given the significant potential for e-Processes as a cornerstone for e-Cadastre.

1.3 Business Rules: A Practical Definition

A business rule is a statement that guides the many aspects of the above-mentioned generic interface among Cadastre activities, tasks, employees and the underlying information be they maps or other kinds of documents. Business rules define the basis for work in any Cadastre organization and the terms of reference for coordination across these activities. Rules begin with citizen's submission of application and what they want to accomplish (say, subdivision update). How rules are implemented defines the contents of work and responsibilities required to meet the citizen's request. The rules establish the transaction type, fees, and technical constraints, legal, and administrative constraints/policies/procedures of the Cadastre organization. Therefore, if business rules can be embedded in software, Cadastre work can be conducted so as to coordinate the activities using the rules directly, linking the various employees and the information they process seamlessly as an integrated e-Process capability. Translating these rules into full-fledged software scripts for the whole workflow becomes the challenge to tackle.

1.4 e-Cadastre: An Example

Consider the most obvious example of embedded business rules, the one that is transforming the basics of Cadastre work in the Lebanese Directorate of Land Registration and Cadastre: map update based on annexation, subdision or map asbstract. Traditionally, these are highly labor intensive, coordination-intensive, and expensive as citizens or applicants work their way through the maze of Cadastre organizational units and employees to place their application for an affidavit or subdivision and wait for its completion.

A simple subdivision requires processing of the application by the secretary, getting authorization from the manager, then it goes to the surveyor, draftman, controller and back: handling all the associated paperwork, and dealing with invoices. This process is illustrated in Figure 1. In the Lebanese Cadastre agency, now this is all routinely handled by software.

e-Cadastre changes the rules and relationships among the Cadastre organization, employees and documents/information. e-Cadastre uses information technologies to connect employees through software and databases. This creates a new interaction among the employees. The on-line system presents the whole Cadastre workflow at the fingertips of the employees with minimal physical transfer of objects such as informations, maps, etc. For example, the module for subdivision in application software contains the whole spectrum of rules which govern the subdivision process administratively, legally and technically. These rules clarify drafting decisions, limits for adjustments based on paper map scales, and boundary "snap"

tolerances. For example, they include specific requirements about individual surveyors who are authorized to perform field survey and enter field data, assignment of draftsmen, which kind of map changes need manager's authorization, and the minimum and maximum tolerances allowed in adjusting of specific boundaries and field data.

In addition, the Lebanese Cadastre department now uses the on-line system to aggregate statistics for different kinds of citizen transactions, and employee skill requirements, giving the manager the power to assign work to various employees to balance their workload. This reduces individual Cadastre department employee's idle time through a more balanced distribution of work. While non-standard transactions, e.g., handling of sporadic surveys in non-mapped areas continues to be handled manually, the volume flowing through the this channel of work is more even among various surveyors due to the work order component of the software.

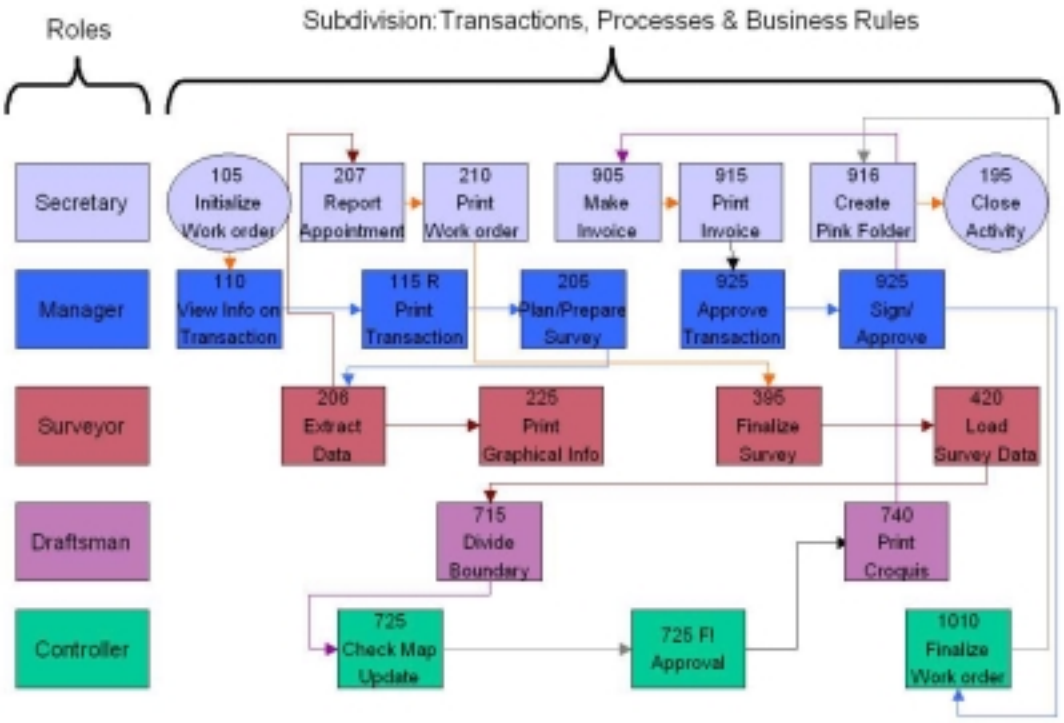

Figure 1—Subdivision Transaction with the Associated Roles and Processes

1.5 e-Process: Process = Rules & Software = Interface

If we view a subdivision map update process as a set of business rules the issue is as follows: Can we define the rules and interactions between the employee and the map information from ground survey to final approval by manager in such a way that software can do a good job of keeping track of various rules better than people? If yes. Then, employees are freed up to

concentrate on doing the map update, rather than all the peripheral activities which makes a paper-based map update a very laborious and error-prone process. Furthermore, this is also the core product which the citizen is interested in, e.g., updated physical description and geometry, etc.

Consider "X%" rule processing (the Lebanese law mandates that map-based acreage should not vary from the title register area by more than X%). Software takes data from the application and field survey, links to existing parcel information, applies the relevant rules, determines the tolerances, performs a (transparent GIS) buffer analysis and comes up with an accept-reject decision.

Business rules define the *interactions* between employees and the specified procedures through the rules. These can involve a spectrum from very simple such as validation edits on a map, a rudimentary form of a rule to checking whether current subdivision is compliant with the X%. Additional rules are embedded in the software in order to:

- Ensure that the application provides all the necessary information. If any information is incomplete, ask for more detail. If it s not forthcoming, reject the transaction.

- Apply the formula for evaluating survey data: it will accept a field survey from a surveyor that has tolerance Y, and Z,... and so on.

- Inform the surveyor of the field survey status and decision. If approved, establish the needed steps to move to the next step; if rejected, alert secretrariat to make the appropriate response to the surveyor.

2. VALUE OF RULES IN E-PROCESSES

2.1 Recurrence: The Value of Embedding Rules in Software

Software is cheaper to run in the long-run. It may be very expensive to build, but if a Cadastre agency can design the business rules for helping an employee to perform a map update as a result of a subdivision, then the cost of electronically handling the process is basically the same for dealing with 5 people or 500 people or 1,000,000 subdivisions! It's pennies. By contrast, the cost to hire and train comparable personnel with similar skills is highly dependent on the number and availability of staff, government budget, and salary levels.

So the software edge comes from recurrence. The more a process is part of the fabric of everyday Cadastre business, the more employees who initiate it—and the more frequently they do so, the more likely the payoff from software. What this means is that the primary target for embedding rules in software is to look for processes that have the following features, as they comprise an obvious and immediate opportunity for embedding them in the employee-workflow relationship interface:

- They are sufficiently well defined in terms of their business rules that only a few exceptional situations can't be handled through an interactive dialogue between the employee and a software "agent." That applies to most of the routine and everyday interactions of Cadastre employees and their workflow. They may not support the full texture of the interaction and therefore can't be fully automated, but given information about the application and given a transaction, they can be at least as well carried out in this manner as through alternative process options.

- They are recurrent enough to justify investing time, money, and brainstorming to work out the best way to design this dialogue and provide the interface. There's no point in committing these scarce resources for a process that only 1 percent of citizens initiate just once a year.

- The employee—typically a staff person—benefits from e-Process by using a software-based approach versus alternative modes of physical workflow because of its reliability and repeatability.

- When there's any inconsistency in existing processes, the Cadastre agency should in standardization. This is important, as embedding rules requires capabilities to handle transactions in a standard fashion.

2.2 Scalability

A national Cadastre agency has scalability when it can support increasing transaction volumes with minor additional investment in people, or remote sites/facilities. Software provides scalability, because it is not consumed as part of the transaction process as are other physical inputs, time, inventory, staff availability, and other resources. This allows the same piece of software to support a theoretically infinite number of transactions. Embedding business rules in software creates scalability, increasing the efficiency in Cadastre tasks and activities.

For example, issuing an electronic map abstract by embedding rules in software to handle the high volume of requests is quite cost-effective. Compare this with how slow and difficult is it for any employee: to re-trace the map on transparent paper; to copy on white paper; and to get such copies immediately to the citizens.

2.3 The Cost and Complexity of Process Workflows

Embedding rules in software and linking them to each other delivers efficiency through greater coordination and reduced complexity. The more that any process meets the conception of process as workflow, tasks, and activities, the higher the cost and complexity of coordination. They are interrelated. The cost comes from the multiplicity of steps, duplication of data, all the paper, and all the staffing and administration those involve. The complexity comes from the levels of staffing, supervision, and management from the many cross-checks, control mechanisms, and procedures required (The scale of complexity is indicated by a 1980s study by Exxon that found that on average every single document in its

head office was copied 40 times, with 15 of them stored permanently.) As we've mentioned earlier, the average administrative cost to process a simple affidavit application is around $20 in Lebanon while it only generates less that $7 in revenue for the government. It's organizational complexity that generates this burden.

And it's e-Process that removes the burden. It's not at all surprising that the most cost-effecitve component of e-Cadastre is to simplify citizen transactions. That's where the cost and complexity have been high for both citizen and agency (production of the map or title abstract through manual copying used to take 1 to 3 days, now it is minutes or less!).

2.4 Complexity: A Creator of Cost

Embedding rules in software improves process efficiency through managing complexity. Complexity can be measured in terms of the number of activities required to complete a process. The greater the complexity, the greater the number of steps, and the greater the cost. Assume for instance that each step of a complex process chain, such as a subdivision request, has an average 95 percent success rate—that is, only in 5 percent of cases does something go wrong, such as incorrect or missing paperwork, misunderstandings, miscommunication, or technical mistakes. How many steps does a process need to involve before the average success rate drops to 75 percent? The answer is just 6 steps, and for a 50 percent efficiency level, 14 steps. Raise the success rate per step to 98 percent and the overall performance goes up from 50 percent to 75 percent. Raise it again to 99 percent and the figure is 86 percent. Take a process that involves 50 steps and there's just an 8 percent chance that it will be done right the first time!

Of course, such figures underlie the ethos of Total Quality Management and reengineering. Small incremental shifts in individual task success—moving from a 95 percent to 98 percent rate—translate to huge improvements. The figures also explain why good organizations so often produce poor results in the masses of administrative background processes that dominate their work, overhead costs, and organizational complexity. It's no wonder that, on average, 10 percent of map abstracts contain some error.

The clearer the business rules, the more recurrent the process. And the greater the complexity, the more likely the process should involve software embedding. We use the somewhat cumbersome term "embed" to stress that this is not merely *automation* of the process. The software doesn't replace the process or substitute for it. It does not eliminate the interaction and personal nature of the process; rather, it governs the flow of information and interaction in context.

3. GUIDELINES FOR BUILDING E-CADASTRE USING BUSINESS RULES

3.1 The e-Process Imperative: Start with the Citizens Transactions

It is important to be aware that in essence, embedding business rules in the software turns Cadastre business processes into products. Your process base then can become a vital part of your revenue generation and operations—Dutch Cadastre revenue based in the last 10 years

has shifted from processing of simple transactions to providing a value-added service based on process-base of rules. Realizing the potential of process as a product asset requires looking at business rules from a citizen-centered, and information-intensive perspective. This perspective reflects the e-Process as business rules, software, and digital data. Here are the guidelines for implementing such projects effectively and efficienctly.

Of course, many complex process chains are anything but interactive and personal. These processes rest on inflexibility—rules that cannot be broken—and citizens that must understand that a rule is a rule regardless of their situation. This is not e-Process. It is the "The misplaced document syndrome" that substitutes personal employee gain (or corruption) for responsiveness. It's a process designed on behalf of the employee, not the citizen. It automates work without service-oreintation against the recommendations of the UN-FIG Bathurst Declarations. But that said, it's not enough to convert business rules into software. That's pure automation, not e-Process. It's fine to improve the efficiency of a transaction, provided that you also increase the effectiveness of the relationship with the citizen.

Producing a win-win situation is the goal of an e-Process. The citizen wins because of better service, greater convenience, and a higher satisfaction experience, which in turn produces greater demand for land Registration and Cadastre services of the Government. The Cadastre organization wins because it can deliver these services and products with increased productivity and efficiency—based on gains the benefits of reduced complexity and costs. This means that the software interface must be designed for supporting the processing of citizen transactions. This is not at all easy to accomplish in practice.

3.2 Look at the Full Spectrum of Transaction: Citizen-back-to-Citizen

You really don't want a distant or bored employee of the Cadastre organization blaming the computer for the lack of response to the citizens. Nor do you want one that is hyperactive, disorganized, unreliable, unavailable, slow, and difficult to interact with. Most Cadastre organizations are beginning to learn about the importance of ensuring that the software entailsease of navigation, security, intuitive interfaces, and the like.

It's outside the scope of this paper to go into the details of e-Cadastre software design, but from the e-Process perspective, we stress that usable and natural interfaces are not a feature of just the MS-Windows® GUI but of the whole process of e-Cadastre implementation. Here are some questions for e-Cadastre implementors to address:

- What type of transactions are you trying to accommodate from the citizen?

- What makes for a completed transaction, starting from what happens when someone comes on-site at the agency for the first time for the fulfillment of a transaction?

- What are the software features that help make the experience useful, comfortable, and safe for the employees?

- What should happen the very first second when citizens come back to the site in terms of the completion of the transaction?

- At what point is it appropriate to start gathering the information and taking the e-Process steps—using embedded software—to formally process transactions?

- How much of the back-office administrative and service processes can and should be embedded in the software for the Cadastre organization?

- What has to be added to these in terms of the employee follow-up to handle exceptions, application tracking queries, etc.?

- How do we provide information at software interface or through other sources for employees, that is win-win for the employee, the Cadastre agency and the citizen?

3.3 Steps for Turning Business Rules into e-Processes

3.3.1 Make It Easy to Start the Transaction and Follow it Up

The first move in the processing of citizen transactions is recognizing when and how the transaction starts. *Defining* when the transaction starts is an important business rule and early design issue. Some projects view a transaction as outside the software automation scope. Regardless of when you believe a ransaction starts, initiation should be simple, timely, and transparent to the employee and the citizen. Unfortunately, this is not always the case. Consider applying for an affidavit. That should never be a problem or involve a large bureaucracy. Sometimes, as with land transactions involving liens, encumberances and adverse possessions, there are legal and regulatory rules that prevent an immediate handling of the transaction. In that case, software must tell the employee and the citizen right up front. Handle every single aspect of the first steps in the transaction at the interface and make it as easy to do as simple as is *possible*—not just practical.

3.3.2 Software Interface as a Workflow Conversation

Think of workflow transactions as conversations. They are of two types, both of which affect the nature of transactions: (1) feedback and closing of any open loops, and (2) alerts and welcome surprises. Closing the loop means keeping employees and the manager informed and making sure there are no unwelcome surprises. Alerts are keeping them up to date about problems.

The more tightly the software is tied to the e-Process base, the more timely and valuable the transaction that can be handled. The alternative is detachment: the transactions are detached in the sense of being limited and impersonal and also in that there can't be a transaction about many aspects of affidavit fulfillment, status, alerts and so on, because the software isn't linked to the relevant process base (rules and databases) of the Cadastre agency. By moving that base from the back office to the software itself, the software knows the business rules and can use them for the handling of transactions.

3.3.3 Add Exception-Handling Capabilities

The further the Cadastre organization moves to embed the routine business rules the more it needs to consider what to do when the rules don't work or if there's a request it can't handle. Our strong recommendation is that managers design the exception-handling e-Processes along with the routine ones. There's no point in a very rigid robot-like environment for employees to purely push buttons but be stuck at a slightest variation in the change of conditions to the applications of the citizens. This can become a common problem in e-Cadastre software, because it requires designing the software for the routine and, from there, linking information and communication back into the process-base, so that its process-base and employee skills can handle the exceptions. That means appropriately layering the components of the e-Cadastre software, so that they are "seamless"—they work together smoothly and without interruption.

3.3.4 Create a Transparent Interface through Business Rules

Cadastre organizations can build e-Processes as they put more and more of their process base into the software interface. It will work well most of the time and probably be far more reliable (at the 99.9 percent level), simple (if the technical design of the software is well handled), and faster than the manual workflow alternatives. But manual workflows have to take over for the 0.1 percent that fail. This is unavoidable and should be recognized from the start.

3.3.5 Standardizing is Key to Reducing Exceptions

How a Cadastre agency handles exceptions may turn out to be a key to its ability for further automation in an environment of scarcity where more and more of the routine will be well processed by online processes. For example, Lebanon Cadastre, is moving towards a comprehensive standardization of data and processes.

In both these instances, it's people and workflows that handle the exceptions *because they are by definition not routine*. Here's where our e-Process approach differs from the ethos of automation. The more you embed processes in software, the more important it will be to carefully consider the people processes that complement them.

3.3.6 Clean Rules Make for Clean e-Processes

Software is cruel in that it obeys instructions, and those instructions must be “clean” in their business rules: no ambiguities, conflicting procedures, duplicated steps, varying definitions of requirements depending on which employee role (secretary, draftsman, manager, surveyor, controller) is handling, and all the other muddying of the process flow. Before processes can be moved from manual workflows to software, the following cleaning-up process is often essential and difficult to achieve, as companies that cleaned up business processes as part of total quality management and reengineering often discovered:

1. Assess the degree of existing standardization of the process and its potential for standardization. If it isn't and can't be standardized without losing something of value to the citizens, redesign it to combine value and clarity of rules and information.

2. Evaluate the business rules to remove decisions and options "downstream"—this is a variant of the TQM mantra of "get it right the first time." For e-Process, this is "get it done the first time, at the software interface." If you have to touch it, inspect it, review it, or approve it, do it through the software and design the steps to be removable! As later redesign of the process or complementing it with exception-handling e-Process capabilities can make it redundant.

3. Identify all the information needed to complete all the e-Process. Capture it once only, and both guard and use it relentlessly to design software e-Processes that capture the information in as few steps and as naturally as possible. Use information from all sources to ensure that once the transaction is complete, there won't be some later ambiguity or information conflict or incompleteness.

4. Remove all reliance for the routine on manual interventions, interpretations, and variations in procedure as much as possible. If you give the process business rules to three people and get more than one answer, this is not a clean process. If your non-technology-oriented spouse, parent, or child can't explain the business rule to you, it's not clean. If you can identify the need for a decision as part of a process but can't state the business rules, it’s not clean.

Remember, too, that as you move processes into the software interface, your back door is wide open. Back-office processes that were previously hidden are exposed by e-Cadastre—how did an inefficient employee stays in the same position with processing so little applications and receiving so many complaints for such a long time!

4. BUSINESS RULES LEAD TO SELF-ORGANIZED PROCESSES & THE WWW

Self-organizing processes mark the difference between process automation and enabling e-Process. Traditional processes follow a chain of inputs-process-output that links the activities required to handle citizen requests. These chains are replicated, much like strands of DNA, to handle different transactions, creating mutually exclusive process paths that create complexity as the automation grows.

Notice that most Cadastre automation projects are designed around a single function. This occurs when Cadastre organizations focus narrowly on improving the operational efficiency of a specific segment. Projects that “improve the efficiency of single functions” often lead to single track processes that work in the “small,” but increase organizational complexity and cost. This happens as the Cadastre organization focuses on inputs, processes, and outputs rather than looking for recurrent business rules, leveraging the process complexity. A rules-based perspective helps identify and create self-organizing processes.

Self-organizing processes break these chains into modules and then link them together according to transaction goal and context. This involves bringing component and object development techniques to the discipline of process analysis and design. Those disciplines focus on understanding a business component and its behavior according to methods (business rules). The result is a process that has greater modularity. This approach gains flexibility and manages complexity as volume of transactions or different fees create different paths through existing modular processes rather than whole new streams. These streams are defined as a "broker" process that manages the different paths, based on context and condition, creating the self-organization of the process.

Embedding rules provides a powerful source of e-Process capability, as the software interface enables you to "jack" directly into the workflow. The results in terms of increased efficiency and cost are self-evident and a powerful enticement to creating a wholly virtual Cadastre agency—e-Cadastre. Embedding business rules in the interface can raise efficiency further when they are designed from the citizen's perspective, respond to needs, and recognize the need for in-depth support. Embedding rules can be difficult, but, when you get it right, the Cadastre back office becomes the citizen front office and provides the base for greater efficiency and cost savings and additional revenues based on value-added services.

It is the embedded bsuiness rules in the software which move e-Cadastre towards self-organizing processes. These same e-Processes can then be aiding the implementation of WWW-based applications based on an existing e-Cadastre infreastructure. Thus, business rules are not an option or a luxury but a necessity for web-enabled applications.