

DECISION SUPPORT SYSTEM FOR CITY HALL – An exploratory research

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ABSTRACT

Public administrations must control budget and expenditures while focusing its actions. These actions should necessarily be focused in the efficient use of central and local government resources. Information Systems have been widely used for information production in public and private organizations. The great amount of information demands development and use of intelligent systems. The public sector (mainly in countries in development) lacks intelligent systems capable of valuing tributes, estimating budgets and expenses, and delivering information about the application of such resources with the highest efficiency. Such information is available intra or inter-organizationally in government sectors, which aids and facilitates processing and analysis of data. That should improve use of information in the process of the responsible agents' decisions in the local administration.

Key words: Electronic Government; Local Governance, Knowledge Management, Intelligent Systems

1. INTRODUCTION

The present paper approaches the technological base of local government administration, pointing the potential of existing technologies. Intensification of the management based on intelligent systems is proposed to support decision making for local government administration. This paper is also based in the reality of Brazilian city administration (local government) in the context of the information society and digital economy. It is also discussed technologies that allow and support that context. Operational instruments (budget) of the city public administration in Brazil is also shown, which is essential for the city public manager decision making, as follows: Multi-Annual Plan¹ (MAP), Budget Guidelines Bill (BGB)², Annual Budget Bill (ABB)³, and Fiscal Responsibility Bill (FRB)⁴, which are the main norms that rule public city administration in Brazil.

The this research intends to provide wider understanding of such instruments as well as pointing out the importance of intelligent systems to support decision making, retrieving an intelligent platform based on the new technologies of business intelligence (BI) such as Data Mining applied for the public sectors. With such instruments, the use of existing information, though currently fragmented and not integrated online, it may improve decisions making as well as the use of public resources.

¹ The PPA of a council set as a resource for strategic planning of medium-term manager of the public, which is responsible for designing, implementing, monitoring and evaluation of development programmes. It is a programme consisting of shares, with targets for 4 years. As a law every four years, special hierarchy and subject to deadlines and peculiar rites of conduct established by the Federal Constitution of 1988, as an instrument standards the medium-term planning and definition of governmental guidelines for national action in each period of four years, and these determinants (mandatory) for the public sector and indicative to the private sector (Article 174 of the Constitution)

² The LDO is also part of local planning and development should be in accordance with the same goals and guidelines contained in the PPA. The LDO establish the annual budgets of programs that are consistent with the demands of society, since the programs are chosen by legislators. The LDO there is also the establishment of fiscal targets of public management.

³ The LOA is a resource for short-term planning and has, by plea, the estimates of revenue and taxation of costs for the fiscal budget for social security and investment companies. LOA includes the estimates of revenue, it is needed a more accurate study of the impacts generated by the implementation of planning, as forecasts wrong may compromise the efficiency of the whole process of planning. Usually, it uses up the expectation of inflation plus the expected change in revenue to provide the total revenue a year.

⁴ The Law of Fiscal Responsibility - LRF sets rules for public finances geared to the responsibility in fiscal management. It is the code of conduct for public administrators that will set standards and limits to manage finances, with accounts of how much and how to spend the resources of society. To achieve this goal the law has the means, among which stands out the planned action and transparent in seeking to balance public accounts, which targets the result between revenue and expenditure must be fulfilled as well as the limits and conditions for surrender of revenue, expenditure on personnel, social security, debts consolidated and furniture, credit operations, provision of security and membership in remains to be paid.

2. LITERATURE REVIEW

2.1 Basic concepts on digital economy

Economy is by definition, a science of scarcity. If goods were not scarce there would not be any problems related to their production and distribution. There would also be no need to study methods or models able to maximize resource usage (BLANCHARD, 2001). However, it is known that society resources are scarcer.

Technological evolution and computer science helped information to become a new and important resource to society. Although the destruction of creativity has affected out of proportion large economical sectors (CASTELLS, 1999), especially the public sector, which has difficulties to reduce cost, and it cannot accompany the private sector improvements due to some rigidity which raises taxes in order to reduce fiscal deficit.

Castells (1989) presented information based on Industrial theories and later he (Castells, 1999) presented the network society while discussing the importance of the role of the Federation, while inserted in the network without losing pace on the digital revolution. Such information revolution, according to Castells, has certainly surpassed mere technological subjects.

2.2 Technological aspects

It is believed that integrated systems based on technologies such as business intelligence (BI) should help government sectors to operate in a more efficient way. Certainly, governments cannot be faced as simple organizations, such as businesses: the role of a government transcends such approach, and it has the purpose of working for citizenship. A government's effectiveness in providing quality services to citizens is also an administrative efficiency, for a good government does not overtax citizens due to low productivity in the public sector.

Along with such logic, tactics to increase significantly the efficiency of Governmental sectors through effective technological innovations is purposed. Nijkamp (1994) shows the correlation between technological changes and innovations in economical structures as a manner of making economical development possible: "Innovations or technological changes are a main source of changes in the economic structure of regions and nations." (NIJKANP 1994 p. 629).

Regarding the subject of database integration, it is found that the base lies in the texts of Davenport and Prusak (1998). They affirm that a small amount of information efficiently used led to reduction of bureaucratic paperwork, while bringing economy and information closer to each other. It is expected that it may reduce concerns with the management of information resources, as well as reduce concerns with information costs.

Laudon & Laudon (1999) defined system of information as a "group of interrelated components working together to gather, retrieve, process, store and distribute information with

the purpose of facilitating the planning, control, coordination, analysis and the decision process in companies and other organizations.”

Regarding the integration it is important to note the governmental system liability and the adequate risk allocation in system structure, as advised by Anderson and Moore (2008). Initially, it was believed that distributed interoperable systems are a diversification with considerable economical risk. This means that a security breach in one node is not as bad as a central governmental system breach. Davenport and Prusak (1998) show fundamental subjects for good information management as the following factors:

- a) integration of several types of information;
- b) recognition of evolutionary changes;
- c) emphasis on observation and on description;
- d) emphasis on informational and personal behaviour.

Among the presented characteristics, the supply of highly summarized analytical data, flexibly related to the information recovery does stand out. Another important subject is visualization which is possible in aggregated data, not only in operational data. These are of great importance on behalf of higher efficiency in a strategic decision making support system for public administration.

The tendency of system integration is to provide a series of interesting possibilities in terms of cross referencing different data sources. Data Mining is one of the tools which can be used for data analysis with the purpose of supporting local government strategic decisions. Palace (1996) defines data mining as a process of data analysis with different perspectives which summarizes those into useful information. According to the author, such systems could allow users to analyze data from many different points of view, and also to label, summarize, or relate data.

2.3 Local government planning in Brazil

In Brazil, city planning is guided by the bills and the budget guidelines, regulated by its Federal Constitution in articles 165th ~ 167th. The MAP is the main government planning instrument, elaborated every four years. BGB and ABB are already short-term instruments which are responsible for guidelines in program execution as described in the MAP.

Public managers should also be able to control the budget and estimate it, by which making fiscal and budget administration more transparent. The FRB has instituted a compulsory nature of fiscal goals, and the public administrator is responsible for providing calculations of budget to the inspection authorities, as well as local government balance.

FRB has an impact in city planning for it induces more rigid budget estimates, though it does not assure any warranties not in agreement with the premises demanded by governmental organs. Socially the FRB is an important tool for transparency, for it demands the public manager to identify economical and social premises that would be used to execute such actions contained in the public management planning.

ABB is responsible for executing the plan directly influenced by the FRB, for the budget estimates and the allocation of expenditures for fiscal budget are described in that instrument. In

the allocation of expenses directs budget expectations. Therefore, not rendered expectations may harm the allocation of budget for planned programs.

In order to estimate calculations it is expected that the inflation is higher than the budget variation budget, then estimating the total budget of a fiscal period. In such manner, erroneous planning could restrain the execution of the ABB and the entire plan in consequence.

Local governments should plan and develop plans which may succeed in local economy development, increasing well-being of the citizenry through improvements on the environment and increasing productivity and competitiveness of companies and public workers. Such factors could be responsible for the endogenous growth of the city district.

Multi-faced organizations bring evidence of the importance of a local public planning. The Organization for Economic Cooperation and Development (OECD) has published in 2004 the "Best Practices in Local Development study", which demonstrates the importance of building strategies to formulate programs to make strategic decisions in order to develop.

The World Bank has published in 2006 (SWINBURN, 2006) "Economic Development: Prime Developing, Implementation of Local Economic Development Strategies, And Action Plans". The study approaches the importance of city public planning, for it recognizes local governments as a healthy atmosphere to elaborate programs which may develop itself through the city's public workers and businesses, which are the organs with the greater similarities to city government. The first step for development should be the elaboration of a plan that estimates initially a realistic budget for an average year.

3 THE USE OF GOVERNMENTAL INFORMATION FOR STRATEGIC DECISION MAKING

Public administrations use and control resources in an effective and efficient way, with the objective to better assist the citizens. The word 'control' does not strictly mean that the only concern is the expenditures; it is a wider concept which allocates budget and also controls the public administration expenditures, which provides more services.

Digital Management use in local US governments has been studied since the late 1970's by Dutton and Kraemer (1978). Since that decade, Information and Communication Technology (ICT) structures have been bringing more possibilities to apply ICT's in local public planning.

Regarding the control of public administration, governments used to engage an elevated number of employees to manage incoming and outgoing resources many times, given the excessive bureaucratization of the previous procedures. Through time and with technological progress, the previous criterion is intended to change gradually to digital informational processes or to Knowledge Management System.

Such knowledge is becoming solid in the current information society, which is focused on the great flows of information by mass communication vehicles (such as television, radio, and Internet).

However it is useless to have an immense amount of information without any treatment of this information. The current capacity to generate accurate and relevant information for an efficient decision process is one of the most important items for national development; many

agree that information is one of the most strategic resources for projects and politics, being those public or private.

It is important to note that the private sector is ahead of governments, searching for efficient ways of treating information in order to improve performance in relations with customers and suppliers.

The electronic commerce (e-commerce) has been generating great sums of money, according to United Nations Conference on Trade and Development (2006). The United States grows constantly in that type of market. In Brazil the E-bit company, which researches and does online marketing, has shown statistics on Brazilian electronic trade in the first semester of year 2006 with nominal budget growth of 76%, compared to the same period in 2005. The first semester of 2006 has represented sales of about R\$1.750 billion, against R\$ 974 million on the first semester of 2005.

It can be noticed that improvements have been coming quite fast, and Castells (1999) evidences such events *a priori*: "information Economy is changing the atmosphere in which businesses, governments, and communities interact. It is fundamentally changing the manner of receiving, treating, and storing information. In this new atmosphere speed, flexibility, and innovation are keywords."

Governments have been investing more in electronic services, though still in an incipient manner, for e-Gov does not concern merely online portal creation for citizens to access; e-Gov has a wider connotation. Firstly, as Zimath (2003) recommends, government must have e-Gov conception focusing on Government-to-Citizen (G2C), Government-to-Business (G2B), and Government-to-Government (G2G) relationships.

However, before it is possible for the citizenry to use benefits which come in the 'Informational era', governments should put efforts in perfecting existent technologies in order to create sustainable mechanisms, and in raising efficiency of its organizations. To perfect the existent technologies is not an easy task, for the use of information technologies does not alone guarantee success and objective achievement.

Intelligent combination based on organizational competences, such as: excellence in work processes; dynamics in the relationship with the community; valorization and motivation of human capital; simplification of the management methods and fast knowledge display; such aspects may bring forward the strategies which have lasted long and may also benefits governments, and society as consequence.

Political organizations such as States and City districts will not develop fully if they do not rely on up-to-date, accurate, fast information in order to distribute public resources in the best way.

Rocha shows new perspectives regarding the information use information for governments in the scope of socioeconomic development. Information use by the government should give support to its actions on behalf of the citizenry. The objectives must be planned in a budget based in these objectives, and governments should set up strategies in order to satisfy data blanks in governmental departments.

3.1 The strategy formulation process

Segundo Hoeschl (2006) “In this sense, the integration of actions and departments with the objective of helping the elaboration of public politics gives since the moment of the system conception, where the institutions involved participate actively in the delimitation of the checked program, defining the critical points and drawing the objectives that will be achieved”.

Regarding the strategy creation process, local governments must focus in actions which would result in easy information use, display, and creation. Local governments must create a dynamic environment in which people could interact among themselves and with the environment. Initially collaborators must be ready to identify the main problems and potentials of the organization, deleting unnecessary processes, correcting essential and problematic processes, and evolving optimal processes.

The mapping of all processes allows the study of information flow within the organization, being therefore possible to map stages of each process and find organizational funnels. Organizational funnel correction is vital do the success of strategy creation for the administrative modernization does not only concern technological infrastructure; it also remodels the existing management.

The organization must focus on the following aspects (Schreiber. Et al, 2002):

- To identify problems and opportunities;
- To decide on solutions and their feasibility;
- To improve knowledge related tasks;
- To plan organizational changes.

The identification of problems and opportunities may allow the detection of organizational areas which need knowledge systems, or the proposal of improvements on existing systems. The decisions on solutions and their feasibility would determine if the total project costs less than the incoming budget expected after its implementation, as well as it would analyze the used technology.

The improvement of knowledge related tasks would allow the analysis of all stages involved in a process and to estimate improvements to accomplish. Planning organizational changes would study the impact of systems in the organization's daily work. The analysis of such aspects and the execution of the necessary procedures is the starting point to change the management model, in order to allow strategies according to the organizational environment, and the use of tools which would allow the decision maker to access all information available. According to Mishkin (2000), the lack of access to information jeopardizes scenario estimated which would improve decision making.

The architecture of a tax collection management system model must emphasize the use of technology through the insertion of intelligent agents, search and monitoring tools, Data Mining, Data Warehouse, Text Mining, and OLAP Online Analitical Processing. According Eder (2003) the possible data and text mining methods are:

- Autoregression – a significantly high absolute and relative difference between a dimension member’s actual value and its value predicted via a simple ARMA (AutoRegression Moving Average)(p,q)-model (or, if necessary, an haps even with

extensions for seasonal periods) is an indicator for a structural change of that dimension member.

- Autocorrelation – the usage of this method is similar to the method of autoregression. The results of this method, however, can be easily visualized with the help of correlograms.
- Crosscorrelation and regression – these methods can be used to detect significant dependencies between two different members. Especially a very low correlation coefficient (a very inaccurate prediction with a simple regression model, respectively) could lead to the roots of a structural change.
- Discrete fourier transform (DFT), discrete cosine transform (DCT), different types of discrete wavelet transforms – the maximum difference (scaled by mean of the vector) as well as the overall difference (scaled by mean and length of the vector) of the coefficients of the transforms of two dimension.
- Singular value decomposition (SVD) – unusually high differences is singular analyzing the whole data matrix. If single dimension members are compared, members (= principal component analysis) can be used in the same way.

The proposed model uses knowledge management processes to produce strategic knowledge through the organization of data. The tools are able to process and simulate digitally human analytical functions, which aggregates value to the pre-analysis and finds hidden knowledge. Data storage in a solid database makes data use, display, and exploration easier through a strategic or intelligent environment.

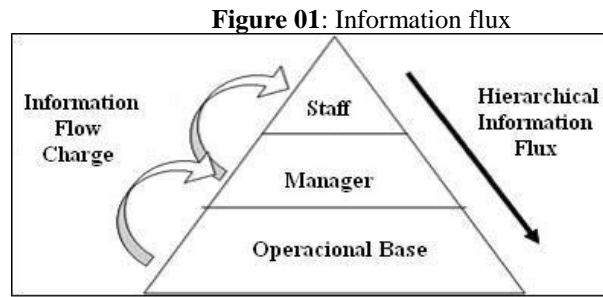
The use of an information retrieval system based on Ontology's, which proposes method and study focused on results, is a knowledge management tool which would help the strategic decision making process through information retrieval techniques which are strategic to the organization; that would make the decision making process more dynamic by displaying information as dynamic, statistic, or relationship tree reports.

According to Bueno (2007) "The interaction of Knowledge Management with Artificial Intelligence makes possible the development of filtering tools and pre-analysis of the information that appear as a reply to the expectations to extract resulted optimized of databases and not-structuralized source, as the Internet. In this case, the implementation of knowledge-based system depends on the analysis of environment so that his operation is contextualized only for determined objective of the Institution, thought ontologies."

According to Trope (1999) the information society has new technologies which continuously influence the way we organize, manage, and define rules for organizations.

Regarding the strategy creation process, it is important to note that the public worker's involvement in this process must necessarily involve command staff, managers and process supervisors, as well as the operational base, under the penalty of hinder development and objective accomplishment as consequence. It is important to note that this is the limit between hierarchical information and the institutions.

This is the base of the hierarchical pyramid, which means that although the institution management occurs through hierarchy, information regarding the best performance should be analyzed by the command staff, which may reduce mistakes in information use when data is linked. Figure 1 shows the mentioned process.



Source: Adapted from ARAÚJO, et all (2007)

Based on information rendered from the base of the operational environment it is possible to idealize an intelligent system for strategic decision making. Most times transactional systems are tools used to register and control facts, as well as daily procedures on the institutions. These have been developed for daily transaction control. Data on such systems is deposited in databases which have been developed to work in a straight line, without cross referencing information that would make possible the association of data in order to produce knowledge.

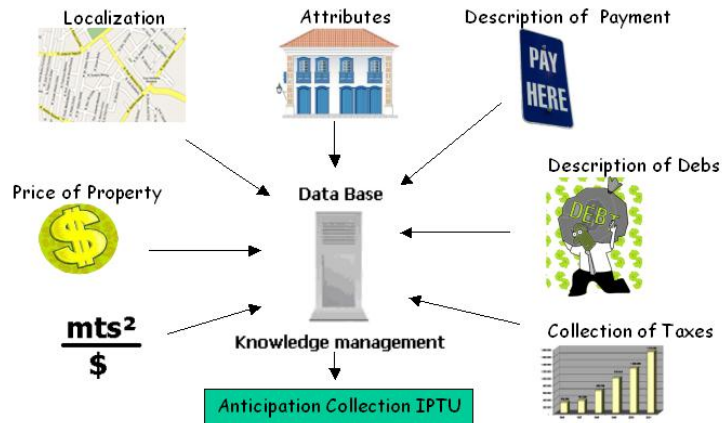
The strategic environment intends to facilitate exploration and analysis of tactical and management data of public organs; from this data it may be possible to make reliable and traceable projections. This system does not generate facts; it can create new points of view or administrative perspectives for efficient administration.

The strategic intelligent system standardizes information obtaining while avoiding that the managers would need to access several systems in a search for information, which may save time in analysis. The information manager could act more reliably by using technology.

One of the main federal modernizations had as result the strategic and intensive use of ICT's in internal relationships of its governmental organs, and also in relationships with citizens and businesses, whether by offering public services, or by governmental purchases. (DINIZ, 2002, p.5)

In this context the trend is that work is to be accomplished by obtaining or treating information. The fast and abrupt current changes which cause strong competition between businesses and the economy globalization are factors which among others, make organizations work not only in continuity and stability, but with their competition – with uncertainty. In such circumstances it is fundamental the existence of an intelligent decision support system for the Government sector managers to access an integrated database which groups information of several governmental city organs and with possible interoperability with other local government systems, as well as the central government. Figure 2 shows the main variables to analyze in budget estimates of TPT.

Figure 2: Variables to analyze in budget estimates of TPT



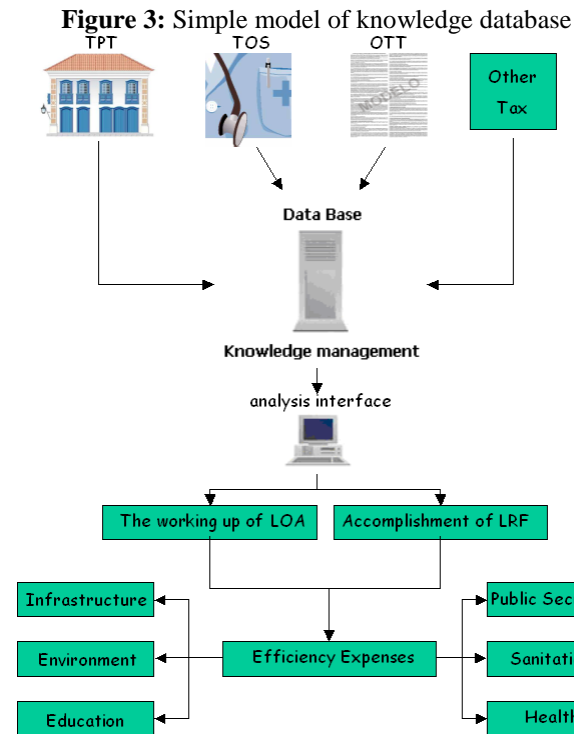
Source: Adapted from ARAÚJO, et all (2007)

Regarding Territorial Property Tax (TPT) Figure 2 shows that the collected value is cross referenced with information related to activities developed in the neighbourhood, size or characteristics of the residence or commercial site, value of Unitary Basic Cost (UBC – a lent property reference used in the Brazilian market), as well as debt or payment history.

These references after data mining are available for the public manager to identify patterns or relations among existent data. There is a possibility to project sceneries, which improves budget estimates of TPT. It is also possible to automatize value updating of TPT, which would avoid overdue values on emission in further years.

The primary information sources are characterized by statistics of city tax collection. These statistics regard values of monthly collection.

However, it is not enough to simulate incoming budget from TPT collection; all collection database sectors in the City Hall must be integrated in order to build a knowledge database able to maximize budget estimates. Figure 3 shows a simple model of knowledge database.



Source: Adapted from ARAÚJO, et all (2007)

In the case of Service Tax (ST) the collected value would be cross referenced with information reviewed in the National Treasury and from a national electronic budget system. Not only types of business activities, such as number of employees, budget, location, rent; it is also possible the cross referencing of information among companies with similar characteristics. The system would allow more efficient identification of fraud cases, and the improved electronic inspection would reduce new fraud cases.

The Ownership Transfer Tax (OTT) is applied in property transfer, and would be treated the same as TPT in which data of transferred property (value), would be cross referenced with registry data of where the transfer has occurred. This would avoid underestimates of tax value from contributors, since tax is proportional on the property real market value.

Local governments must keep property values up-to-date. Without underestimates on OTT tax values, it would also be a manner of securing the market value of property use, and reducing real estate speculation. The figure below displays the planning process when using technology information systems as a tool for TPT budget projection; such methodology is also applicable to several other governmental taxes.

Knowledge management is of great importance, for tax budget is the most prominent factor in the plan and budget of a local government, especially in ABB. Budget estimates are an initial point on planning, and any mistake could hinder effectiveness and efficiency on resource use.

In other words, estimates inferior to the accomplished value put entire plans in jeopardy for many investments do not accomplish though there were resources. In the other hand, estimates above the accomplished value put public administration in jeopardy based on the Fiscal Responsibility Bill.

The elaboration of ABB is directly associated to the City Hall budget estimate, which means that the local public manager needs the annual budget estimate in order to define which programs or projects will be executed in the next fiscal year, and how much funds will be spent on each. Badly elaborated estimates may jeopardize the execution of projects in two ways.

If the public manager has estimated higher budget values than the actual fiscal year budget, there will be no opportunity to execute more projects or to finish others, for the FRB impedes the use of more funds than expected. The local public manager loses negotiation power for (s)he will have to execute projects in stages, which are more costly than the continuous project, and total investment will be less effective.

Estimating a smaller budget value than the actual budget is more dangerous for the local public manager defines projects which should be executed in that fiscal year, but to estimate less fund than the necessary would result in a lack of budget project to paralyze; that would elevate costs and make total investment less effective.

Budget estimates are a fundamental part of the City Halls planning, for the estimate will define which projects will be executed and how much will be spent on each throughout the year. The more exact an estimate, the higher possibility for the manager to decide how resources will be allocated and the entire process will be more efficient.

Applied knowledge management should promote economical efficiency through efficient allocation of available resources. It should also be simple and administratively flexible, with wider integration between information technology and human resources. It should also guarantee the administrative responsibility of public managers, for an intelligent decision making support system enhances performances within possibilities and improves public administration itself, relying on estimates for further years and facilitating plans of future projects.

CONCLUSION

The present work approaches the importance of information technology on public sector administration planning. It has been discussed how technology has an impact in economy, and how digital economy is quickly improving. Later the private sector concepts which could be used by governments have been shown. Some concepts such as Business Intelligence and database integration are clear examples.

Information Technology can and should be a path to improve public resource administration, bringing efficiency and effectiveness to a historically unproductive process. The use of IT can aid strategy choices in socioeconomic maximization of applied resources.

It is also easier for an efficient administration to develop projects and reduce costs in governmental services for the citizen. The technology used may not able to solve all problems of public city administration, but it is a path to reduce costs, and increase efficiency.

Information Technology can also, improve city planning. Mainly in ABB and in executing FRB, this would save public funds as well as current sanctions on plans that did not obey FRB. The use of information Technology for storage and data treatment is beneficial to public administration, for data is used to formulate and elaborate possible scenarios. The estimated for collection of TPT, ST and OTT is an initial point for city planning, for it would start on fixation budget with which the public manager would create guidelines for the expenditures.

The use of information technology tools is an important weapon against fraud and overdue on registry data. There is also the possibility of data integration between the National Treasury and the ST collection database of the city hall. TPT would cover the current lack of updating.

Fighting fraud by data updating is only feasible by the use of intelligent systems and Information Technology; otherwise, a highly bureaucratic atmosphere would be generated, which would reduce efficiency of public services.

The proposed model is based on contemporary Engineering and Knowledge Management concepts which have the goal of analyzing organizational processes for further development of tools which would enhance value of intangible capital, especially knowledge. Usually City Halls have many internal processes which are executed bureaucratically, with a very long information path through several departments until the information is analyzed by the final user, the decision maker.

Information is lost along the path, which jeopardizes decision making. Therefore, in an Engineering and Knowledge Management model, all organizational processes are analyzed for further proposal of a knowledge management tool. This impedes bureaucracy to be digitalized for a dynamic information path is created to run only through relevant process sites. The digitalization of optimized processes and the deletion of unnecessary processes would assure an efficiency enhancement to the organization administration, for public workers would focus on the analysis of relevant organizational processes.

It is important to note that the World Bank does finance public modernization of city administration projects. IT investments have high costs, whether in software or equipment acquisition. The existence of financing sources tends to reduce investment impact in the public accounts, for the amortization occurs usually after the systems have been implanted; That may have already generated a raise on budgets due to higher efficiency.

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