A Business Intelligence Model in Public Administration

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Abstract:

Business intelligence (BI) is a collection of procedures, programs, and tools that together make up a valuable resource for timely information analysis and interpretation, allowing users to make informed decisions and gain knowledge for those in charge of public administrations. The need for trustworthy, timely, and personalised information is evident in the municipal public administration's search for it in order to support decision-making and aid in the creation and management of municipal strategic planning. In order to support the various bodies' decision-making processes, this article analyses and develops a technological and organisational model of a Business Intelligence (BI) that is viable and appropriate for municipal management. The technology under investigation proposes to challenge some BI solution paradigms. A BI model for the municipal public administration is produced using the method of exploratory bibliographic research, which addresses the aspects of technology, processes, structure, people, and skills required to carry out a project of this content. The proposed BI model, it is reaffirmed in the conclusion, enables organising the data scattered throughout a city hall so that they are timely, unique, and understandable. The maximisation of the use of public resources, as well as the direction of the efforts in accordance with the intended and achieved objectives, will be provided, and they can be used to develop strategies and support the decision-making processes of municipal management.

Key words*: business intelligence, public entities, Municipal Strategic Planning, Municipal Public Administration, Decision Support Systems.*

1. INTRODUCTION

All companies of any line of business pay special attention to the decision-making process (Aldehayyat, 2012). Today, an essential component in decision-making is the effective and efficient management of information, for which it is necessary to find new ways of organizing and using the large amount of data that companies produce and accumulate.

Almost every organisation has a lot of data sources. Not just from inside the organisation, but also from outside. Every day, it tries to turn a lot of data into useful information that can be used to make decisions. For example, private companies use one or more operational information systems to help them run their daily business. In the same way, the public administration has a set of management and support solutions for activities that aim to improve the efficiency of the whole. "Over time, the applications get to know the history of the company, and the data in the databases can be used to support any decision you want to make to make the company better" (Neamah, Ali.2021). In practise, the most difficult thing is to find the right data and make it available to users as complete information. This information must be used correctly so that users at all levels can make good decisions that are in line with the organization's goals and strategies and fit with its culture. The main goal of Business Intelligence is to help government agencies quickly analyse information that will help them make better decisions (BI).

Managing a city or town is a very difficult job. It includes the need to find a way to satisfy the most different interests and get results despite having few resources and structures that are often out of date and mainly needing better and more accurate management information.

The municipal public administration doesn't do a very good job of looking for accurate, up-to-date, and personalised information. This makes people wonder what tools and how to set up this situation with new technologies to help people make decisions while keeping in mind the nature of municipal management. This lack is an example of the problem that this article talks about. The goal of this article is to analyse and come up with a technological and organisational model for a good and workable Business Intelligence (BI) for municipal management, which will help its different bodies make decisions.

The reason for researching this topic is that there might be a BI model that makes it easier to get accurate, up-to-date, and personalised information to help with operational and strategic activities of municipal management.

2. THEORETICAL BACKGROUND

2.1. Data, information and knowledge

With the importance given to information and knowledge in this so-called era of knowledge, the difficulty of many organizations in working or measuring knowledge makes its management and use an extremely complicated task for most organizations that still find it difficult to separate and understand what information, knowledge is, or simply data. And mainly to understand that the creation of organizational knowledge largely depends on human contact, intuition, hidden knowledge, cooperation, explanation of mental models and diversity of opinions, which adds subjective concepts currently impossible to be resolved by Information Technology (IT) and Information Systems (IS). And that would be the essence of intellectual capital (Subramanian, 2018).

This appreciation of knowledge for many organizations and especially for public administration is still something new. New theories and technologies are emerging to support this new form of information management and the decision process. With the correct information formatted in a way that allows the correct understanding of decision-makers, it is possible to predict trends, locate bottlenecks, simulate scenarios, optimize resource use, and give the manager the power to plan based on actual facts supported by factual information. And this makes it possible to convert information into knowledge that enables administrators to plan and decide on the best course of "navigation" for their organizations and society in general, see Figure 1.

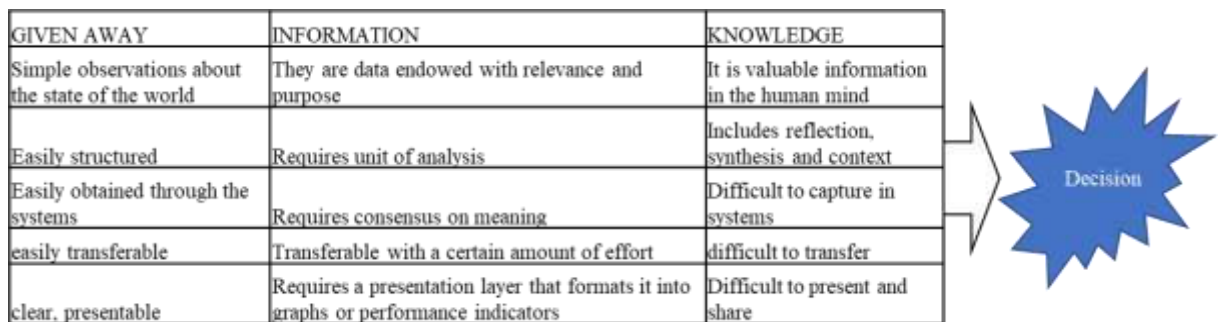| GIVEN AWAY	INFORMATION	KNOWLEDGE
Simple observations about the state of the world	They are data endowed with relevance and purpose	It is valuable information in the human mind
Easily structured	Requires unit of analysis	Includes reflection, synthesis and context
Easily obtained through the systems	Requires consensus on meaning	Difficult to capture in systems
easily transferable	Transferable with a certain amount of effort	difficult to transfer
clear, presentable	Requires a presentation layer that formats it into graphs or performance indicators	Difficult to present and share

Figure 1. Data X information X knowledge X decision (Subramanian, 2018)

For Whyte, (2011) data is a set of letters, numbers, or digits, which, taken in isolation, does not convey any knowledge, that is, does not contain a precise meaning. It can be understood as an element of information. It can be defined as something deposited or stored. As an example, the following can be cited: 5; May; value; X Y Z. For initial conceptualization, information is all data processed or treated. It can be understood as data with a significant value attributed or added to it and with a natural and logical meaning for those who use the information. It can be defined as something valuable. As an example, the following can be cited: customer name, automobile color, number of equipment; birth date; bank balance amount. It is observed that information always requires more than one word. When information is "worked" by people and computational resources, enabling the generation of scenarios,

simulations, and opportunities, it can be called knowledge. The concept of knowledge complements that of information with relevant value and defined purpose. It can be defined as human (tacit) perceptions or computational inferences. As an example, the following can be cited: perception of the difficulty of reversing future losses from an organization's activity; practices that can be used given the current scenario, based on previous similar experiences; the conception of which equipment, materials and people are vital for a service; understanding of which active contracts can be negotiated, aiming at adapting to the reality of an activity. Data, information and knowledge, cannot be confused with decisions (mental acts, thoughts), actions (physical acts, executions), or processes or procedures. As an example, it can be cited: as going to the bank; adding the values, calculating interest; pay the bill. It is observed that always a verb in the infinitive is necessary to characterize a decision or action or process.

Information cannot be just trivial; it must have a personality and opportunity character as a strategic resource in city halls and public organizations (Whyte, 2011). Any and all peculiar information can be called personalized information. Whether physical or legal persona, a business, a product or a differentiated service. It can also be related to a unique characteristic of a "prospect," customer, consumer, or competitor and even a product or service. Any and all information of unquestionable quality, however, anticipated, can be called timely information. Timely information is the antithesis of past information and does not generate an undisputed future scenario. Along with personalized information, they are called intelligent information or information that effectively contributes to the intelligence of organizations. They are also called non-trivial information (Whyte, 2011).

2.2. Decision support systems, data warehouse and business intelligence

Decision Support Systems (DSS) have an essential role in business and today's society, enabling the transformation of primary data into meaningful facts and forms, or instead generating information. And generating knowledge through relationships and aggregation between the data and its guidelines. It is through these sets of facts that value is assigned to information.

As Stair argues, "to be of value to managers and decision-makers, information must have several characteristics. The information must be accurate, complete, cost-effective, flexible, reliable, relevant, easy to understand, current and verifiable. The value of information is directly linked to how it helps decision makers to achieve the organization's goals" (Stair, 1998).

Our society is becoming dependent on information technology, and practical information systems can significantly impact corporate strategy and organizational success. For the reduction of expenses, security, better services, and decision-making with a more remarkable power of analysis and foundation. The definition of Data Warehouse (DW) varies significantly from author to author; for Inmon, one of the principal authors and known as one of the "fathers" of this area, "is a subject-based, integrated, non-volatile, and variable in relation to time, to support managerial decisions". For Devlin, it is simply a complete, consistent store of data from different sources. (Kurnikova, 2019)

Business Intelligence is a term more used today and more comprehensive than the previous ones. It can be translated as Business Intelligence or Business Intelligence - it is a set of management methodologies implemented through software tools, whose function is to provide gains in managerial decision-making processes and senior management in organizations. It is based on the analytical capacity of tools that integrate in one place all the information necessary for the decision-making process. Business Intelligence's objective is to transform data into information, mainly knowledge, supporting the decision-making process, with the objective of generating competitive advantages (Wixom, 2011). The term Business Intelligence (BI) was created by the Gartner Group (a consultancy that conducts market research in the area of information technology) in the 1980s (Negash, Solomon. 2004). Bearing in mind the particularities of Municipal Public Management and observing the words of Alvin Toffler, who emphasizes "the contradiction between the need for careful channeling and rigorous control of information, on the one hand, and the need for innovation, on the other. The more secure and certain a business information system, and the better it is protected, predefined, pre-structured and policed, the more it will restrict creativity and stifle the organization" (Song, 2018).

We have to be concerned with establishing a system that allows us to provide information relevant to the decision-making and structured process in a consolidated manner. That favors the analysis of large volumes of data and obtaining strategic information, facilitating decision-making and meeting municipal management's needs and specifications, not incurring the error of generating information that restricts the decision-making process or induces errors by the data they generate. Poorly qualified information that stifles creativity or leads to faulty decisions. But yes, keeping in mind the analysis of large volumes

of information, past events, that allow us to make decisions in the present, and the desirable, the prediction of future events.

2.3. Strategic Municipal Administration

Strategy is a word that is used a lot these days, but it is something that has been introduced previously. Strategic thinking can be observed since the 4th century BC, when Sun Tzu, a Chinese general who lived at this time, prepared his manuscripts compiled in the book "The Art of War" and remains so current, as it deals with the leader's responsibility, actions and decisions in the confrontation to the challenges and confrontations aiming to reach an objective. The concept of strategic management has evolved over time and there needs to be more consensus on its precise meaning. A modern approach can define strategic management as a continuous and iterative process that aims to keep an organization as a whole adequately integrated into its environment (Aldehayyat, 2012).

Strategic management is a broader term that encompasses a series of stages, steps and activities (internal and external) that top management must carry out in the organization (Ferreira, et al 2014). It is a continuous and iterative process that aims to keep an organization as a whole adequately integrated into its environment. Management is a science. Strategy can be understood as a set of activities necessary to achieve objectives or results. It can be composed of a plane, pattern, position, perspective, agenda, or pretext (Arveson, Paul.2012).

Public administration is going through a moment of rethinking its role in society, changing its objective, which was previously seen as controlling the course of society, to a vision where it seeks to support citizens in finding their interests. With this change, the public administration needed to rethink the modus-operandi of the productive processes currently existing in the government and seek ways to improve its internal and external processes, placing citizen satisfaction as one of the main objectives to be achieved. In the municipal public administration, this transformation is felt more intensely, as it is the Public Power that is "closest" to the citizen and has the task of managing the infrastructure of cities, being closely related to the quality of life of its citizens (Schiavone, 2020).

As an alternative in the search to overcome these challenges, the application in public administration of management models from the private sector and the use of new technologies in the transformation and modernization of public management, including municipal management, emerged. This new "doctrine" was named New Public Management (NPM), or New Public Administration. NPM presupposes applying management models from the private sector to public organizations and the concepts of strategic management focused on corporate business and entrepreneurial principles.

2.4. Municipal Strategic Planning

For the purposes of analysis, municipal public management can be broken down into two strong strands: urban management and municipal management. Urban management is the definition of guidelines and norms to guide the physical growth, construction and public or private works of cities, focused on urban territorial expansion, demographic management and socio-economic development. The main product of this urban planning is the Master Plan of the municipality; this plan is mandatory for municipalities with more than

Twenty thousand inhabitants and metropolitan areas, according to the Federal Constitution. Municipal management is related to the management of the municipality through its servants, being the administration of the public machine (Schiavone, 2020).

According to Poister (2005), the MSP is a management instrument that, like any other, has a single purpose: to make the work of a city or city hall more efficient. The strategic focus on local development reduces indecisions and favors economic, social and political transformations in cities, to coherently deal with the multiplicity of initiatives on the municipality, seeking a consensus among the multiple actors (including the government) in the selection of a future desirable and feasible. For Sasanpour, (2012), the MSP coordinates a city's various levels and strategic functions in a global project, considering the mission, strategies, budget and control of objectives and municipal actions. Still, Moshtari, (2006) reiterates that planning is a way of learning about external demands and needs and about the capacity of response of the municipal administration to reveal expectations and value references, and essences to a workgroup.

With the Federal Constitution of 1988, a process of decentralization began that resulted in greater autonomy for municipalities, where traditional urban planning instruments were no longer adequate to deal with transformations in medium and large cities. In this context, as an application of the NPM and

an evolution to the existing plans and plans, Municipal Strategic Planning (MSP) appears. The MSP aims at elaborating long-term strategic planning for the city, involving the participation of the most significant possible number of actors and perspectives, seeking to develop the strengths and work on the city's weaknesses. Although the Municipal Strategic Planning is still in a maturation phase in the country, with several municipalities spread across Iraq carrying out their MSP, this planning is not yet mandatory and its methodology and final format still depend on the results that will be achieved in these pioneering cities.

In Europe and the United States, there are already many consolidated cases of success in planning the city in the long term, preparing and implementing a Municipal Strategic Planning (for example, the city of Rock Hill's). Municipal strategic planning is influenced by several laws and norms, including the laws of the budgetary system (Pluriannual Plan, Budgetary Guidelines Law, Annual Budget Law), Fiscal Responsibility Law and even the Master Plan, which becomes Law after approval by the Chamber of Councillors. The Pluriannual Plan (PPA) is a long-term plan (4 years) that aims to determine guidelines, objectives, and goals of public administration related to programs of continued duration. It is prepared in the first year of the mayor's term and continues until after the end of his term. The Budget Guidelines Law (LDO) will guide the elaboration of the Annual Budget Law, encompassing the goals and priorities of the public administration. It is prepared annually, dealing with the subsequent financial year. The Annual Budget Law provides the resources for each action contained in the LDO, establishes expected revenues and authorizes municipal expenditures. It is annual. The Fiscal Responsibility Law dates back to 2000 and aims at planning and transparency of public accounts, through the fulfillment of results goals (Schiavone, 2020).

Municipal policies are proposed actions in a given area, making public the activities that the public administration intends to carry out. Participatory projects encompass actions carried out by public authorities in conjunction with the private sector, the third sector, civil society, and citizens. Still, according to Schiavone, (2020), human resources planning still interacts with the conception of Municipal Strategic Planning, defining the qualification of the people involved in the referred process and the planning of information and technologies, defining the organization of information and technologies to support the planning.

The complexity of preparing the Strategic Planning of the municipalities and the great relevance, even in essence, of providing the municipal manager with reliable information quickly and in the most diverse spheres of municipal public management is evident.

Only an effective information system will allow the public manager to prepare a plan consistent with the population's wishes, but mainly, only with an efficient information system supporting decision-making will he be able to control the directions, interactions, actions and effectiveness of what was planned.

2.5. Agile BI Municipal Strategic Planning

To implement business intelligence, it is necessary to follow a series of phases where the project is planned, the work teams are structured, the data is analyzed to make decisions, and once the corrective actions are implemented, a follow-up is carried out. And control. However, most organizations face the challenge of rapid and frequent adaptation to their information systems to respond to emerging requirements. It happens similarly to BI systems that must also adapt to the dynamic environment quickly.

In a survey conducted by Forbes (Moreno 2017), 92% of top executives surveyed believe that agility in organizations is critical to business success.

An agile BI solution should provide access to accurate information in the correct format to the right person at the right time (Soon, 2011).

Its principles are:
• Continuous improvement in short cycles.
• Quick deliveries of value.
• Validated learning of business intelligence.

There are numerous agile methodologies used by different companies that can also be defined as frameworks; however, whichever method is chosen, you must ensure that it fits with the culture of your company. This is the only way to get all the value they can bring (Shamsi, 2016)

The question of which work methodology works best is a challenging one. However, a methodology that manages projects iteratively and aims at continuous improvement of the process, always being carried out through visual workflows, was considered.

3. RESEARCH METHODOLOGY

This is a descriptive study, classified as qualitative and exploratory. Kitchenham's methodology (2004) was used for the Systematic Literature Review, having defined the question and, from there, selecting, evaluating and extracting the information contained in the identified works. Exploratory bibliographic research of electronic documents, books, periodicals and notes was carried out (Pasian, Beverly, 2015). The conceptual basis for strategic administration, public management and Business Intelligence was sought, resulting in the construction of hypotheses, with the proposition of a viable BI model for municipal public administration. This study involved a "case study" field research, which according to Yin (2005) investigates a contemporary phenomenon within its real-life context, specifically when the boundaries between phenomenon and context are not clearly defined. Due to the uniqueness of the studied phenomenon, we realized the need for a more detailed description of the case that will be based on several sources of evidence.

The methodology to model the BI structure for a public administration included the following phases: the constitution of the theoretical-conceptual bases; study of municipal public administration structures; study of BI technologies and solutions in organizations; study and use for testing and knowledge of the proposed BI technology, in addition to surveying its costs and complexity; and documentation of results.

The research methodology has great emphasis on the inductive method favoured by the lived experiences of the authors and seeks to present ways to satisfy the need for information of municipal public managers. Therefore, it fits the qualification of qualitative research (Lakatos; Marconi, 1991). The research has a practical objective for city halls; therefore, it can be considered applied research (Silva; Menezes, 2001). Thus, it encompasses a vision of multi-methods to meet the proposed objectives, merging approaches and integrating inseparable research instruments (Rouhani, 2012).

4. BUSINESS INTELLIGENCE (BI) FOR MUNICIPAL PUBLIC ADMINISTRATION

Initially, a study of a "classic" BI is carried out, addressing the technology involved. Then, a new BI model is proposed, supported by an emerging, proprietary technology that is still being disseminated in the market, resulting from the evolution of data processing and storage technologies. In this proposed model, aspects of the technology itself, the process and structure for implementation in a city hall, as well as the people and skills needed for a project of this type, are addressed.

4.1. *A "Classic" BI model*

The technology of a BI, which here was called "classic" (with the existence of a Data Warehouse), can be seen in Figure 2. The structure begins with operational databases resulting from OLTP (Online Transaction Processing) systems. OLTP are the information systems used in the operationalization of the daily needs of organizations; they are based on applications and transactions, have a high number of accesses, and are constantly updated (INMON, 1997; PERKINS, 2005).

The next phase is the ETL (Extract, Transform, Load), in this phase, the data is cleaned, edited and reformatted, as these come from different sources, are in different file formats and business rules.

Then there is the Data Warehouse itself; there are several Data Warehouse project models; among them the star schema can be highlighted, as it simplifies the project to be better understood by non-technical users; in this schema, the data is normalized and structured in different dimensions. In the Data Warehouse, a new entry is created for each change, creating the dimension of the variant in time, essential and differential item of a Data Warehouse.

Data Marts can be thought of as subject-oriented subsets of the Data Warehouse. Data access is performed through OLAP (Online Analytical Processing) tools, which allow the Data Warehouse and Data Mart data analysis function, enabling research, mathematical calculations and data formatting. Metadata, which is the "data about data," it is a dictionary of the data, with information about the origin,

name, format and various other information related to the data of a Data Warehouse (Bodendorf, 2000; Dell'Aquila, 2006).
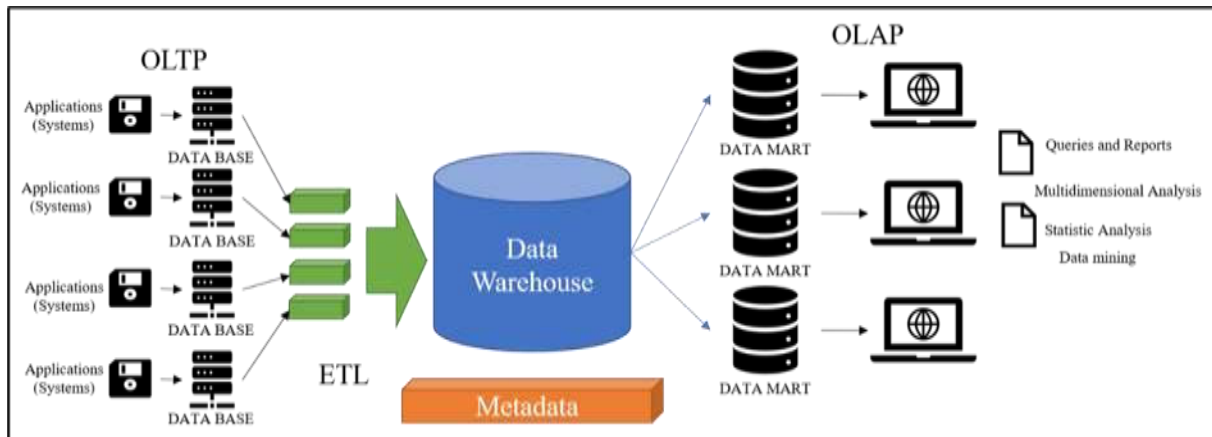

Figure 2. Traditional BI with Data Warehouse.

4.2. The proposed BI model

4.2.1   The technology to support this new BI model:

The technology to support this new BI model: Some organizations are looking for alternative BI solutions without going through the Data Warehouse, first building the coordinated Data Mart using the exact dimensions throughout the model, ensuring corporate integrity. With this, a modular implementation is achieved, according to the budgetary possibilities of the moment, without having to rework for a corporate solution, integrating these different modules.

But even these solutions, which adopt OLAP tools, are primarily necessary for large ETL projects with the extremely painful acquisition, implementation and maintenance costs, in addition to the high costs of storing these large volumes of "redundant" data.

In an unstable environment, where decision-making processes are based on information and knowledge, private and public organizations are looking for solutions that enable a future vision, strategic planning and management indicators. With technological advances, solutions are emerging to improve this cost-benefit ratio, offering a BI solution but without going through lengthy and costly Data Warehouse and Data Mart projects or costly OLAP tools.

In this new context, which in the future may be analysed as a moment of the breaking of BI paradigms, when alternative solutions with lower costs arise, it may represent the opportunity for municipal public administrations to have their BI solution, to support their process. Decision-making and strategic planning. This technology is practically unfeasible and beyond the reach of municipal administrations in the way, it was previously proposed.

In this alternative model, a "script" is generated, loading data directly from the OLTP databases. With the mechanism called AQL (Associative Query Logic), which while moving data to a repository, does not replicate information, it associates records using pointers, so reading only non-duplicated data and pointers is loaded and used from the repository in memory. When a selection is made, it propagates through the memory-generated relational database. It already has the ETL (Extraction, Transformation and Load) built-in and integrated into the tool, enabling data cleaning and loading. It works as an analytical engine, which can have unlimited dimensions and compresses the loaded data by up to 80%. Finally, it also has reporting functionality similar to OLAP tools, enabling the creation of dashboards, KPIs, charts and several other report formats (QLIKVIEW, 2004; QLIKVIEW, 2005).

There is a relational database in the AQL file, and each search is propagated in this relational database, which is loaded in memory, as shown in Figure 3, bringing answers quickly and enabling the modeling of searches in a flexible way. Here the relational data model is combined with the multidimensional data model; it can be analyzed that several cubes are generated that relate to each other.
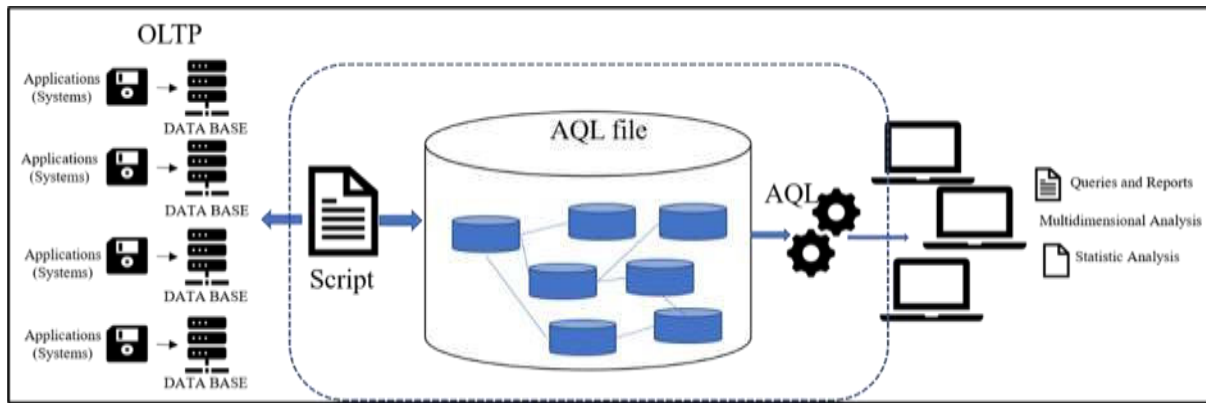
Figure 3 - How the technology of the proposed BI model works

4.2.2   Structure proposal to adapt this BI model to a municipal public administration:

As previously mentioned, with lower costs and project time, this model can make it feasible for city halls to implement a BI for public administration to support their decision-making and strategic planning process.

In a city hall, this model could be structured by a secretariat (Municipal Secretariat or Municipal Thematic), and a secretariat can consult data on several subjects (such as health, education, finance, works). So, each secretariat should have its own BI structure, consulting data on subjects that a given secretariat deals with and being able to relate these data with other databases referring to matters pertinent to other secretariats. For example, in the health department, the vision desired by the health manager but crossing with the financial data, if this was desired by the manager.

Each secretariat would then have its Intelligence Center (the name given to the environment where the BI would be operationalized) directly linked to the secretary responsible for this secretariat, see Figure 4. This Intelligence Center would have the primary mission of supporting the decision-making process of this department. Secretary and assist him in the conception and control of his sectorial strategic planning and in his alignment and reach of the municipal strategic planning, using the proposed model and BI for this.

In this Intelligence Center, information at a tactical (or managerial) level will be worked on, as well as at a strategic level, in terms of compliance by the given secretariat with the objectives of the municipality and the municipal administration as a whole. Another exciting action would be to use the tool to carry out audits, search the databases for abnormal situations, such as active servers over 70 years old, or cross the amount of paper with the number of ink cartridges and printers for the detection of waste or disappearance of paper or ink.

The Municipal Intelligence Coordination would be created in the Mayor's Office, this coordination would have a role similar to that of the Intelligence Centers, with the difference that it would be focused on the Mayor's vision and needs and would work mainly with strategic information. This coordination could access all the results of the Intelligence Centers, but only by viewing this information. In addition, it would work independently from the other Centers, creating its own surveys, analyses and reports, with the mission of supporting the Mayor's decision-making process and the conception and control of municipal strategic planning with a comprehensive and future vision.

In this model, "metadata" would be of great importance and its format with the information that must be included (such as data origin, data format, definitions of business or public activities, data quality indicators, among others). It would be standardized for the entire municipal administration. Each Intelligence Center or Coordination would be responsible for its metadata, which would follow the standardized format and be disclosed to the rest of the structure.

This BI model structured in this way would allow great freedom and power to the secretariats; through their Intelligence Centers, they could format and use the BI according to the manager's needs, customizing the support system for decision making and monitoring of strategic planning, at a tactical (or managerial) and mainly strategic level.
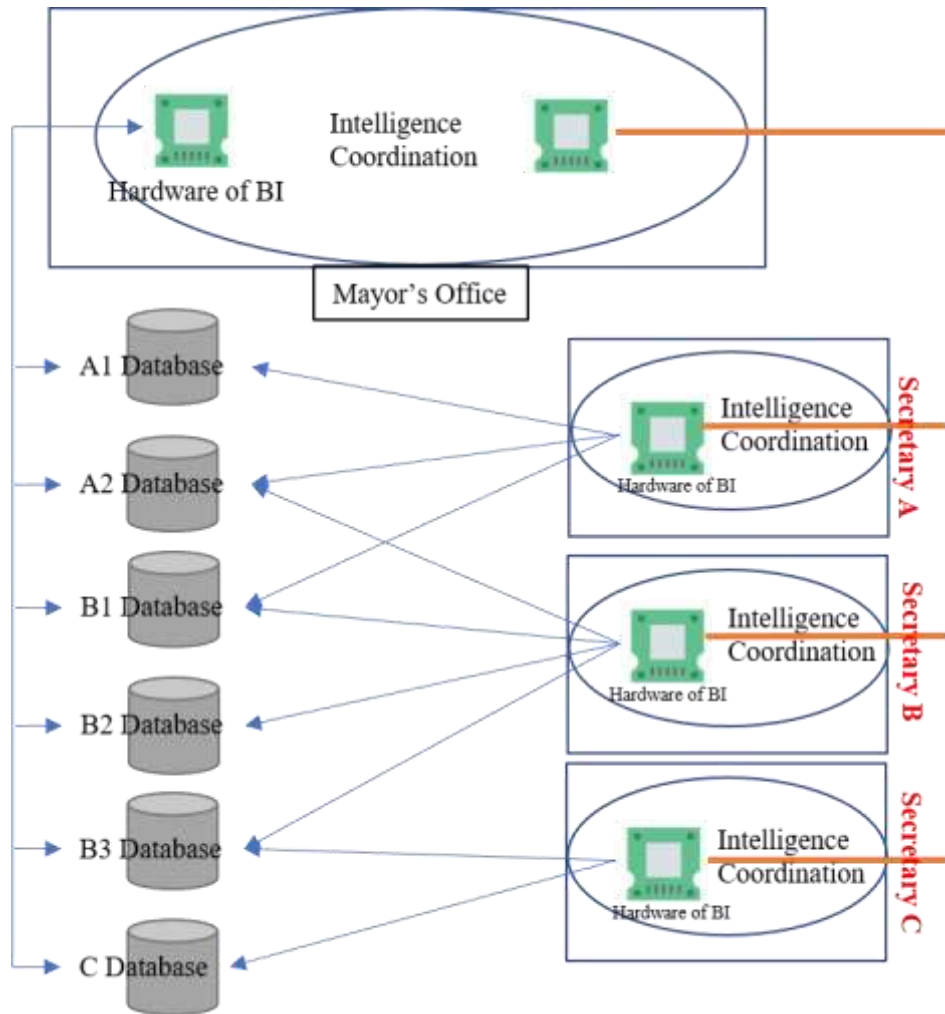
Figure 4 . Proposed BI model in a city hall

An Intelligence Center could group several departments in medium city halls with fewer resources available.

It would be possible for the Mayor to monitor the work and use of BI in all departments, viewing the consultations, results and use of BI in these departments in parallel with the secretaries. The mayor would then have at his disposal several perspectives, elaborated by the intelligence centers of the different secretariats, represented in Figure 5.

The mayor would also have the municipal Intelligence Coordination at his disposal, customizing the use of BI in a personalized way, according to his needs, to directly support his decision-making and the strategic planning of the municipality with a comprehensive and future vision of the municipal administration.

Ahmad et al. (2020), through a case study carried out in different countries with the managers of 12 multinational companies in the textile and clothing segment, which have a staff ranging from 5,000 to 57,016 employees, concluded that the implementation of BI, in general terms – and considering the due peculiarities – had a positive effect on decision-making, improving resource utilization in business processes, energy consumption and the use of materials with better alignment of processes across the industry, leading to sustainable financial improvements in the era of Industry 4.0, and providing, in effect, the leadership of this market segment. According to research conducted by Divatia (2021), certain indicators indicate the degree to which an organization's BI&A capabilities have developed. Companies with more developed BI&A capabilities used it in more departments and reaped more benefits from it overall, as evidenced by the study's findings.
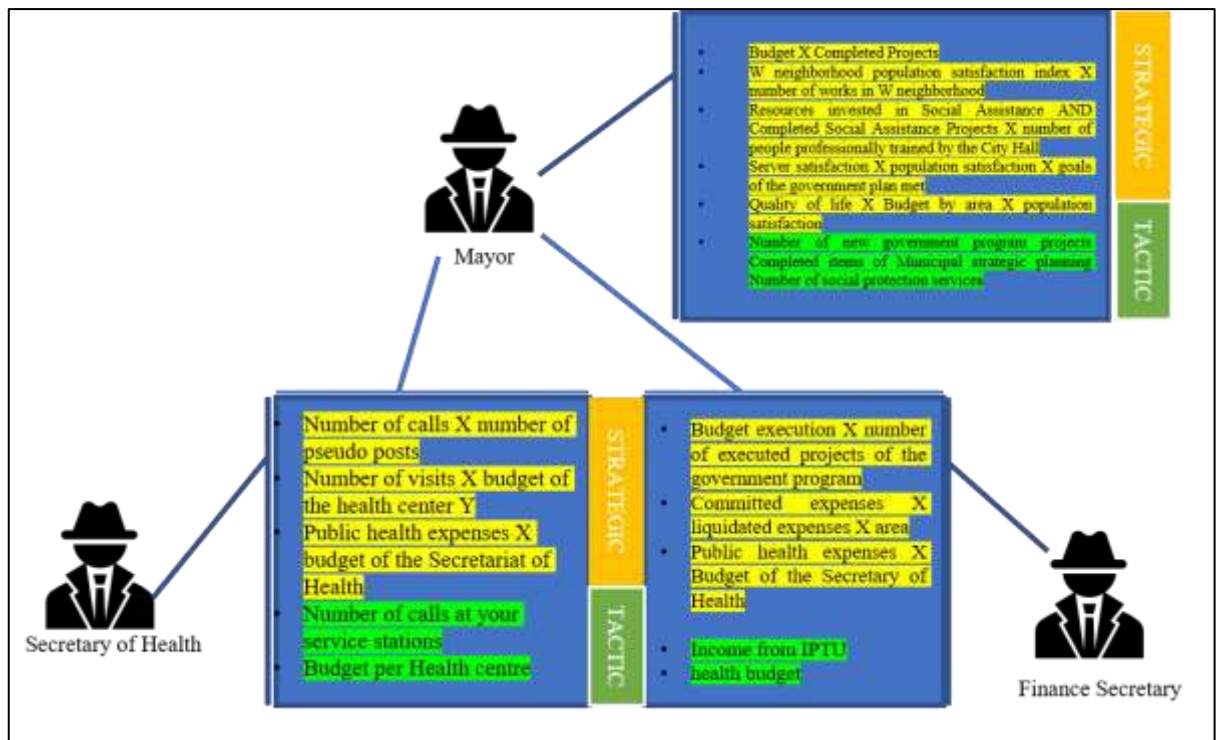
Figure 5. Example of the different views of the information generated (strategic, tactical or managerial level) by the work of the Intelligence Centers and by the Intelligence Coordination (Whyte, 2011).

It is essential to highlight the significant differential of BI when it allows the treatment of the time dimension in the analyses that are carried out, allowing historical analysis together with other tactical (or managerial) and strategic information.

4.2.3   people and skills needed to implement the proposed BI model

The people involved are fundamental for successfully implementing the proposed BI solution. The proposal is firmly based on the training and competence of the actors involved in the model.
The actors and capabilities involved in the proposed BI model are:
⇒ The Mayor or Municipal Secretary: the actor who has the power of decision-making and the main "client" of the BI solution. Understanding their vision and information needs for decision-making is essential.
⇒ Business Analyst: Actor with knowledge of the business, existing processes and the strategic planning in which it is inserted. Must have direct contact with the Secretary or Mayor to raise their real needs and desires about decision-making and strategic planning. Must be trained, at least at a basic level, in the BI tool and it is desirable to understand the model as a whole.
⇒ BI Specialist: Actor with extensive knowledge of the tool and model of the BI solution.
⇒ Database Administrator (DBA) or Data Administrator (AD): The first is responsible for the technology involving the databases, the second is responsible for the logical model of these banks. In many organizations, these roles are developed by the same person. In the proposed model, the DBA must provide access to the databases and the AD has the critical role of explaining the logical models of the databases involved. It is desirable that the AD has training in the BI tool and understands the model as a whole, being able to contribute with BI specialists and business analysts.
Despite being separate and having different technical knowledge, these roles could even be performed by the same person.
In this structure, each secretariat would have its own business analyst, who must be a trusted person with direct contact with the secretary of the given secretariat, not needing to dedicate himself exclusively to the BI (a minimum dedication of 20 hours/week is suggested) .

There would be a group of specialists in BI, which does not need to be a large group of people since they will be circulating through the secretariats, and they are the ones who will be implementing the BI tool.

The work of the group of BI specialists would be supported and executed together with the ADs and DBAs, who should actively participate and, when necessary, go to the intelligence centers to, together with the BI specialist, implement the BI solution requested by the business analyst business.

So, the business analyst would be defining the needs of the secretary/mayor and operating the BI tool together with the BI analyst. The BI analyst would implement what was defined by the Business analyst in the BI tool, seeking to make the most of all the possibilities and functionalities that the BI tool provides, with the support of ADs and DBAs, represented in Figure 6.

There should still be a structure responsible for technical support to information and communication technology resources.
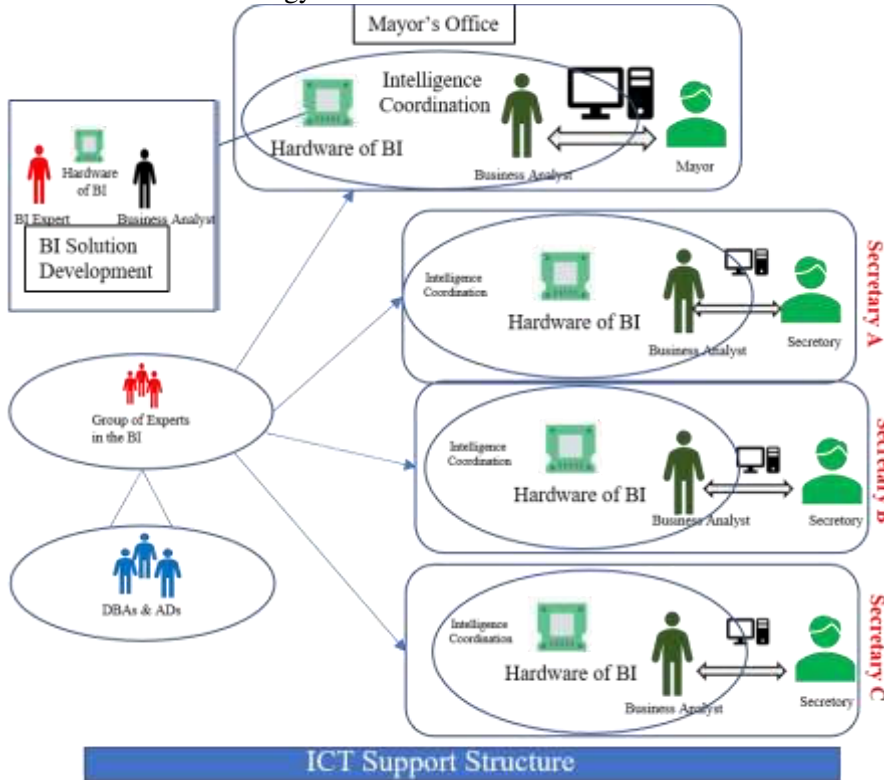

Figure 6. Structure and roles involved in the proposed BI model.

4.2.4   *Positives and Negatives of the proposed BI model*

The following summary in Formal Table 1 was developed to understand the advantages and disadvantages of the study based on the above explanation.

Table 1. Positive and negative points of the proposed BI model

Strengths	Negative points
Technology	
Much lower costs compared to classic BI solutions	Model-based on a proprietary technology
Faster model execution compared to classic BI solutions	Less robust than a classic Data Warehouse solution
Flexibility	relatively new technology
Unlimited number of dimensions	

Possibility to organize and browse different levels of information	
Technology being used by some big companies like: IBOPE, Honda, Pfizer	
Process and Structure	
Possibility of customizing the solution to meet the needs of the Secretaries/Mayor	Existence of conflicting information due to different views that will exist of the data
Metadata is known to everyone involved in the solution.	
Possibility of modularization of the solution	
People	
Training and dissemination of the model to virtually everyone involved	Dependence on a good understanding of the actors involved (highlighting the critical role of the business analyst)
The interaction of actors from different areas of knowledge enriches the solution	
Well-defined roles for the success of the BI solution	

These positive and negative points allow the municipal manager to evaluate the proposed model and analyse its implementation.

5. CONCLUSION

Since the management of municipalities is a challenging and highly complex task to measure, with limited resources and structure available, which are often obsolete, there needs to be more adequate, accurate and timely management and strategic information.

Technology was approached as a new tool that proposes to break some BI paradigms. The process was also addressed regarding how to structure this scenario and the role of the people involved in such a solution. The proposed technology has lower costs than other traditional BI projects, which were unfeasible even for large city halls.

The advantage of the proposed model is directed to the organization of data dispersed in the municipal public administration to make them intelligible and then study them to generate knowledge. As a practical application, it would be helpful to develop strategies and support the decision-making processes of municipal management, providing the maximization of the use of public resources. As well as directing efforts following the intended and achieved objectives, guided by coherent information (timely and personalized), agile, and arranged in an organized manner according to the needs of the managers of the various municipal bodies and mainly of the mayor.

The contribution of this work to the academy is the survey of a possible evolution in available BI technologies. This evolution is not directly linked to quality, but accessibility, since these solutions were costly and inaccessible to most private or public organizations. This technology can represent a new form of BI with lower costs. For city halls, it serves as an initial model for a BI project at affordable costs and with results in a short or medium period (which is not possible with traditional BI solutions).

The main limitation of this work is related to the non-effective use of the technology studied in a natural environment of a city hall since more applied field research with a municipality that used the proposed model would allow an analysis of the practical impacts in a municipal management the implementation of a solution such as a proposal.

As an evolution of this work, a case study of this technology and some elements of the proposed model could be carried out to meet the needs of a municipal secretariat or even a city hall.

References

Ahmad, F., Widén, G., & Huvila, I. (2020). The Impact Of Workplace Information Literacy On Organizational Innovation: An Empirical Study. International Journal Of Information Management, 51.

Aldehayyat, Jehad & Anchor, John. (2010). Strategic planning implementation and creation of value in the firm. Strategic Change. 19. 163 - 176. 10.1002/jsc.866.

Arveson, Paul. (2012). Strategic Management of Scientific Research Organizations. Journal. Washington Academy of Sciences, Washington, D. C. 98. 31.

Barzelay, M., 2001. The New Public Management: improving research and policy dialogue. Regents of the University of California. Ucpress, California.

Bodendorf, Freimut & Saueressig, Gabriele. (2000). Internet Based Self Service Systems for Customer-Oriented Processes in Public Administration.. 1131-1135.

Dell'Aquila, Carlo & Lefons, Ezio & Tangorra, Filippo. (2006). Building data warehouse: Design and case analysis. 3. 510-517.

Divatia, A. S., Tikoria, J., & Lakdawala, S. (2021). Emerging trends and impact of business intelligence & analytics in organizations: Case studies from India. Business Information Review, 38(1), 40–52.

Ferreira, João J. & Raposo, Mario & Mainardes, Emerson. (2014). Strategy and Strategic Management Concepts: Are They Recognised by Management Students?. E+M Ekonomie a Management. 17. 10.15240/tul/001/2014-1-004.

Kitchenham, Barbara. (2004). Procedures for Performing Systematic Reviews. Keele, UK, Keele Univ.. 33.

Kurnikova, M.V.. (2019). The Model Of Municipal Strategic Planning In The Context Of Digital Economy. 1469-1482. 10.15405/epsbs.2019.03.149.

Moreno, H. «to jump through the hoops of digital disruption be agile» [Online]. Available: https://www.forbes.com/sites/forbesinsights/2017/11/16/to-jump-through-the-hoops-of-digital-disruption-be-agile/#4ef395bb559b.

Moshtari, Mohammad & Emamian, Mohammad. (2006). Strategic Planning Process of Municipality. SSRN Electronic Journal. 10.2139/ssrn.1569512.

Nachmias, D.; Nachmias, C. 1987. Research methods in the social sciences. 3th ed. St. Martin's Press, New York.

Neamah, Ali. (2021). Adoption of Data Warehouse in University Management: Wasit University Case Study. Journal of Physics: Conference Series. 1860. 012027. 10.1088/1742-6596/1860/1/012027.

Negash, Solomon. (2004). Business Intelligence. Communications of the Association for Information Systems. 13. 10.17705/1CAIS.01315.

Pasian, Beverly. (2015). Designs, Methods and Practices for Research of Project Management. Gower PublishingEditor: Beverly PasianISBN: 978-1-4094-4880-8

Poister, Theodore & Streib, Gregory. (2005). Elements of Strategic Planning and Management in Municipal Government: Status after Two Decades. Public Administration Review - PUBLIC ADMIN REV. 65. 45-56. 10.1111/j.1540-6210.2005.00429.x.

Rouhani, Saeed & Asgari, Sara & Mirhosseini, Vahid. (2012). Review Study: Business Intelligence Concepts and Approaches. American Journal of Scientific Research, Issue 50 (2012), pp. 62-75

Sasanpour, Farzaneh & Mehrnia, Siamak. (2012). Comparative Survey of City Development Strategy in Several City of Worldwide. Journal of Sustainable Development. 5. 10.5539/jsd.v5n4p192.

Schiavone, Francesco & Appio, Francesco & Mora, Luca & Risitano, Marcello. (2020). The strategic, organizational, and entrepreneurial evolution of smart cities. International Entrepreneurship and Management Journal. 16. 1155–1165. 10.1007/s11365-020-00696-5.

Shamsi, Deedar. (2016). Comparative study of Agile Business Intelligence and Agile Data Warehouse. Global Sci-Tech. 8. 37. 10.5958/2455-7110.2016.00005.7.

Song, Xiaoyang & Liu, Jinlin & Wu, Jingxian & Mao, Ying. (2018). Study on health management decision support system. Journal of Interdisciplinary Mathematics. 21. 1463-1470. 10.1080/09720502.2018.1512202.

Soon, Lisa & Fraser, Campbell. (2011). A Knowledge Management Approach: Business Intelligence in an Intranet Data Warehouse. GSTF International Journal On Computing. 1. 10.5176/2010-2283_1.2.59.

Subramanian, Kalpathy. (2018). Doing Business In The Information Age. International Journal of Innovative Research in Engineering & Management (IJIREM) ISSN:, Volume-5, Issue-3, page 99-104.

Wheeland, C., 1993. Citywide strategic planning: an evaluation of Rock Hill's E. Public Administration Review. Vol. 53, Iss. 1; pg. 65-73. Washington.

Whyte, Jennifer & Levitt, Raymond. (2011). Information Management and the Management of Projects. The Oxford Handbook of Project Management. 10.1093/oxfordhb/9780199563142.003.0016.

Wixom, Barb & Ariyachandra, Thilini & Goul, Michael & Gray, Paul & Kulkarni, Uday & Phillips-Wren, Gloria. (2011). The Current State of Business Intelligence in Academia. Communications of the Association for Information Systems. 29. 299-312. 10.17705/1CAIS.02916.

Yin, R.K. (2005). Case-Study: Design and Methods. Bookman publisher.