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PAPER:

USING INFORMATION TECHNOLOGY TO IMPROVE TAX AND REVENUE COLLECTION

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Acknowledgment

I am profoundly thankful to God for the opportunity to be here.

Contents

1. Introduction

> *"This [Cybernation[1]] results in a system of almost unlimited productive capacity which requires progressively less human labor. . . . Potentially unlimited output can be achieved by systems of machines which will require little cooperation from human beings." Robert Theobald and Ad Hoc Committee on the Triple Revolution, 1964.*

The technological innovation has been an important matter in tax and revenue collection. The advent of new instruments to help businesses work more efficiently affects the way taxes and revenues are collected. Information Technology (IT) changes at a rapid pace that the existing fiscal systems become obsolete in a short period of time. The necessity to integrate former existing structures is becoming more demanding since new applications need to be created to assist the dynamics of financial processes. In addition, the quantity of processing data augments each year, which requires a scalable infrastructure to keep the fiscal processes working.

For a long time, IT has played a major role in data oriented businesses, which extracts and process information in order to achieve their goals. Tax and revenue service is basically founded on financial data about individuals and businesses. In order to serve the government – indirectly the nation that elected the political agents – the Internal Revenue Service (IRS) is almost completely dependent on IT since its activities are essentially based on processed data that yield information to collect taxes and revenues.

[1] "Cybernation is a combination of automation (in which human energy is replaced by mechanical energy) and cybernetics (in which human thought is replaced by computer thought)." William Braden. The Age of Aquarius; Technology and the cultural revolution, p.135. Chicago, Quadrangle Books, 1970.

The mission of collecting tax and revenue in accordance with the applicable legislation is a complex task because of the massive amount of taxpayers and the different rules that are applied for each case. To perform the alluded duty, many different systems exist with the intention of assisting the IRS personnel to carry out their job. Nevertheless, with the amount of data growth and the constant advancement of technology, a permanent rational sustainable innovation practice may be necessary to keep the IRS business processes running adequately.

A well elaborated IT project with a robust and stable infrastructure is not sufficient to perform a good job in terms of data processing. Once the mechanisms are prepared to initiate the data processing, a very important factor is the reliability of the information that feed the system. Since the processes work with previously collected records, depending upon the input, the output may substantially oscillate. A known expression that could be applied for that behavior might be “garbage-in, garbage-out”. In order to predict discrepancies in calculations, it would be necessary a history of past trustworthy data, which show the evolution of the outcomes taking into consideration a number of consistent parameters.

The creation of a trustworthy history of digital records is essential to adjust the precision of the results. The process to obtain reliable information involves different activities such as inspection, auditing, assessment, and data entry. It is expected that every part of the process precisely does its task supplying the information that acutely exhibits the fact. The activities related to customs inspection, income and revenue assessment, and fiscal policy enforcement are vital in the process of obtaining dependable input data.

Since most of the fiscal processes are performed on individual basis with intense manual procedures, the final result may yield a relevant margin of errors. The computerization of all the processes steps plays an important role in minimizing the errors, standardization of the operational procedures and reducing costs. It may assure that the practice is in accordance with the current legislation. Furthermore, a computerized tax system may reduce the operational costs of revenue collections. With a reduction in expenditures, a probable residual budget may be invested in means to enhance the citizens' welfare prioritizing the society needs.

2. Motivation

The worth of having an efficient, reliable and fair way to collect tax and revenue may be justified by understanding the importance of taxation in our society. The following statement[2] written by Dr. Jaffe with reference to the William J. Ashworth's book entitled *Customs and Excise: Trade, Production, and Consumption in England, 1640–1845* may show the alluded line of thought:

"The importance of taxation for the state and civil society has always been both evident and multivalent. At one level, taxation is a simple shillings-and-pence issue that readily evokes deep-seated expressions of anger and resentment. Protest movements, demonstrations, and, of course, revolutions have been sparked at least in part by high and inequitable taxes. On another level, however, taxation expresses a wide variety of political objectives and social meanings. The relative distribution of wealth, the progress and poverty of commerce and manufacturing, the power and might of nations, what is eaten and what is worn, the nature of law, justice, and liberty – all of these issues are reflected in the history of customs and excise taxes. Indeed, as William J. Ashworth notes, some have suggested that ***taxation and revenue not only contributed to the formation of the modern state, they essentially created it****."*

[2] http://muse.jhu.edu/journals/technology_and_culture/v046/46.1jaffe.pdf as of November 24, 2008, p.247.

The benefits of taxation are usually embedded into the social structure and may not be recognized by the citizens. The judiciary system, the national defense organization, and the public infrastructure financed by the government can be considered examples of outcomes yielded by the taxes. The judiciary system can be viewed as a regulatory institution, which ensures that the society conduct will meet the terms of existing laws. In this way, the citizens may feel secure because an institution can assure their legal rights. In an international context, the national defense organization is responsible to ensure the nation's sovereign and defend its interests overseas. The public infrastructure that includes road and rail network is directly available to use by the citizen.

According to Oliver Wendell Holmes, former Justice of the United States Supreme Court, "taxes are what we pay for a civilized society."[3] In a certain way, the organization of a society demands resources in order to accomplish a level of welfare. The stabilization and maintenance of social order may help to promote safety, development and prosperity. A secure and stable nation gives people more condition to promote long term plans to improve the society wellness. In this manner, such benefits are paid through the government taxes charged from the citizens.

In order to understand the modern taxation mechanism, it is important to analyze the entire tax cycle to comprehend how it is originated. A particular analysis is from the perspective of a democratic society in which people can vote to elect their public representatives. The elected representatives are supposed to act for accomplishing the voters' common will. The representatives' duties include making laws regarding taxes

[3] http://www.ustreas.gov/education/faq/taxes/taxes-society.shtml

which will support a variety of government entities such as judicial system, national security, Department of State, and so on. Following this line of thought a possible conclusion is that the decisions taken by the representatives are aimed for the majority of the society.

The following diagram (Figure 1: Tax Cycle) shows a simple global way to visualize the tax flow in the society.

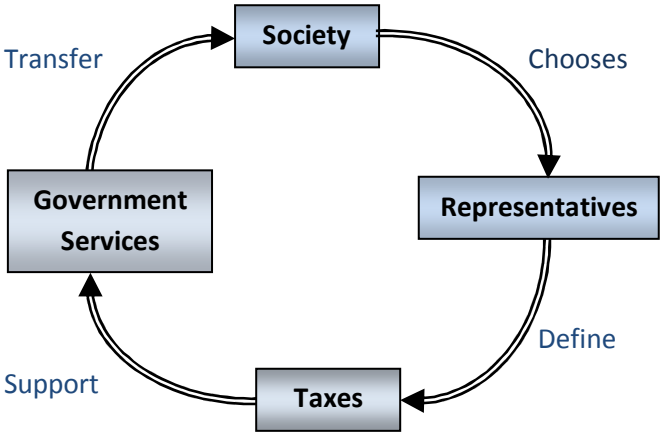

Figure 1: Tax Cycle

Considering the Society as the beginning of the cycle, the presented tax flow may be divided into four separated segments that can be analyzed sequentially. The four segments: Society-Representatives; Representatives-Taxes; Taxes-Government Services; and Government Services-Society may explain the way taxes are defined and how they are applied into the Society:

Society-Representatives segment: the first segment represents the Society choosing the Representatives in a democracy. Conventionally, the Society elects their Representatives according to their political platform, which may include tax policies that will be applied in order to support the government machinery. In this segment it is

assumed that the Society provides for the Representatives the prerogative to represent the population desires in terms of law making, including the establishment of tax rates. Hence, the Representatives' decisions are expected to reflect the Society's aspirations[4].

Representatives-Taxes segment: the second segment exhibits the institution of taxes by the Representatives. The creation of new taxes or the modification of an existing tax rate is defined by the legislative body that represents the population. The tax burden is presumably established in this segment of the tax cycle as a result of the legislators' decision. The determination is supposed to fulfill the electors' expectations with respect to the fiscal policy.

Taxes-Government Services segment: the third segment gives an idea about how collected taxes are expected to be spent. In a certain way, taxes are created to the finance the Government expenditures with services to the citizens. The budget allocated to each government sector may define the society's priority, which may vary according to the political, economic, and social situation. As an example, using the collected taxes to support the nation's financial institutions may demonstrate the priority on the economic affairs.

Government Services-Society: the fourth segment shows the outcomes generated by the taxes. The Government Services are the results of the taxes disbursed by the Society. The Government Services may include the National Defense,

[4] This statement assumes that the Representatives are loyally acting for their electorate. The argument that small groups of large corporations can influence the Representatives' decisions is not subject of this tax cycle.

the Judiciary System, and Transportation Infrastructure. Other public services[5] that, directly or indirectly, serve the population can be considered as a result of government expenditures financed by the collected taxes.

Therefore, an efficient, reliable, and fair tax collection system may help the government to gather financial resources to support the public services available to the society. Information and Communications Technology (ICT) may increase the overall fiscal performance with the potential tools that permit to control and manage a massive amount of data in a short period of time.

3. About Receita Federal do Brasil

"Pay to all their dues, taxes to whom taxes are due, toll to whom toll is due, respect to whom respect is due, honor to whom honor is due." Romans 13:7.

Receita Federal do Brasil (RFB) is the Brazilian Internal Revenue Service organization – an agency hierarchically subordinated to Brazilian Ministry of Finance – that performs duties with the purpose to enable the State to achieve its goals[6]. The agency is responsible for the administration of the Federal Taxes that consist of Internal Revenues, Social Security Contributions and Customs Tariffs. Furthermore, RFB assists the Federal Executive Branch to formulate the Brazilian Fiscal Policy, in addition to prevent and combat fiscal evasion, contraband, piracy, commercial fraud, drug and endangered animals traffic, and other illicit acts related to international trade.

[5] The quality of the public service is not the scope of this work. In this paper, the efficient use of the collected taxes is subject of other sectors of the government such as the Government Accountability Office (GAO). Improving the collection of tax and revenues does not imply a immediate enhancing in the public service.

[6] http://www.receita.fazenda.gov.br/SRF/ConhecaRFB.htm as of October 27, 2008.

The objective of the Receita Federal do Brasil can be expressed with its published statements about the Mission, View and Values of the institution[7]. The RFB Mission is basically composed by the following characteristics: enabling the State with resources to guarantee social welfare; providing service of excellence for the society; and providing security, trustworthiness, facilitation for the international trade. The agency's View of the future is being a management excellence model organization, national and international reference in taxation and customs administration. The organization's Values are respect to the citizen, integrity, loyalty with the institution, legality, and professionalism.

Regarding the organization structure, RFB is composed by centralized and decentralized units, located across the national territory. The centralized units are basically situated in Brasilia, the capital of the country. The jurisdictions of the decentralized units are geographically distributed across the country in ten Fiscal Regions[8] (RF: Regiao Fiscal). The following map (Figure 2: RFB decentralized units) shows the fiscal regions and their respective States.

[7] http://www.receita.fazenda.gov.br/SRF/missaovisaovalores.htm as of October 27, 2008.

[8] http://www.receita.fazenda.gov.br/SRF/Estrutura/descentralizadas.htm as of October 27, 2008.

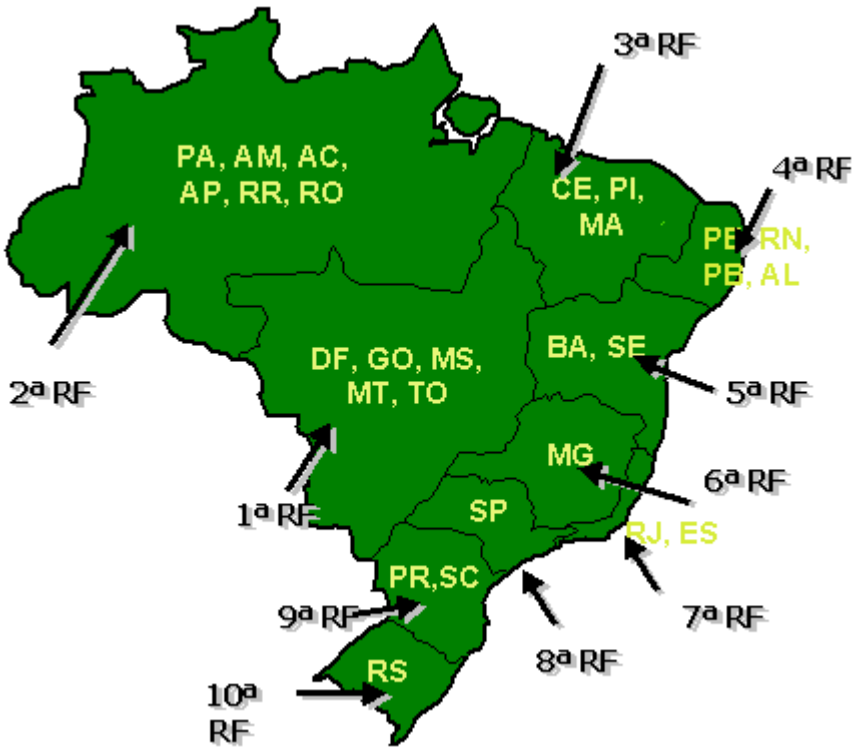

Figure 2: RFB decentralized units

Most of the Fiscal Region is composed by two or more States. The 6th , 8th , and 10th Fiscal Regions represent respectively the States of Minas Gerais (MG), Sao Paulo (SP), and Rio Grande do Sul (RS). Each Fiscal Region is administered by a distinct superintend, which is subordinated to the RFB secretary. With the exception of Distrito Federal (DF) – the superintendence is situated in Brasilia –, the regional superintendence is located at the capital of each first State described in the map. In this way, as a illustration, the superintendence of the 4th Fiscal Region – composed by the States of Pernambuco, Rio Grande do Norte, Paraiba, and Alagoas – is established in Recife, the capital of Pernambuco (PE).

In terms of tax and revenues collection, the 8th Fiscal Region – formed by the State of Sao Paulo, with the superintendence positioned in the city of Sao Paulo – is the most relevant constituent in the national context. In 2007, the total amount of federal taxes collected by Receita Federal do Brasil in the State of Sao Paulo jurisdiction counted 43.9% (R$ 189,532,321,311) out of the total (R$ 431,281,737,630) revenues administered by RFB[9].

RFB is under a constant innovation process redefining and realigning the business processes in order to meet its Mission, View, and Values. The Strategic Map of RFB – 2008-2011 – represents a compass, the clarification of the challenges referred to the RFB in the period 2008 to 2011, and how they relate in a relation of cause and effect. These forthcoming challenges, which will enable the institution to meet its mission and achieve its vision, are represented by a series of 24 strategic objectives, distributed by the global perspectives that tell the history of the strategy of its business plan, to be followed throughout the house over the next four years. The strategic objectives are distributed in the prospects of budget and logistics, technology, people and innovation, internal processes and results[10].

[9] http://www.receita.fazenda.gov.br/publico/arre/2007/PorEstado/ArrecadacaoUFJanDez07.xls as of oct. 30, 2008.

[10] Strategic Map of RFB – 2008 – 2011, SRFB/Copav.

4. Information Technology at Receita Federal do Brasil

According to the RFB Information Technology Director Plan[11] (ITDP), as a result of the high value of information and computing for the RFB, the institution, historically, maintains a specific area to manage IT in its organizational structure.

As stated in the institution's ITDP, a clear definition of roles of the participating agents, the differentiation of strategic and operational tasks, the professionalization of the servants that work in the IT area, changes in the organizational structure and the evolution of the model of relationship with service providers are examples of structural actions that have contributed significantly to consolidating the management of IT within the RFB.

Excellence in IT systems

The high level of IT systems at Receita Federal do Brasil has provided for the institution the ability to offer superior computerized services to citizens. Many services are integrated with other public and private institutions and are directly offered to citizen through the RFB website or indirectly accessed by the existing systems at the regional offices. The RFB IT systems are acknowledged by the society and have been awarded with national and international prizes.

In the national context, RFB has received relevant awards in recognition of its efficient services. The RFB website was awarded by the 2007 Internet Top of Mind Prize[12] in the public service category. The RFB website was the most voted amongst all

[11] Information Technology Director Plan, Brasilia-DF, July 2007.

[12] http://www.receita.fazenda.gov.br/Historico/SRF/premios/premioTOPOFMIND2007.htm as of November 2008.

the public entities that services the population. Furthermore in the countrywide perspective, the agency's Digital Certificate Project – developed by the Information Technology Coordination (Cotec) – was rewarded by the 10th Innovation Contest[13] in the Federal Public Administration promoted by the National School of Public Administration (Escola Nacional de Administração Pública – ENAP).

The works of RFB have been recognized by international awards. The World Summit Award (WSA) elected[14] RFB website as one of the five best systems of the world in e-Government category[15]. The WSA is the global initiative to select and promote the world's best e-Content and innovative Information and Communication Technology applications[16].

Serpro

Many systems are developed in partnership with Serpro – a company created to provide IT services and subordinated to the Ministry of Finance–, which participates in the applications development and maintenance processes. Serpro – Serviço Federal de Processamento de Dados – (Data Processing Federal Service) is a public enterprise created by Federal Law nº 4.516 in December 1st , 1964 with the purpose of modernizing and providing agility to the strategic sectors of the Brazilian Public Administration.

[13] http://www.receita.fazenda.gov.br/Historico/SRF/premios/ProjCertDigitaSRF2006.htm as of November 2008.

[14] http://www.receita.fazenda.gov.br/Historico/SRF/premios/cupulamundial.htm as of November 2008.

[15] http://www.wsis-award.org/winners/winners.wbp?year=2003 as of November 2008.

[16] http://www.wsis-award.org/about/index.wbp as of November 2008.

Serpro develops programs and services that permit better control and transparency on public collections and expenditures, including facilitating the relationship between the citizens and the government[17]. Amongst the several solutions developed by the company with those characteristics, the main products are the income tax filling via internet (ReceitaNet) and the systems that control and assist the Brazilian international trade.

Since its establishment in the 60s, RFB counts on the services of Serpro that was created to offer a structure that allowed the use of IT with the purpose to increase the organizational effectiveness. The model of relationship with the Serpro has evolved over time from a passive stance by the RFB, without much interference in the decisions of IT, to a new relationship in which each institution takes on the appropriate role and decisions are made in a participatory manner, taking into account the specificities and constraints of the parties involved[18].

5. Challenges

"If we can only agree on our goals, our technology can do the rest." Gerald Feinberg, The Prometheus Project, 1968.

The use of Information Technology in government reorganization is a conventional practice presented in the majority of administrations' agendas. Nevertheless, "a lack of coordination or communication between various initiatives increases the risk of creating more so-called 'islands of automation' and 'stovepipes'

[17] http://www.serpro.gov.br/instituicao/quem as of November 11, 2008.

[18] Director Plan for Information Technology – Receita Federal do Brasil, Brasília – DF, July 2007.

within and between levels of government."[19] Regarding the government's fiscal agencies, there are three perspectives from which the presence of technology innovation produces intense effect: taxpayers, business, and employees.

The taxpayers' perspective deals with the perception about the influence of the technology in improving the services offered by the fiscal agency. In this prospect, aspects related to efficiency, facility, and transparency are likely to be improved with the use of new technologies. In terms of expected fairness, the utilization of advanced tools might assist to strictly act in accordance with the applicable legislation.

The business's perspective is connected with how efficient is the technology improvement in assisting the government to enforce the current fiscal policy. This standpoint is about the operational procedures that are involved when a fiscal policy is implemented. Having a effective structure with modern technology and trained personnel may lead the government to leadership in fiscal matter. The leadership in technology may help to assure that the defined policies would be complied accordingly.

The employees' perspective is about the influence of information technology in the activities of the personnel in the fiscal agency. The role of modern techniques is to assist the workers to perform their duties more efficiently minimizing possible errors that could occur during the process. The advanced systems may contain the entire fiscal legislation and the acceptable entries embedded into the system. In this manner, the personnel could feel more confident in view of the fact that only permitted transactions would be performed reducing the chance of mistakes.

[19] Seifert, J. W., McLoughlin, G. J., State E-Government Strategies: Identifying Best Practices and Applications, E-Government in High Gear, Ventura, R. B., p.1, 2008.

In each perspective, the presence of 'island of automation' can become a barrier in the workflow of the processes. Information systems need to be integrated among themselves in order to exchange data to perform a wide range of functions. The complete integration of the systems is expected to deliver the results in a satisfactory period of time. That means that the performance is a crucial feature that should be taken into consideration when planning the integration project. In addition to integration and performance, security is a very relevant and critical topic. The systems should guarantee that the information is accessed only by permitted users.

Small corporations with few computerized systems may have less difficult to implement those features in their organization. Nonetheless, large institutions with a variety of systems in different platforms may face a enormous challenge to have those elements – integration, performance, and security – applied in their business processes. The maintenance procedure and the technological innovation process should be taken into consideration when dealing with extremely large IT projects.

The three relevant topics – integration, performance, and security – are part of the Strategic Map 2008/2011 of RFB in the Technology Perspective. The Technology Perspective contemplates the "search of integrated systems with secure and high performance technological environment" while "providing technological infrastructure, integrated information systems, and secure, updated, consistent, innovative, efficient and acceding to needs of the institution procedures, in order to expedite the implementation of demands and to support the streamlining of procedures and to assist the decision-making."[20]

[20] Strategic Map of RFB – 2008 A 2011, Technology Perspective, SRFB/Copav.

Integration

Consistently with the RFB IT Director Plan, the IT area has increasingly been integrated with other agencies and facilitated the exchange of information in electronic form with other institutions of the Public Administration. In this way, the spectrum of information is expanded and made available to the operational and decision-support procedures. In the case of information provided to other agencies, the purpose is the optimization of the public resources. The efforts are to standardize the exchange of information at RFB, with the consequent establishment of rules that regulate and facilitate the access to the data by interested parties.

Performance

As indicated by the IT Director Plan, a new phase is being established at RFB for the management of IT services with the following goals: ensuring the availability and the accomplishment of service level agreements; ensuring the most effective proactive treatment of incidents and problems; improving the communication amongst the chiefs, the technical areas and the users about occurrences and the implemented solutions; providing prompt answers with the intention of minimizing the inconvenience for the user.

Security

The vision about IT security in RFB has evolved substantially since the formal arrangement of the information security division in 1996 until the present time. The focus has advanced from a simply passwords administration to the deployment of a professional security policy. In search of a broad vision of quality, in which security must be present at all stages – from infrastructure definition to systems development – the information security division has constantly been innovating and improving the expertise. Moreover, the process of users' conscientiousness about information security is continuously supported by conducting training for users and security personnel.

6. A collaborative model

A few decades ago, the contact with computing equipments was restricted to a selected group of privileged people. At that epoch, those fortunate people were served with machines – like mainframes and minicomputers – with the intention to have their job performed faster and more efficiently. In order to carry out certain tasks, the collaboration of skilled people – such as systems analysts and programmers – were indispensable to perform simple duties such as typing a formatted document, calculating financial accounts activities, and creating mailing databases.

Nowadays, computers are easily reached by many people and have become a popular item to be used in different places. The user does not need formal education or an intense training period to access a computer because the modern interfaces permit a friendly interaction with the machine. Even earlier complex tasks of typing a formatted document or calculating financial activities are very straightforward with the new

equipments and programs. The evolution of computer technology has changed the way the processes were being performed.

The new technologies and methodologies have empowered the computer users and turned obsolete prior practices. In the recent days, a simple personal computer is able to run small to medium size databases (up to 4 Giga Bytes) that are satisfactory for a number of businesses. The activity of programming and developing computer systems has become accessible for everyone who wants to code an application. Even the historical software engineering methodologies may be reviewed with the launching of innovative programming techniques.

The idea of collaboration appears to be a new trend in the computer world. The Web 2.0 is transforming the web applications promoting the collaborative elements. Web-based applications are becoming reality and large companies such as Microsoft[21], Amazon and Google are investing in internet-based programs.

The collaborative applications are about to reach government agencies. Google Corporation is expanding the company's presence foraying into government business[22]. The use of web-based applications such as e-mail service, online document editor, and spreadsheet is an actual example of "cloud-computing" usage. The main infrastructure consists of a cluster of servers "in the cloud" where the applications and stored information reside. The system can be configured to be accessible by a browser with an internet connection anywhere in the globe.

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[21] Microsoft Plans 'Cloud' Operating System, http://www.nytimes.com/2008/10/28/technology/28soft.html?_r=2&ref=technology&pag

[22] Google Goes to Washington, Gearing Up to Put Its Stamp on Government, The Washington Post, page D7, September 29, 2008.

Cloud computing technology

"Cloud computing" is a contemporary expression related to a set of distinct computers physically interconnected by a network, which is accessed by a single interface. Also known as "clusters"[23], cloud computing is a technique to make a software available without installing it in the final user machine. The software and data are distributed and stored across the cluster. "Whether it's called *cloud computing* or *on-demand computing*, *software as a service*, or *the Internet as platform*, the common element is a shift in the geography of computation."[24]

In addition to the mobility consideration, cloud computing provides a range of benefits including scalability. Today's conventional web servers are the main victims of lack of scalability in terms of software and hardware. Since the applications are developed and deployed in one physical machine, as the demand for the services grows, the applications achieve rapidly its limit. The throughput of the system plunges possibly halting the entire structure. A scalable construction – such as clusters – permits to add more modules of computers up to a satisfactory performance.

Another important issue in this construction is the facility to expand the system's power with the insertion of new machines into the cloud. That means that when the processing capacity is reaching its limit, more servers can be added to improve the overall performance. Furthermore, this feature can be extended to the storage function

[23] http://knowledge.wpcarey.asu.edu/article.cfm?articleid=1655# as of October 28, 2008.

[24] Hayes, Brian, Communications of the ACM, Vol. 51, No. 7, p. 9, July 2008.

each time the space achieves its boundary. All those modifications may not be perceived by the end user and the changes may occur in a transparent manner (Figure 3: Concept of Cloud Computing).

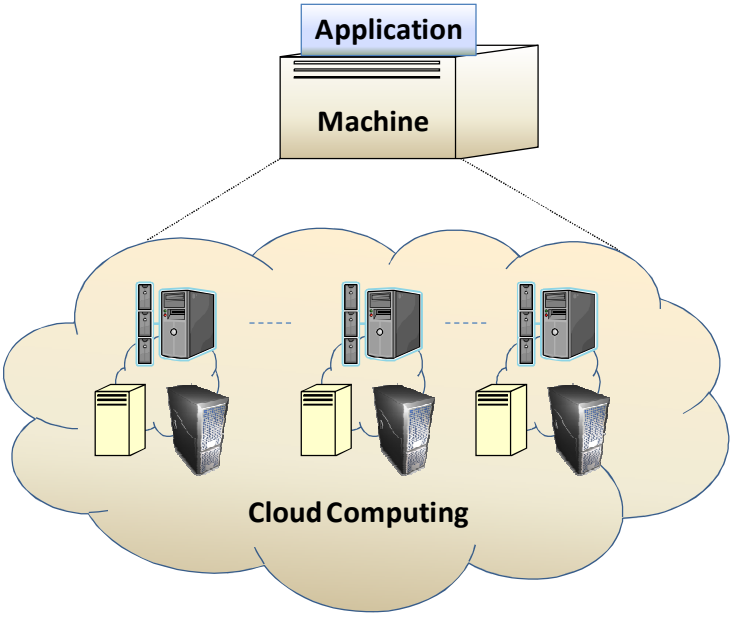

Figure 3: Concept of Cloud Computing

The possibility of including open-source systems into the cloud may result in a more sustainable solution. Depending upon the cost of software licenses and the return generated by the venture, the use of open-source – free software – applications can be decisive in the continuity of the business. Proprietary solutions usually offer a friendlier interface enabling a fast deployment of the systems. Nevertheless, a cloud structure developed by the combination of proprietary and non-proprietary solutions – such as

Microsoft Windows Azure[25] and Kernel-based Virtual Machine[26] (KVM), respectively – may seem more sensible when considering independence of supplier.

Private Cloud Computing System

The concept of cloud computing – operating over the Internet and hosting data and programs in third party's servers – may seem treacherous when manipulating government fiscal information. Moreover, the idea that "mainstream adoption of cloud computing could present a mixture of privacy and ownership issues, with users potentially being locked out of their own files"[27] may lead to a rejection of the presented structure.

However, if the problem regarding privacy and data ownership is overcome, the cloud computing structure may give an excellent source of inspiration to improve the government IT infrastructure. The issues about integration, performance, and security may be improved in a collaborative manner resulting in a sophisticated and mature system. The facility of extending the usage of certain functionality to other modules inside the cloud may enhance the overall throughput of the systems.

A model to reduce the menace to information privacy and to data ownership is built over a private cloud computing framework inside the organization (Figure 4: Private Cloud Computing Plan). The attribute' private' means that the system is apart from the

[25] Microsoft to Offer 'Cloud Computing', The Washington Post, page D2, October 28,2008.

[26] An Evaluation of KVM for Use in Cloud Computing, M. FENN, M. A. MURPHY, J. MARTIN, and S. GOASGUEN, http://cirg.cs.clemson.edu/papers/icvci08.pdf as of November 30,2008.

[27] http://www.guardian.co.uk/technology/2008/sep/29/cloud.computing.richard.stallman as of November 30, 2008.

internet with strict access to the web. Regarding the hardware supervision, the array of machines – also known as computer-server farm – remains under the organization's control. Concerning the software element, the policy to keep all application source code in-house and the use of non-proprietary programming language is assumed to be enforced.

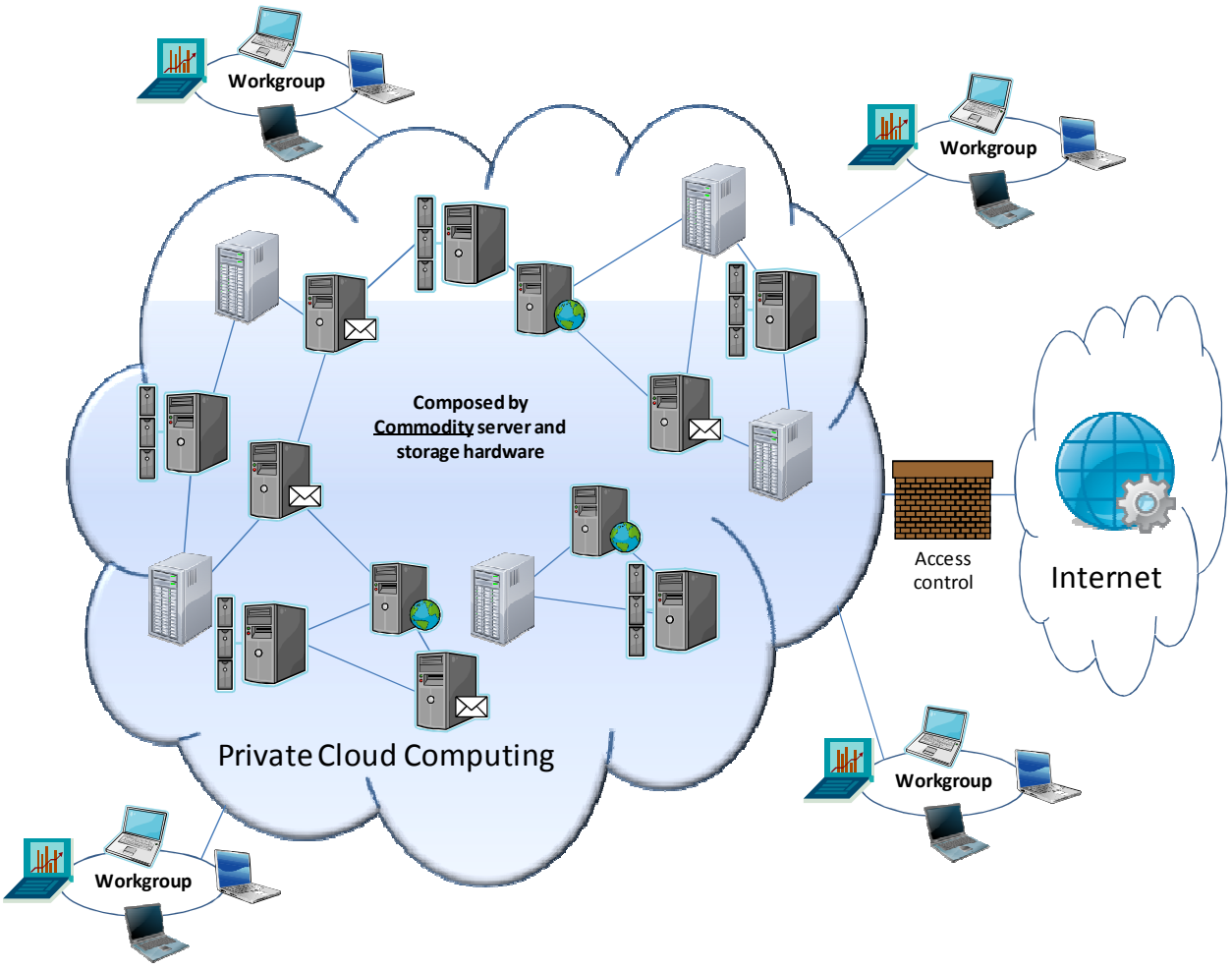

Figure 4: Private Cloud Computing Plan

In order to realize the great benefit of using the cloud computing structure, it is necessary to look inside the computer-server farm. The computer-server farm acts as a huge powerful machine that performs adequate operations to execute existing applications. However, in terms of hardware, the remarkable advantage of making use of cloud computing is the "ability to use **commodity server and storage** hardware."[28] The array is composed by individual equipments, which can be switched separately in case of damage, while the contingency system is operating. In some sophisticated settings, the new inserted server performs its self installation, configuration, and updating over the network. The mission of improving the performance and storage capacity is achieved by simply connecting into the cloud a new server prepared to join the set of machines.

With reference to the software, the installation process occurs in one place and become available throughout the cloud from where a connected computer can access the application. Similar to the installation process, the updating procedure is performed at the same location where the application resides. The environment enables the software development in a collaborative manner enabling the utilization of reusable source code.

The Power of Collaboration

The proposal of using a private cloud computing environment aims to standardize the application platform where the resources – processing and storage – can be scaled in order to support the demand of the any projected system. With a

[28] http://netseminar.stanford.edu/seminars/Cloud.pdf, as of November 30, 2008.

standard platform, the same purpose applications developed by different groups can be combined seizing the best features of each program and linking them into one single enhanced system. In this way the final improved product might be used by all groups.

Suppose that three different sectors – A, B, and C – at the same organization use the cloud to build applications for the same activities (Corporate Analysis and Customs Verification) performed in distinct locations. Each sector has its own group to develop the applications. Consider that there is no exchange of knowledge among the sectors and the size of the groups indicates the number of developers allocated to build a particular system. To illustrate the situation, consider the following diagram (Figure 5: Example of Number of developers in each group):

Sector	Corporate Analysis	Customs Verification
A	32	8
B	6	4
C	19	9

Figure 5: Example of Number of developers in each group

In the diagram (Figure 5: Example of Number of developers in each groupFigure 5), sector A has the largest group developing the Corporate Analysis system with 32 developers allocated to the related task. Regarding the Custom Verification application, sector B has the largest group with 9 people. Assuming that the larger the size of the group more sophisticated the application is, it is reasonable to consider that the sector A has the highest developed version of the Corporate Analysis system. In a similar consideration, sector C has the highest developed version of the Customs Verification system.

Suppose that the groups of the same application begin to work collaboratively exchanging the knowledge and dividing the tasks to build a particular advanced system

to be deployed in all sectors of the organization. For this reason, as seen in Figure 6, the Corporate Analysis application would have a new larger group of 57 developers instead of the 32 people in the previous top system. Analogously, the Customs Verification application would have a group of 21 developers in contrast to the previous 9 members in the group.

Sector	Corporate Analysis	Customs Verification
A	32	8
B	6	4
C	19	9
Total	**57**	**21**

Figure 6: Example of Collaborative groups

Therefore, according to the exposed facts, the implementation of the collaborative model may result in a more productive approach in terms of using IT to assist fiscal activities. The integration among systems throughout the cloud is a matter of authorization since the programs and data are present inside the same environment. Furthermore, the private cloud computing framework is fundamental when considering scalability as a key factor for the performance success.

7. Impact of Technology

A methodology to measure the technological impact over the fiscal administration can demonstrate the relationship between the use of technology and the collection of taxes and revenues. Since information and communication technologies (ICTs) are essential to optimize the collection of tax and revenue, it could be noteworthy to quantify

the effects of ICTs on fiscal practices. Besides ICTs, other key factors should be taken into consideration to analyze their influence in the overall tax collection.

The collection of taxes and revenues may vary depending upon aspects such as political rearrangement, economic situation, and legal issues. Incidents like a transitory reorganization in the internal revenue service structure, an alteration in the country economic condition, and a reform in the fiscal legislation can substantially modify the amount of tax and revenue collected. After the transition period, the events may transform the financial scenario generating a new expected amount of tax collection.

An example of transitory reorganization in the internal revenue service structure is the fusion that occurred in 2005 of two Brazilian Fiscal Agencies: Secretaria da Receita Federal (SRF) and Secretaria da Receita Previdenciária (SRP) creating a new agency named Secretaria da Receita Federal do Brasil (SRFB), established with the Federal Law 11457/2007[29]. The new agency inherited the main duties of the two previous existing entities with a cumulative tax collection. Since the systems were distinct, it was necessary to integrate and develop new applications to facilitate the processes operations.

Suppose a stable economy, without relevant changes in the fiscal policies and public entities along the years, and that total amount of taxes collected by the Federal Government depends only upon three aspects: technology factor, the number of employees at IRS agency, and the budget received by the bureau. The study about a relationship between output and input in the tax collection may show the influence of the information technology in tax collection.

[29] Available at http://www.planalto.gov.br/ccivil_03/_Ato2007-2010/2007/Lei/L11457.htm

Considering that other parameters may vary slightly that cannot substantially affect the final result, and that the fiscal activities have an analogous behavior to the production function of a national economy. Following this line of thought, a potential methodology to evaluate the technology effect on tax collection may be using a production function applied to the internal revenue service habitat.

In the case of a national economy, a production function with quantities of capital and labor as input can be represented in the following way[30]:

$$Y = A.F(K, N),$$

where

Y = real output produced in a given period of time;
A = a number measuring overall productivity;
K = the capital stock, or quantity of capital used in the period;
N = the number of workers employed in the period;
F = a function relating output Y to capital K and labor N.

Using the an equivalent reasoning applied to the federal tax collection system, a convenient way to show the function is

$$\boldsymbol{T = A_{IRS}.F(K_{IRS}, N_{IRS})} \qquad \textbf{(Equation 1)}$$

where

$T = Total\ Federal\ Tax\ Collected$T
$A_{IRS} = Existing\ technology\ at\ IRS$
$K_{IRS} = IRS\ Budget\ (outsourcing, training, \dots)$
$N_{IRS} = Number\ of\ employees\ at\ IRS$

Assuming

$$\boldsymbol{F(K_{IRS}, N_{IRS}) = K_{IRS}^{\alpha}.N_{IRS}^{1-\alpha}} \qquad \textbf{(Equation 2)}$$

From (Equation 1) and (Equation 2), the function becomes

[30] Abel, A B., Bernanke, B. S., Croushore, D., Macroeconomics, Sixth Edition, Addison-Wesley,2008. p.64.

$$T = A_{IRS}.K_{IRS}^{\alpha}.N_{IRS}^{1-\alpha}, where\ 0 < \alpha < 1 \qquad \textbf{(Equation 3)}$$

Isolating A_{IRS}

$$A_{IRS} = \frac{T}{K_{IRS}^{\alpha}.N_{IRS}^{1-\alpha}}, where\ 0 < \alpha < 1 \qquad \textbf{(Equation 4)}$$

Considering the following table (Table 1: RFB data related to years 2004, 2005, and 2006) with provided data about RFB in years 2004, 2005, and 2006

Year	T[31] (R$)	K_{IRS}[32] (R$)	N_{IRS}[33]	A_{IRS} $(\alpha = 0.1)$	A_{IRS} $(\alpha = 0.5)$	A_{IRS} $(\alpha = 0.9)$
2004	300,530,360,062.00	1,105,116,556.12	14,199	6,863,024.67	75,867.44	838.68
2005	346,955,192,050.00	1,741,396,429.58	18,369	6,004,912.22	61,345.37	626.70
2006	372,266,569,967.00	1,756,745,529.81	20,773	5,762,804.05	61,624.02	658.97

Table 1: RFB data related to years 2004, 2005, and 2006

The productivity factor (A_{IRS}) is calculated based on given T, K_{IRS}, and N_{IRS} for each year – applying the function defined by equation 4 – and using α with values 0.1, 0.5, and 0.9. The results of the calculations are graphically represented in the illustrations of Figure 7, Figure 8, and Figure 9.

[31] http://www.receita.fazenda.gov.br/Historico/SRF/RelGestao/2006/IndGestao.htm – *Receita Administrada Bruta no exercício* – as of November 17, 2008.

[32] http://www.receita.fazenda.gov.br/Historico/SRF/RelGestao/2006/IndGestao.htm – *Despesa realizada no exercício* – as of November 17, 2008.

[33] http://www.receita.fazenda.gov.br/Historico/SRF/RelGestao/2006/GestaoRecHum as of November 17, 2008.

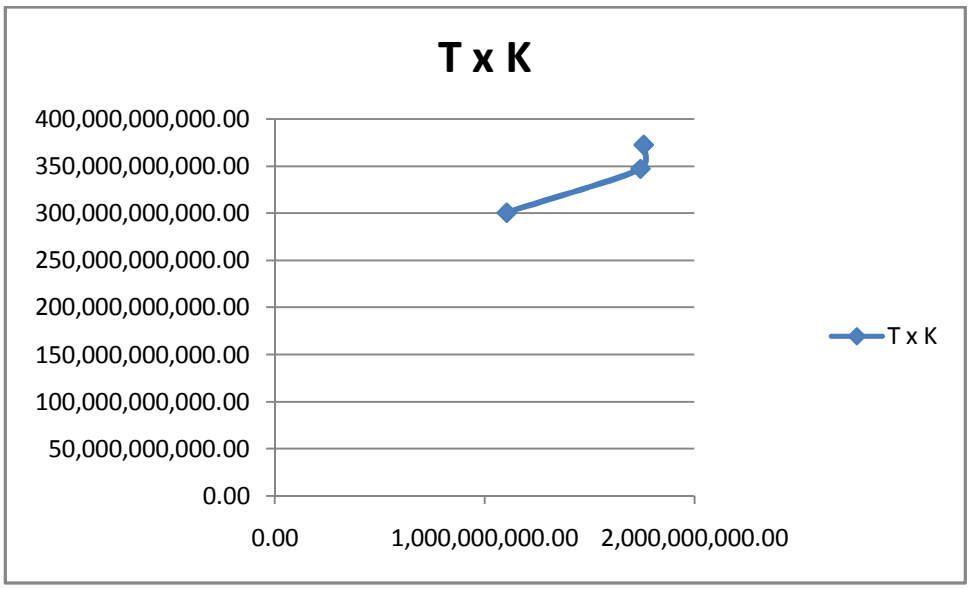

Figure 7: Graph T versus K

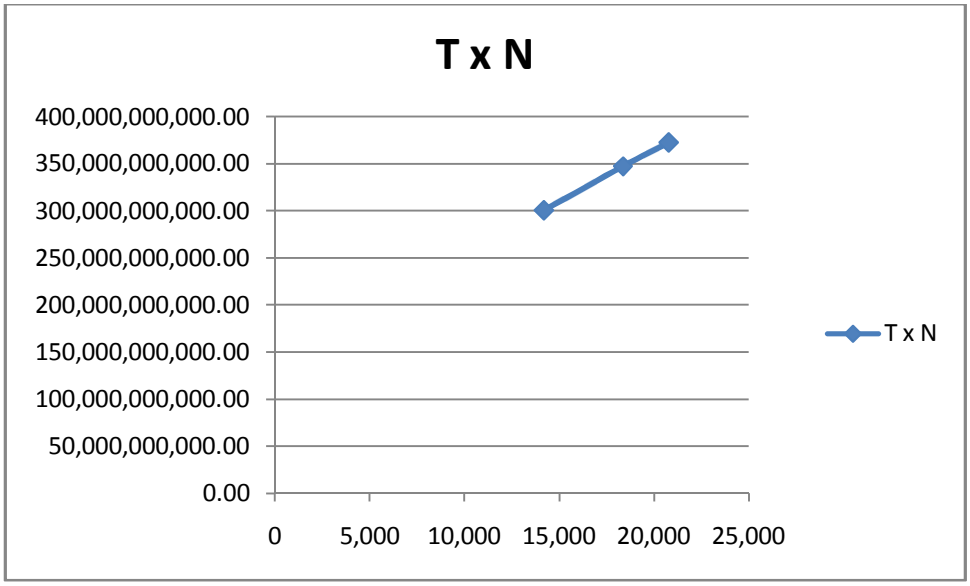

Figure 8: Graph T versus N

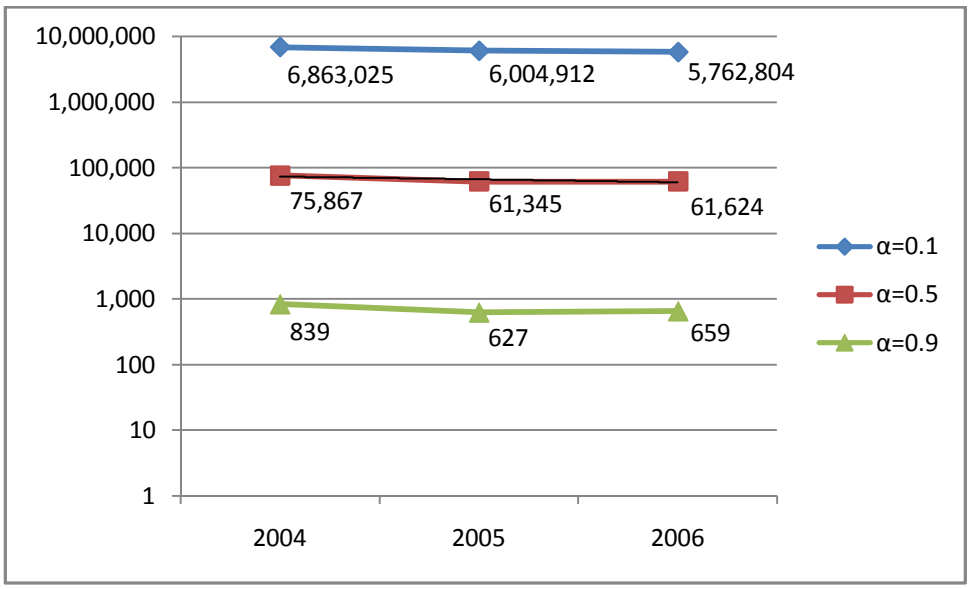

Figure 9: Graph technology factor A_{IRS} along the years – logarithm scale

Observing Figure 9 the behavior of A_{IRS} shows a significant erosion of technology over time. Between 2004 and 2005, for the three cases – α equals to 0.1, 0.5, and 0.9 –, the value of A_{IRS} decreased substantially. The reason for this variation may be the fusion that occurred in 2005 of the two Brazilian Fiscal Agencies: Secretaria da Receita Federal (SRF) and Secretaria da Receita Previdenciária (SRP) creating a new agency named Secretaria da Receita Federal do Brasil (SRFB). Furthermore, between 2005 and 2006, for α equals to 0.1, the reduction of A_{IRS} may be explained by the increase of number of employees.

8. Comments

An effective tax collecting computerized structure may help to better evaluate a tax gap. As stated[34] by IRS “the tax gap measures the extent to which taxpayers do not file their tax returns and pay the correct tax on time” and "understanding the tax gap and what its components are allows the legislative and executive branches of government to make better decisions about tax policy and the allocation of resources for tax administration.”

As result of recent research[35], “State politics and culture can impede or support e-government development” and “strong leadership can support e-government programs and drive IT improvements by encouraging and promoting new projects.” Furthermore, “the degree of centralization or decentralization is a key component in e-government management because it affects the level of interaction between agencies.” Likewise, “funding is an important issue because IT projects are costly and success is uncertain. Legislatures must choose between programs and, in many cases, e-government competes with other priorities.”

In order to perform a collaborative activity, the relevant players of the technology industry might be considered to participate in the institution’s IT plan. This is supposed to mean that public, private, and non-profit organizations may be expected to contribute with the process of IT innovation at RFB. Nevertheless, the decision to maintain in-house the dominance of the technology may be a cost-benefit effective strategy along

[34] “*Understanding the Tax Gap*”, http://www.irs.gov/newsroom/article/0,,id=137246,00.html , as of November 30, 2008.

[35]] State E-Government Strategies: Identifying Best Practices and Applications, Seifert, J. W., McLoughlin, G. J., E-government in high gear, Ventura, R. B., Nova Science Publishers, Inc., 2008. p.2.

the years. As example, the American Internal Revenue Service announced it is resuming management of taxpayer files at seven regional submission processing centers[36].

The alternative of bringing knowledge from external entities may be an excellent policy when considering[37] the technological spillovers – a positive externality from R&D resulting from the spread of knowledge across organizational or regional boundaries – with the participation of the knowledge brokers – individuals or organizations that transfer information from one domain to another in which it can be usefully applied. The government agencies may act together the purpose of developing an advanced technological infrastructure.

Considering the impact of technology over the fiscal activities and in light of the analyzed fall in productivity, the improvement of information technology may be a decisive aspect in order to increase tax and revenue collection.

In this manner, the improvement of tax and revenue collection is directly related to the progress of information technology. In view of the fact[38] that "governments run on data" and "technology has made it easier for government to store information about their citizens", it is essential to have a constant process of technological innovation with reference to the fiscal activities in order to offer better service and enhance the society's welfare.

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[36] "*IRS Brings Tax-Processing Work Back In-House*", The Washington Post, September 12, 2008. p. D3.

[37] Strategic Management of Technological Innovation, Schilling, M. A., Second Edition, McGraw-Hill International Edition, 2008. p.30.

[38] Technology and society, Harrington, J. L., Jones and Barlett Publishers. 2008. p.195.