Using Connectivity to Build e-Government

by

Emilio José Pellet-Lastra

Ingeniero Civil, Universidad de Buenos Aires, 1983
MBA, IAE Universidad Austral, 1991

Submitted to the Alfred P. Sloan School of Management
in Partial Fulfillment of the Requirement of the Degree of

Master of Science in Management of Technology

at the

Massachusetts Institute of Technology

June, 2003

Signature of the author _____

Sloan School of Management
May 09, 2003

Certified by _____

James M. Utterback
David J. McGrath jr. Professor of Management and Innovation
Thesis Supervisor

Accepted by _____

David A. Weber
Director, Management of Technology Program

Using Connectivity to Build e-Government

by

Emilio José Pellet-Lastra

Submitted to the Alfred P. Sloan School of Management
in Partial Fulfillment of the Requirement of the Degree of

Master of Science in Management of Technology

Abstract

Developed countries are increasingly using information technology to access and deliver information across all the organizations that comprise the government. Argentina is in the first stages of adopting Internet technology for the government.

This thesis proposes that Argentina's e-government construction can be optimized if a good foundation for systems connectivity is put in place first.

The author argues that the current time lag in the construction of Argentina's e-Government can be used in a positive way if experience from more developed countries is used.

Chapter 1 provides a strategy for building e-Government in Argentina using standardization and connectivity. In Chapter 2, a theoretical analysis about the economics of systems integration is presented. In Chapter 3 the importance of standardization and specially the use of XML are outlined. Chapter 4 develops the basis of IT infrastructure and its importance to enable e-Government. Chapter 5 evaluates the current state of e-Government in three developed countries. Chapter 6 and 7 provide a potential framework for building the e-Government in Argentina based in the ideas of the previous chapters.

The author has found that developed countries are defining standard connectivity based on XML and that they are in the process of becoming a full e-government by 2005. At the same time Argentina is lacking a coherent plan to enable the creation of the e-Government in the near future.

Finally, the thesis proposes the standardization of systems interfaces using XML and the definition of standard XML data schemas to facilitate connectivity. At the same time the thesis encourages building an IT infrastructure and the use of standard applications to gain efficiency and lower the cost of e-Government.

Thesis Supervisor: **James M. Utterback**
Title: **David J. McGrath jr. Professor of Management and Innovation**

Acknowledgement

This thesis is the last step of a dream that started in March of 1981 when for the first time I stood in front of the dome of the main building at MIT. Since then I have dreamed of returning to MIT, not as a sightseer but as a student. I want to thank the Sloan School of Management at MIT, and especially David Weber, the director of the Management of Technology Program, for the opportunity to transform my dream into reality.

I want to thank my advisor Prof. Jim Utterback, Chair of the Management of Technology Program at MIT, for the inspiration and the time he has provided for me. I will remember forever the advice to be more innovative and look forward, not only in this thesis but in the rest of my activities. This is something I will carry as an invaluable present.

A special thank to Kippy Estol, for reading my thesis with care and professionalism as he always does everything, and all the valuable suggestions he has provided to me.

I would like to thank Prof. Stuart Madnick and Prof. Peter Weill for all the ideas I learned from their classes at MIT, as well as Prof. Jerry Melching from the Kennedy School of Government at Harvard University.

I am indebted to my Mother and Father who have given me the values that allowed me to reach where I am.

Finally I want to thank my family, especially my wife Dolores, who supports me in this adventure with all her love.

And thanks God for all the blessings I have received in my life; I hope I can return part of them to others.

Table of Contents

Introduction

The changes that come about as a result of the use of Internet technology in the last 10 years have been enormous, both in the private and public sector. Developed countries' governments are using this technology with the objective to increase efficiency and change the way governments interact with citizens. Argentina is still in the first stages of use Internet technology to integrate the operations of the different parts of the government with these objectives.

A major issue in building e-Government is the ability to interconnect all government information systems to provide cross-organization integrated information and processes. It is not only difficult to understand but its execution will demand efforts of a far greater magnitude. On the other hand it demands not only technical knowledge but also management skills, experience and good judgment.

The objective of the thesis is to analyze what should be done to make possible connectivity with the purpose of building a better e-Government for Argentina in the coming years.

Chapter 1: Defining a Strategy to Build e-Government in Argentina

The world is transforming at a fast pace. The processing power, bandwidth, and storing capacity are doubling at an average of every 15 months, and this exponential growth is enabling deep changes in human organizations. The key to achieving efficiency and new services would be through the use of technology. There are two basic methods to accomplish a complicated task [Galbraith, 1973]: one is to simplify it up to the point where it is possible to manage the task, limiting the scope of the solution and introducing rigidities of the outcome. The other is to use more technology to accomplish the task. Because technology would be available at increasingly lower prices per unit of power, new services and organizations would emerge for those that can manage the technology and apply it to complex situations.

The evolution of society and business has been to access more information, about more aspects, from more places and in less time. This trend has been supported and accelerated with the evolution of Information Technology (IT). At the same time the information alone does not create value; it is the ***use*** of information that can create value. Value can be created in several forms, such as by the use of information for operations, gains in efficiencies, changes in organization structures, or the creation of new services. Government cannot stay out of this trend and the only possible path is to use the new Information Technology (IT) to create value for its citizens and support the development of the private sector.

In recent years, the Internet has enabled an information revolution, changing the way the private sector is doing business. New technologies such as Web Services are emerging as a way of using Information Technology (IT) not only to process information but also to create automated services to allow interaction of computer-to-computer ("Web Services" and "Semantic Web"), and facilitating the emergence of "Grid" computing [Foster, 2003] where information "products" would be bought and sold in the same way as gas and electricity are bought and sold today.

While the most revolutionary implementations and use of IT technology have come from the private sector in developed countries, the public sector in developing countries such Argentina cannot be left out of this trend in the mid-term.

A dual effect would take place. First, because citizens are daily users of private services, either as customers or employees, pressure on government to match the level of service and efficiency of private sector would be inevitable. There would be no excuse for the public sector when citizens demand a similar efficiency and efficacy that they receive from the private sector. Second, to create an "Electronic Government" (e-Government), a basic infrastructure to allow easy interoperability would have to be defined and built. Although the trend is clear, a strategy has to be defined to allow a painless transition and maximize results.

The Government would be forced to use IT technology for two main reasons. First, government has to make it simple for citizens and businesses to interact with it. This would demand changing the paradigm from a bureaucratic-centric organization to a

client-centric organization. Second, government has to improve its efficiency and effectiveness. Government will not have enough resources to achieve the demand of private sector if IT technology is not used.

The transformation of the government into an e-Government (a government able to operate electronically) would require the accomplishment of different objectives. First, citizens would need to interact with the government remotely, 24 hours a day, 7 days a week. Second, different parts of the government would need to interact with one another electronically, allowing the automation of tasks and processes. Consolidation and aggregation of information would be needed to operate efficiently. Finally, all of the above has to be accomplished in a systematic and economic way, because resources would be as scarce as they are today, and more importantly, if the implementation is not simple and scalable, no real cross-organization solutions would be achieved.

The main idea of this thesis is that the only possible way for a full integrated e-Government to happen is by making it easy and cheap to interconnect all the parts of the government. Interconnection would allow the building of an IT infrastructure where each part of the government would connect applications, interchange information, and share common resources.

In this thesis I am proposing a plan based the following principles.

- First, **adopt XML** as the standard technology to build the interfaces for the information systems interact with one another**.**

- Second, **standardize data schemas** to facilitate connectivity between different parts of the government.
- Third, **build an IT infrastructure** to share common resources and to simplify data interchange.
- Forth, **use standard and open technology** throughout all parts and levels of public sector.
- Finally, create the conditions to develop a market for **standard applications** for government operations.

If key decisions are taken at the early stages of technology evolution, the growth would be organic and scalable, allowing a learning process and the development of correct practices and polices. But if wrong decisions are taken or chaotic growth is allowed, connectivity would be limited or very expensive, and the use of IT restricted to a few operative applications.

There are other dimensions to complement this basic strategy.

- First, a common policy has to be followed for the government to allow a common "vision" for the problem.
- Second, IT strategy and implementation must have the support of high-level officials.

- Third, management of the process has to be undertaken by highly skilled and motivated CIOs, who know one another, share common ideas, and can build a trusted informal network.
- Finally, limitations have to be resolved to allow flexibility at local levels, and not inhibit technology evolution.

This thesis will explore the cost and benefits of connectivity and identify why connectivity is a key factor in building e-Government. I will show that the best strategy to build an e-Government is through the construction of a common IT infrastructure and the definition of a policy of standardization of data interfaces to facilitate connectivity.

Finally, the success in implementing these proposals will come from the willingness to create an e-Government from the high-ranking public officials. Once they agree with the implementation of an electronically integrated government, all the recommendations of this thesis will have to be implemented to make the e-Government possible. Then the advocacy for IT infrastructure and standardization to allow connectivity will be the advocacy to build the e-Government.

I know that this is very ambitious, but I expect that the main ideas will map out future research to define the path for the development of an e-Government for Argentina.

Chapter 2: Economics of Information Systems Integration

With the advent of IT as a business tool, information systems were implemented locally to automate existing processes and resolve specific needs of an organization. In recent years, the declining costs of IT and more sophisticated applications changed the use of IT, and the use of these resources. The need to use information from different systems has created the need to integrate those systems. Making things more complex, organizations have now started to share information and integrate across industries. This chapter explores the economics of the integration of different systems applied to the integration of different parts of the government.

2.1- Value, Cost and Benefit of Information Systems Connectivity

The basic problem with evaluating information systems integration is how to appraise the value that arises from connectivity. This, apparently clear and simple, issue has no precise answer in a general context. To understand the problem, I will try to define it first.

The most basic case in system integration is that of two independent information systems, system X and system Y. Information from system X can be used to make decisions and extract a certain value V(X), and the same can be done with system Y, creating a value V(Y). If nothing changes the total value that can be extracted from the systems is independent and equal to V(X) + V(Y) and since it is not possible to use the

information of X in conjunction with the information of Y no additional value can be created.

Sharing information in a networked organization creates more value than not sharing [Van Alstyne,1997]. In the case that we use some mechanism to interconnect the systems, then the total value of X when is connected with Y, is equal to the independent value of X, V(X), plus the independent value of Y, V(Y) plus certain value derived from the combination of the information of system X and system Y, which I will call V(X*Y). All of these values are potential values that can be extracted from the use of information by the systems.

Adopting the convention of using:

- Symbol "+" to mean "aggregated with" and symbol "*" to mean "connected to"
- Letter B to mean "potential benefit of," the letter V to mean "potential value extracted from," the letter C to mean "cost of" and letter S for to mean "savings from."

$$V(X+Y) = V(X) + V(Y) + V(X*Y) \qquad (1)$$

V (X+Y) is reduced by the cost of connecting X and Y. Then in general terms, the total benefit B would be V(X+Y) less the cost to connect X and Y which I will call C(X*Y). Additionally, some savings can be achieved when two systems are connected, that I will

call S (X*Y). The potential benefit that can be extracted from the new systems (X+Y) will be:

$$B(X+Y) = V(X) + V(Y) + V(X*Y) - C(X*Y) + S(X*Y) \quad (2)$$

The potential value from connecting V(X*Y) can be expressed with a coefficient a to measure the amount of value that results when X and Y are connected.

$$V(X*Y) = a\,(V(X) + V(Y)) \quad (3)$$

Let us examine the qualitative characteristics of the a coefficient.

There are two major characteristics of the systems that influence the value created for connectivity.

- **Interdependence**: The value resulting from interconnecting two systems must increase if the interdependence of the systems increases [Goodhue, Wybo and Kirsch, 1992][1]. As more interdependence exists, the need for coordination, and the probability of finding a new use for the information increases. And as interdependence decreases, the need of coordination and the probability of finding new uses for information decreases. In the case where total independence exists, no need for coordination exists, the probability of

[1] *"All other things been equal, as the interdependence between subunits increase, the benefits of data integration will increase, and the amount of data integration in rational firm should increase."*

sharing information tends towards zero, and then no value can be created to link two systems.

- **Uniqueness**: As two systems become more similar, the value that can be extracted decreases, though in the limit one system would became identical to the other and it is clear that connecting two identical systems cannot create new value. The more different that the information of one system is from the other, or the more unique is the information of one system with respect to the other, the greater the increase in value that can be created from the connectivity. This also can be thought of as the opposite of overlap of the information of both systems.

From the above, the coefficient a can be thought of the product of two coefficients, i (interdependence) and u (uniqueness).

$$a = i * u \qquad (4)$$

The value of i = 0 means no interdependence, and is the lowest possible value.

The value of u = 0 means that both systems are identical, and is the lowest possible value.

Then a has to be greater or equal to 0, (a >=0).

The value from connecting two systems would be:

$$V(X*Y) = i_{x*y} * u_{x*y} \; [V(X) + V(Y)] \quad \text{or} \quad V(X*Y) = a_{x*y} \; [V(X) + V(Y)] \qquad (5)$$

Where $a_{x*y} = V(X*Y) / [V(X) + V(Y)]$ is the relationship between the net value gained from the connection and the total value of both systems before the connection.

Following a similar reasoning for the cost (C), the cost to connect X and Y can be expressed as:

$$C(X*Y) = ß_{x*y} [C(X) + C(Y)]$$

Where $ß_{x*y}$ is the relationship between the cost to connect A and B and the total cost prior to the connection.

$$ß_{x*y} = [C(A*B)] / [C(A) + C(B)]$$

The same can be defined for the savings associated with the connection of both systems.

$$S(X*Y) = d_{x*y} [C(X) + C(Y)]$$

Where d_{x*y} is the relationship between the savings derived from connecting A and B and the total cost before the connection.

$$d_{x*y} = [S(A*B)] / [C(A) + C(B)]$$

The benefits from connecting X and Y would be:

$$B(X*Y) = V(X+Y) - C(X*Y) + S(X*Y) \quad (6)$$

$$B(X*Y) = i_{x*y} * u_{x*y} [V(X)+V(Y)] - ß_{x*y} [C(A) + C(B)] + d_{x*y} [C(A) + C(B)] \quad (7)$$

$$B(X*Y) = a_{x*y} [V(X)+V(Y)] + (d_{x*y} - ß_{x*y}) [C(A) + C(B)] \quad (8)$$

From equation (7) we can see the different ways to increase the benefit from connectivity between two systems:

- Increase the value of either system X or Y.
- Decrease of the cost of connection ($ß_{x*y}$)
- Increase the savings from the connection (d_{x*y})
- Increase the interdependence (i_{x*y})
- Increase the uniqueness (u_{x*y})

If the cost of connectivity exceeds the potential value, the net potential benefit is negative. In the cases where the net potential benefit is negative, the better solution would be to make a limited connectivity [Goodhue, Wybo and Kirsch, 1992].

2.2- Escalation of System Integration

In the previous section, the incremental value from connecting two systems was defined, and the potential value increased by the amount of $V(X*Y) = a_{x*y} [V(X) + V(Y)]$.

Then the new system created for the aggregation of both systems has the value of:

$$V(X+Y) = V(X) + V(Y) + V(X*Y)$$

$$V(X+Y) = V(X) + V(Y) + a_{x*y} [V(X) + V(Y)]$$

$$V(X+Y) = (1+ a_{x*y}) [V(X) +V(Y)] \quad (9)$$

Once X and Y have been connected, an aggregated system X+Y is created.

If a new system Z is connected with (X+Y) then:

$$\begin{aligned} V((X+Y)+Z) &= V(X+Y) + V(Z) + a_{(x+y)*z} [V(X+Y) + V(Z)] \\ &= (1+a_{(x+y)*z}) [V(X+Y) + V(Z)] \\ &= (1+a_{(x+y)*z}) [(1+ a_{x*y}) [V(X) +V(Y)]+ V(Z)] \\ &= (1+a_{(x+y)*z}) (1+ a_{x*y}) [V(X) +V(Y)] + (1+a_{(x+y)*z}) V(Z) \end{aligned}$$

Each time a new system (Si) is connected to the aggregated system (Sa) the total value of the systems increases in the amount of:

$$V(Sa+Si) = (1+a_{a*i}) (1+ a_{a}) V(Sa) + (1+a_{a*i}) V(Si) \quad (10)$$

This can be generalized as follows: as the number of systems aggregated (i) increases the total value of the resulting aggregated systems can be expressed generically as:

$$V(S\ Si) >= [\prod (1+ a_i)] * [\sum V(Si)] \quad (11)$$

Since sharing information creates more value than not sharing [Van Alstyne,1997], implying that $a > 0$, then the potential value as a function of the number of aggregated systems would increase each time a new system is connected. This value is potential and depends of the uses of information, but because now a more rich system is available the potential value has increased.

Following similar reasoning the following relationship can be derived:

$$C(S\ Si) >= [\prod (1+ \beta_i)] * [\sum C(Si)] \quad (12)$$

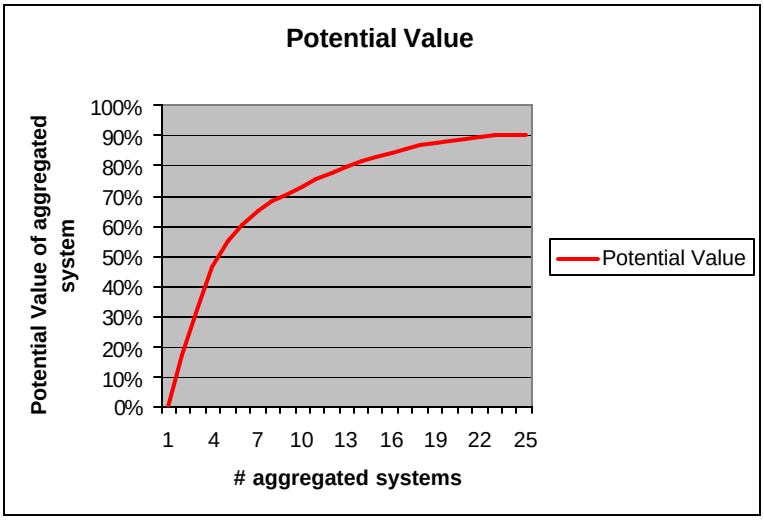
$$S(S\ Si) >= [\prod (1+ d_i)] * [\sum S(Si)] \quad (13)$$

Certain inferences can be shown from the equations above:

a- The value of the aggregated systems increases as the number of systems increases. The following assumptions apply:

- Because the value is potential, additional work has to be done to extract the value and this depends at the same time upon the capabilities of the users.
- Because value depends of the interdependence of the systems, the number of systems would be limited.
- There is a maximum possible value of the aggregated system; this means that the growth of value has a limit equal to this maximum possible value.
- The more valuable connections would be done first and the less valuable would be done last.

If we represent the potential value as a function of the number of systems connected, taking in account the hypothesis defined, the shape of the representative graph would be a convex curve, asymptotic to the maximum potential value of all interdependent systems.

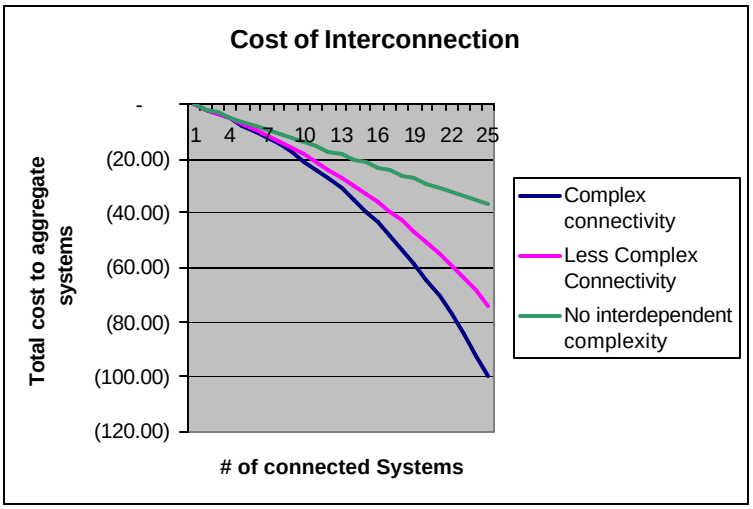


b- Cost increases as the number of aggregated systems increases. The following assumptions apply:

- This cost is real (can be estimated in monetary value) and is incurred when connection is done, and during the time the connection is used.
- If each time a system is connected, the next connection becomes more complex, then the cost will increase exponentially.
- If each time a system is connected, the next connection is independent of the complexity of the aggregated system, then the cost will increase linearly.

If we represent the cost as a function of the total number of aggregated systems the shape of the function is an exponential descending curve which becomes steeper with the (greater) complexity of adding the next systems [Goodhue, Wybo and Kirsch, 1992][2]. In the limit when adding a new system is independent of the others the function will be linear.

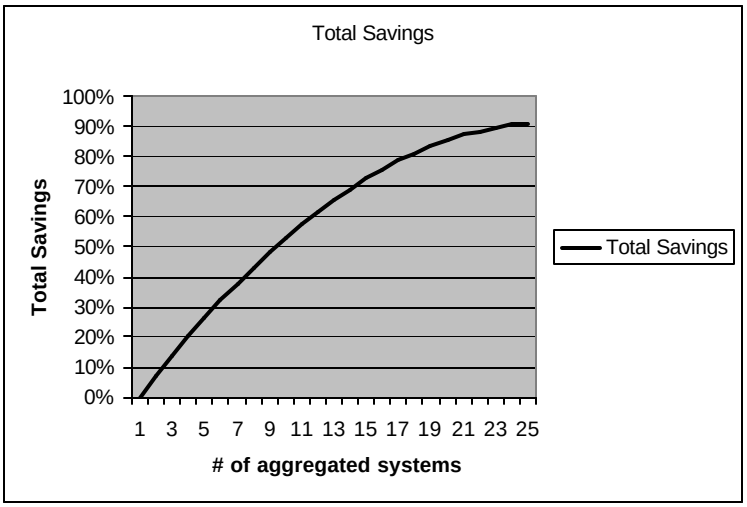
[2] *"All other things been equal, as the number and heterogeneity of subunits information needs increases, the difficulty or arriving at acceptable design compromises increases and the cost of resulting design will increase more than linearly. Thus rational firms will integrate less when there are many heterogeneous subunit involved."*



c- Savings increase as the number of aggregated systems increases. The following assumptions apply:

- Each time a system is connected, some redundancy of the system and some costs associated can be reduced.
- The total savings is limited to the reduction of redundancies.

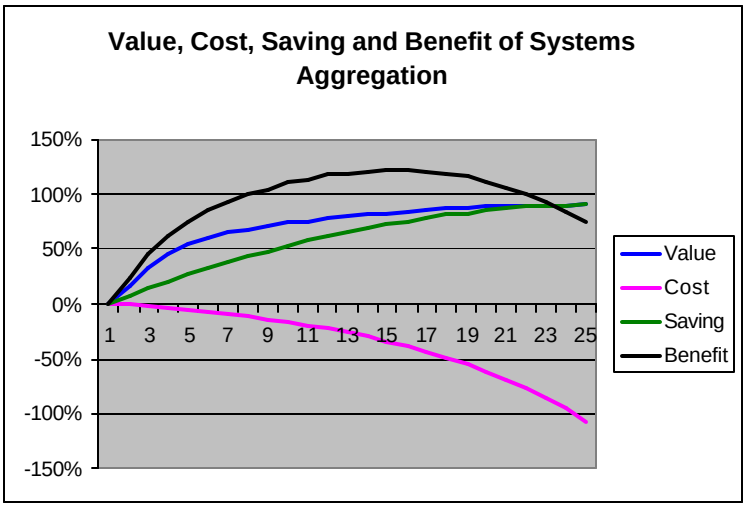
If we represent the cost as a function of the total number of aggregated systems the shape of the function is a convex curve asymptotic to a maximum value of savings



Then the total potential benefit is:

$$B((S\ Si) = V(S\ Si) - C(S\ Si) + S(S\ Si) \qquad (14)$$

This is a convex function with a maximum that depends on the cost function. The more complex the integration, the fewer the number of aggregated systems needed to reach the maximum. At the same time, the cheaper integration becomes, the greater the number of aggregated systems, and therefore the maximum value that can be extracted from the total aggregated system increases.



As can be seen from the graph above, the maximum value is reached with a limited number of interconnected systems. As explained before, the cost of connection is the critical factor that defines the number of total systems that deliver the maximum value from the aggregated system. Therefore, that cost is the limitation to delivering additional marginal value, and the major limitation to deliver more sophisticated services to the users.

2.3- The Dynamics of Connectivity

There is an intrinsic dynamic in the connected system. The analysis in the previous section does not tell anything about the variation of all the terms as a function of time. It is clear that all the terms in equation (14) are variables in time. And so are the total benefits that can be extracted from an interconnected system.

After being connected, the system can increase the potential value that could be delivered if any or all of the following happen:

- Value of any of each system increases.
- Interdependence of the systems increases after connection has been established.
- Uniqueness of each system increases if redundant data is consolidated.

The value that is created after the systems are connected is potential, because the new aggregated system has new capabilities, but the value is not yet delivered. To extract that value, new work has to be performed, developing new applications to make use of the increased potential, or using the new available information to make new decisions. This would be a dynamic process whereby new services would be created, and new users would be added. The final state would be of more interdependence of the two connected systems, and if data redundancy is reduced, both systems would increase their uniqueness.

Using the tools of System Dynamics to describe and analyze the process showed in the previous section would be helpful in understanding this problem.

The following are the key states of the aggregated system:

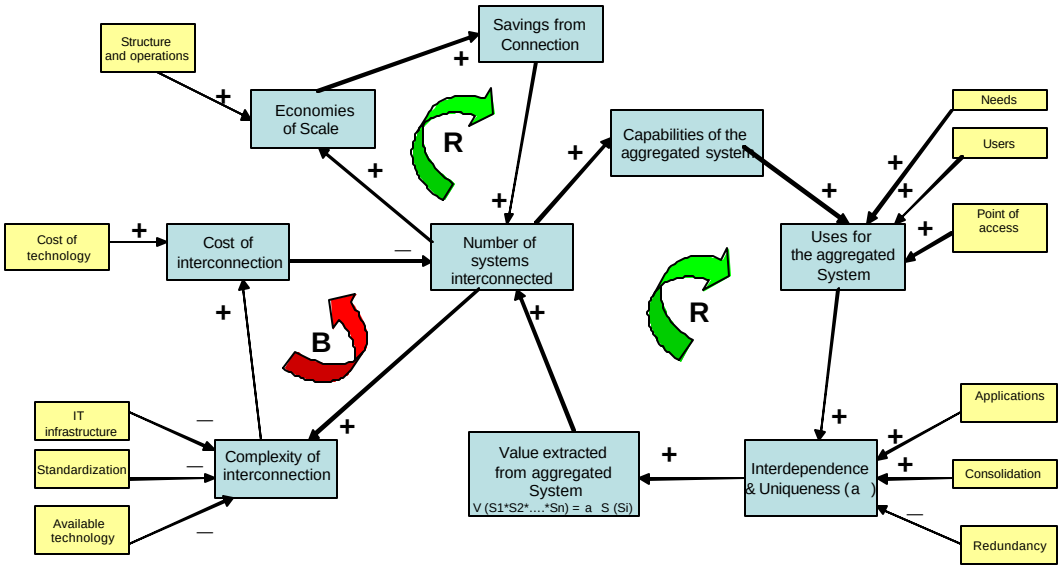
- Complexity of the aggregated interconnected system
- Aggregated cost from interconnection

- Aggregated savings from connections
- Number of systems aggregated to form the interconnected system
- Aggregated value extracted from the interconnected system
- Aggregated capabilities of the aggregated system
- Uses of the aggregated system
- Interdependence of aggregated system

The following are the key external effects on the aggregated system:

- Available technology
- Cost of the technology
- Structure and operations
- Standardization
- Availability of IT infrastructure
- Services provided using the aggregate system
- Needs fulfilled through the use of the aggregated system
- Users of the aggregated system
- Point of access of the aggregated system
- Applications
- Data consolidation
- Data redundancy

Dynamic of Aggregation of Interconnected Systems



The total system has a balancing behavior. There are two loops that increase the total value of the system. The first is driving the value that can be extracted from a more complex system. The second is driving the economies of scale that can be achieved when more systems are aggregated. The balancing loop is driving the cost to connect the systems. The more complex is the system, the more expensive it is to connect and operate it.

From this model, we can infer that each time a new system is connected to the aggregated system, the value that can be extracted increases, but at the same time complexity increases and the cost of this can make the net benefit positive or negative.

Frequently the potential value is unknown up to the time where the availability of connectivity allows for new uses of the aggregated system, which drives new unexpected uses for the aggregated system.

The model leads to several conclusions:

- As more systems are aggregated using connectivity, more value can be extracted.
- The more systems are aggregated, the more complex the connectivity becomes.
- There is a state of equilibrium in which the marginal value that can be extracted from a new connection equals the marginal cost of connectivity.
- The value of a can change if connectivity leads to more interdependence or more uniqueness.
- More connectivity creates new potential capabilities for the aggregated system
- Users can take advantage of the new capabilities increasing the uses of the aggregated system.
- Needs that could not be fulfilled before because of lack of information, can be fulfilled after connectivity.
- More points of access increase the uses of the aggregated system.
- Due to the trend in the development of more potent technology, connectivity would increase over time.

- Due to the trend in the reduction of cost in technology, connectivity should increase over time.
- A policy that facilitates the development of IT common infrastructure would facilitate connectivity and then the probability of delivering more value from aggregated systems.
- A policy that forces the adoption of standards would facilitate connectivity and then the probability of delivering more value from aggregated systems.
- Applications built upon the aggregated systems increase interdependence.
- Consolidation of information of the aggregated system increases interdependence
- Reduction of redundancy increases uniqueness.
- Increased interdependence and uniqueness drives value of interconnection up (as defined above) which means the a coefficient increases.

2.4- Economic Value of Connectivity

From all of the above when systems are interconnected, new potential uses for the information arise, allowing users to exploit the new capabilities, and fulfill old and new needs. New and old applications could use the information of the aggregated system. At the same time consolidation of data allows decreased data redundancy. In conclusion, connectivity would allow a new state of information that lets the creation of value through applications, which give the users new capabilities.

As defined in the previous sections, the economic aspect has two sides: the creation of value and the cost of connectivity and applications. Because of the dynamic nature of this problem, benefits change as the aggregated system evolves and matures.

The strategy that leads to maximize the benefit would be the one that minimizes the complexity of connectivity. That is because the value that can be extracted would be maximized as opportunities to use the greater capabilities of the aggregated system increase.

To minimize cost I propose to act in advance with regards to two key issues. One is standardization, and more precisely standardization of system interfaces and data schemas that would simplify the data interchange of the systems (see Chapter 3 for more details). The other is the development of a common IT infrastructure that facilitates the process of plug-in applications on this common infrastructure sharing common services across different systems (see Chapter 4 for more details). The effect of a standardized data and common infrastructure would allow the emergence of standard applications for government needs, creating economies of scale deriving from a bigger market which, in my opinion, would start a "positive cycle" where bigger market increases quality and reduce prices.

The proposed strategy would minimize the future cost by using a policy towards the creation of a common platform to increase probability of value creation. Then the problem of how to measure the value created from connectivity has now become the problem of how to reduce the cost of connectivity. Cost reduction is more systematically

manageable, and allows a long-term trend toward cost minimizing; in other words it creates the conditions to permit value creation as circumstances evolve. All of the above would give users the potential to extract value from richer systems, in a much more efficient way.

The interdependence of the aggregated systems has more than one dimension. Therefore the impact of connectivity can be wider than effects seen at the beginning of the process. For instance, once connectivity has been established to improve coordination between two organizations for procurement, other parts of the value chain can be impacted, when other organizations become part of the integration, or when customers are allowed to use information from the aggregated system. This shows how difficult it could be to determine the value that can be extracted from connectivity, when the number of aggregated systems and dimensions are not only large, but difficult to determine.

Finally, another important aspect to take in account is the scalability of the aggregated system. This scalability can be maximized if the marginal cost to connect the next system to the aggregated system depends only on the complexity of the interface and not on the complexity of the systems themselves. This again can be done with standardization of the IT infrastructure.

2.5- Network Externalities (NE) in a Connected Government

The proposal for the creation of standard data schemas, standard interfaces and IT infrastructure is based on the idea that this would facilitate the connectivity of government systems, and that the value of the connected systems would increase. Adding to the analysis made above, it is useful to consider whether this standardization would increase the value of the total system as the number of users increase. Katz and Shapiro [Katz and Shapiro, June 1985] defines that "*there are many products for which the utility that a user derives from consumption of the good increases with the number of other agents consuming the good*." This phenomenon is known as "Network Externalities." It is clear that network externalities increase with the size of the market, and if network externalities are significant so are the benefits.

The most common example has been the telephone network. As more users are using a phone, more value can be extracted for the user who in turn has the possibility to communicate with more people. The network externalities benefits for government interconnection are similar to telecommunications networks, where benefits increase as more users have access to the network.

Katz and Shapiro [1985] make several conclusions applicable to my analysis.

- Consumers prefer to use the product they think would be the dominant in the market to maximize the value they can extract from the use.
- Firms' joint incentives for product compatibility are lower than the social incentives.

- If the cost of an adapter is negligible and there are no other barriers, the market will be perfectly competitive.

Based on the above, the following conclusion can be inferred for the case of defining the data schemas for system interconnection:

- If a common data schema is defined and the users perceive it as the dominant standard, they would prefer this to other non-standard interfaces.
- A centralized policy is needed to create a common unique data structure due to low incentives for individual organizations to create it.
- The standard data schemas and standard interfaces will play the role of adapters, and the market for applications and software would become more competitive.

The final conclusion is that network externalities can play a significant role in increasing the rate of adoption of standardized interfaces because the "wagon effect" for connectivity in the government can be accelerated using standard interfaces for data interchange. If interchange is simplified through the standardization of system interfaces and data schemas, the incentives for interconnection will be greater and more connection will mean more incentives, with a "positive circle" as described in the previous sections.

2.6- Economies of Scale and Scope for System Integration

The creation of standardized data schemas and a standardized IT infrastructure should generate economies of scale and scope and drive total cost down.

Once a common infrastructure, standard interfaces, and data standardization are built, the use of economies of scale would allow consolidation of operations and expanded the use of standard applications.

2.7- Reducing Transaction Cost to Change Organization Structure

The use of standardization and a common IT infrastructure, and the economies of scale and scope associated, will reduce the cost of transaction. The reduction of transaction costs are not only important for the savings associated, and the enabled of connectivity, but they can also change the shape of an organization and the structure itself. According to the "Principal-Agent Theory," a system of control has to be implemented to assure that agents that act on behalf of the principal do it in an appropriate way. Information technology lowers the agency cost [Van Alstyne, 1997]. More connectivity allows a more extensive use of information technology, and reduces transaction costs. If the dynamic process of connectivity increases the reach and lowers the cost to control the agents, then lean structures can be put in place, driving costs down and creating more value.

Additionally, if transaction costs decrease, the place to make decisions changes, allowing for the designing of organizations in a different way. This would be an opportunity and a challenge. These changes in organizations and tasks will inevitably create resistance and political opposition.

2.8- Risk and Disadvantages of System Integration

Although system integration and data interchange has in general a positive value, some aspects must be taken into account at the time when connectivity is made. First, security of the overall system decreases because of complexity and the number of points of potential breach increases. Second, privacy of the aggregated data is more difficult to define, control and enforce. Third, hidden costs are more difficult to evaluate. Finally, the scope of connectivity must be analyzed. Integration is not always economical, and in some cases a limited integration is better than complete connectivity [Goodhue, 1992].

2.9- Conclusions

The value extracted from information systems increases with the interconnection of the independent systems. The right strategy to maximize the probability of extracting value from information is to execute a policy that reduces interconnection costs and makes cost

independent of the number of systems to be connected. In other words, the strategy must lead to the reduction of complexity of interconnection.

This strategy should be based on two parts. First, the strategy has to establish policies for the standardization of systems interfaces and the standardization of the data schemas that the systems use. Second, the strategy has to enable the creation of an IT infrastructure that will consolidate the function and services common to all the applications, allowing economies of scale and reducing the overall cost of aggregated systems.

Due to the nature of the government, an active approach to define common standards will increase the "network externalities" associated with these standards and facilitate the emergence of standard applications for different functions and parts of the government.

Chapter 3: Standardization for Building an e-Government

As I developed a theory of benefits from connecting systems, the main issue became not the planning and making of a policy to increase value, but rather developing a policy to systematically reduce the cost of connectivity to facilitate the process of system integration. The main idea is that it is very difficult to define a precise value that can be extracted after the integration of several systems. Due to the dynamics of the needs and uses of these information systems, the most effective policy would be to reduce the cost of connectivity systematically, in order to allow more opportunities for system integration. Value would be created for individual organizations that would use the IT infrastructure, which in turn can take advantage of the low cost of system integration. This chapter analyzes one of the basic tools to reduce cost of connectivity: standardization.

3.1- Tradeoff between Standardization and Innovation.

Standardization is a tool for reducing cost establishing a small number of common predefined properties of an object. But when restrictions are imposed on variety, the process of innovation would be constrained. Thus a tradeoff between cost and variety arises when standardization is used.

In the field of standardization, the issue of technology maturity has been used to sketch the dilemma about when to standardize. Early standardization forestalls diversity and precludes experience with the alternatives, while late standardization makes it more difficult

to reach consensus [Egyedi, 2000]. Not only does standardization reduce cost, but if a standard is widely implemented, compatibility frees resources for innovative activity [Egyedi, 2000]. Thereafter cost and benefits of this process can be evaluated not only from the limits to innovation, but also for the greater efficiency that is created through standardization.

The idea about the use of common standard interfaces is supported in some recent studies; for instance Gandal [2002] states that standardization of data schemas to define standardized interfaces will favor competition and innovation in the rest of the technology (software, applications, communications, services, and so on).

A trade off between standardization and variety would be always present, but the implementation of standardization can lead to more rigid or flexible solutions.

Although standardization limits the innovation process, it has a great value because standardization throughout reduction of diversity facilitates interoperability and thus plays an important role in diffusing IT uses [Egyedi, 2000].

There are two basic ways to achieve compatibility. First, products are designed to work together, even if they are based on different technologies. Second, market forces make a dominant technology prevail and then compatibility is achieved for the use of only one "de facto" standard, which has been defined by Utterback [1994] as the "dominant design."

According to Katz and Shapiro [1986], more variety can be achieved from standardization but this process needs inter-firm cooperation.

Standardization of interfaces for data interchange reduces cost not only through efficiencies gained, but also through more competence among the suppliers of data

applications. That is because if the cost of adoption is negligible and there are no other entry barriers, the resulting market will be a perfectly competitive one [Katz and Shapiro, 1985]. Standardization in the early phase of technology was seen to be a more effective way to achieve interoperability [Egyedi, 2000]. In information technology the critical issue of standardization is not to provide "uniformity" but to provide "compatibility" [Krechner, 1996].

My opinion is that the tradeoff can be minimized if standardization is created for the data interface between the systems, allowing a more flexible use of information in the local systems, and defining a global data schema for specific domains.

When used wisely, standardization can increase efficiency for the "global" system, with few restrictions for "local" systems. In the case of data integration, standardization implies the standardization of data definitions through the use of common data schemas across a collection of data sources [Heimbigner and McLeod,1985].

3.2- Implementing Data Standardization in the Public Sector

Based on the previous premise, a strategy of standard data schemas and standard interfaces can be defined. The data schemas of organization tend to be stable in time and quite similar across similar organizations [Goodhue, Kirsch, Quillard and Wybo, 1992]. Data schemas can be also improved in time according to experience and new needs.

A key point in the standardization process is the difficulty of transmitting the value of data standardization to non-technical senior management [Goodhue, Kirsch, Quillard and Wybo, 1992]. At the same time, without the support of senior management, it is impossible to succeed in the implementation of data standards. Then the challenge is how to demonstrate the value of data standardization to gain support.

An IT strategy utilizing IT standards provides benefits in many areas, the most important of which are [Moreton, 2000]:

- Business demands will be responded to more quickly, because the strategy helps to minimize the variety of systems and software being used.
- Expenditures on IT can be reduced by minimizing the need for different software that performs basically the same function.
- Training costs may be reduced for staff and users.
- Interconnection between applications is facilitated, and when future requirements arise applications will not require major changes or complex interfaces.

But standardization is not a simple task. Beside the benefits listed above there are significant challenges in implementing standardization [Mahonen, 2000]:

- Difficulty in understanding the decision-making problem.
- Standards committees produce “too little, too late.”

- Consensus processes lead to less optimal solutions.
- Sometimes standards can conflict with intellectual property (IP).

Finally, to value standardization benefits is not simple, because there is no single methodology to measure the contribution of standards to business performance. Since the value of IT is inextricably linked with the organization's ability to exploit its information assets, putting a precise value on the contribution of standards alone would be misleading [Moreton, 2000].

A very good example of the value of standardization is the Universal Product Code (UPC) used to identify all kinds of products, in general using bar code. It is easy to figure out how important this is in the efficiency to manage product information. At the same time this is a good example of centralization of standardization. Each company number is assigned in a central worldwide organization and the product specific numbers are assigned for each company. Then a unique number is formed for the number of the company plus the number of the specific product of this company. In this example it is possible to see a penetration of almost 100% at the world level of a standard definition.

For integrating heterogeneous information systems, semantic interoperability is necessary to ensure that exchange of information makes sense [Hasselbring, 2000], and then data standardization is critical to facilitate the interchange of information.

Traditionally, the integration of heterogeneous information systems proceeds in a bottom-up process. Information stored in existing legacy systems is analyzed with respect to

potential overlaps, whereby overlapping data in dissimilar systems describes the same or related information. The overlapping areas of related information sources are subsequently integrated. The integration is generally realized by means of mediators, federated databases or similar mechanisms. The bottom-up approach is to sum up the capacity of existing information systems in one global model. As the result, the usability and maintainability of data schemas can become a serious problem [Hasselbring, 2000].

To avoid the problems of semantic meaning that arise from the bottom-up process, the integration process would proceed in a top-down way, starting with the data models to all the local systems involved [Hasselbring, 2000].

Hasselbring [2000] proposes the use of domain-specific standards as the basis for the common data models. This idea can be adapted to the existing technology, through the use of XML schemas for government organizations, and the centralization of XML schemas using an approach similar to the Publicly Available Specification (PAS), with a central authority that publishes the accepted PAS XML schemas in a central Web base repository. PAS allows the submission of a standard-like specification to the appropriate standards body to have it fast-tracked to become a standard. A PAS Submitter is an organization authorized to submit a PAS to a standards body [Rada, 2000].

This idea is similar with Mahonen's [2000] about the need of public awareness, where a central database with all standards and with limited or full access to standards specifications for everyone through the Internet should be carefully considered. The standard XML schemas would allow the connected systems to receive and send information to other systems.

At the same time the data would be stored in each system in the most efficient way, and with local autonomy, and mapped to the XML centralized schemas, but transformed in local data models as needed.

Using this idea to integrate the "local" system to the "global" system, the work is reduced to understanding the local data model and the XML standard schema, but not any other local data model. Then the data interface becomes a standard that any system can talk to. The final result is a very scalable way to aggregate different systems.

The key to the top-down process is a common standard data model -- in our case using eXtended Markup Language (XML) technology. In the case that a system has to be connected, and the data model of this new system can match the standard XML schemas, the centralized data model has to be modified to include the new needs. From this point it becomes a global common data model that grows from unique needs and allows the adaptation to the new requirement, and would allow the support of new systems with this local need in the future.

The use of standard XML schemas would alleviate the integration of standard compliance applications [Hasselbring, 2000]. With standard compliances interfaces like the XML schemas proposed, the integration of different systems would became straightforward. At the local level, only parts of the global XML schema would be used and the local level and the system would have the flexibility to manage the local data model in a local way, with the only restriction of respecting the XML schema to interchange information with other systems.

The task is then to provide to the government with the domain specific standards for the different functionalities of it, such as justice, health, police, etc.

Shapiro and Variant [1999] establish some lessons from standardization from the private sector. I believe this can also be useful to determine the impact of standardization for IT on the public sector summarized as follows:

- Incompatibility can arise accidentally and persist for a long time. To avoid future problems with connectivity, the solution would be to act proactively as soon as possible to establish shared data schemas, and adopt standard technology to avoid the creation of proprietary standards, in order to preclude fragmentation.
- A large buyer can have a greater influence in setting standards to suppliers. In the case of government, the standardization can be extended to other organizations or companies that want to interact with the government.
- A “killer application” is needed to accelerate and gain momentum in the use of standards. Looking for this application and supporting the adoption of it would be a priority task to incentive connectivity.
- Alliances are needed to achieve critical mass and consensus. Government has to establish the rules to force recognition of the need for such alliances between the different parts of the public sector.

Data schemas can be used to connect new systems in a direct way, or connect legacy systems through a well-defined data interface. As noted above, once the data schemas have been established, a learning process would begin. Each time a new need arises, an update to the specific data schema would be done, allowing the evolution of the data standards to adapt to the demands of the given environment.

One key aspect in this proposal is based in the relatively slow changes in the data schemas of public organizations, because data schemas tend to be stable in time and quite similar across organizations [Goodhue, Kirsch, Quillard and Wybo, 1992]. Then standard data schemas shared across the same domain, and improved with the contributions of the community of users, like an "open source" development or a PAS process, would be a very desirable strategy to accomplish a standardized connectivity.

The concept of standardization of data schemas can be expanded to the standardization of government applications. Because government has a large number of organizations that have common needs, standardization can lead to a bigger market for the development of applications, which in turn would lead to better quality and lower costs, due to economies of scale and scope.

A policy to establish data schemas standardization for the different domains of the public sector can allow more efficient and less costly system integration. This would not be a static situation, but a steady process toward a more connected public sector, where opportunities to create new uses for information would be favored, creating a "network effect." This process

would be self-reinforced, and the standards themselves would grow from the experience and needs arising with system integration.

3.3- XML and Web Services to Facilitate Interconnectivity

Today Internet technology continues to evolve. The incredible success of the Internet has been based on public standards, TCP/IP and HTTP for data transmission and HTML for data presentation. But those standards are not able to deal with the problem of semantic use of data. This is not only a problem for the people that search for information in the Internet, but more importantly, a difficult to automate interchange of data between applications. To resolve this problem, eXtended Markup Language (XML) has been defined. XML allows the definition of data schemas using the Extensible Markup Schema Definition (XSD) for the structured definition of data.

XML is very useful for interchanging information between two different systems, basically because the data is transferred in text format, and text is a standard established and used for all information systems. Then XML standard data can be used not only for Internet applications but for any kind of system.

In the last two years, a new technology has emerged to facilitate not only the interchange of data but to provide programmatic services in a standardized way, which can be used for any system. Web services are in the process of maturing, but some standards are still immature or incomplete.

The basic idea is that loosely coupled systems could not only interchange information, but also allow application-to-application interactions. Information would be transfered in XML format and will require a specific service to be performed for other systems. The expectations for Web services in the government are:

- Dynamic Business Operations: different government organizations would interact dynamically and automatically, because Web Services will allow the interoperability of applications.
- Accessibility: The services provided by the applications will be accessible from different types of communications devices.
- Efficiencies: organizations will be freed from the slow and complex process of software development, and be able to focus on mission critical tasks. Applications will be accessed transparently and provide services for other applications.
- Universally Agreed Specifications: Web Services are based on standard structured data interchange, messaging, discovering of services, and business process orchestration.
- Legacy integration: legacy systems can be integrated now using XML interface, and in the future using Web Services that would be a logic evolution.

Although Web Services are still immature, the potential benefits are enormous, especially for system-to-system process integration, and a large impact is expected. I

expect this impact would start to be seen by 2005, and full deployment of Web Services will be around 2010. Then XML would be the first stage for governments to participate in the expected changes that Web Services will produce.

3.4- Conclusions

Standardization is the basic tool for achieving connectivity. In the case of information systems and especially in the construction of e-Government, the most important use of standardization is to achieve compatibility.

Standardization has to be established for the systems interfaces and the data schemas in vertical domains. Systems interfaces have to be standardized to facilitate the connectivity across the government's systems. Data schemas have to be standardized to avoid semantic conflicts and simplify the interconnection of the applications. The most suitable technology to standardize interfaces and data schemas is eXtended Markup Language (XML), which will be the path toward the use of Web Services in the future.

The standardization of system interfaces and data schemas will increase the availability of standard applications. A less fragmented market for government applications (of both suppliers and users) will reduce cost and increase quality of the applications, due to more competence and more economies of scale.

Finally, the standardization of interfaces and data schemas has to be done in a centralized way, and enforced for all the government organizations to be effective.

Chapter 4: Building an IT Infrastructure for Argentina's Public Sector

The objective of this chapter is to analyze the best alternatives to facilitate the creation of local and global IT infrastructure for Argentina's public sector. Building such an IT infrastructure will facilitate the development of e-Government, increase the efficiency of IT investment, facilitate connectivity and increase intergovernmental coordination.

4.1- An IT Infrastructure for the Government

IT infrastructure is a set of technologies, services and people that are shared by an entire organization, enabling the use of specific applications. Weill and Broadbent [1998] state that "*IT infrastructure is delivered as reliable services shared throughout the firm and coordinated centrally*."

Argentina's government organizations differ from business organizations in several ways. First, the size of the government is larger than any private organization. Second, more than one level of government exists, because the political organization of Argentina, with a federal government, 23 state governments and hundreds of local governments. Third, objectives and motivations of government are not the same as the private sector. Finally, the level of political rivalry is greater in governmental organizations than in a homogenous business organization.

The private sector is driven by profits and faces competition. On the other hand, government most often seeks equality and enjoys monopoly. Equality means every citizen has the same rights to use and access public services. Monopoly means the services provided by the government (police, tax collection, justice, defense, etc.) can be provided only by it. However, the resources of the government are limited and the demand of quality from citizens is increasing.

How much of the ideas and experiences gained from the private sector can be used in the definition of the scope and characteristics of the IT infrastructure for the public sector, given the differences that exist?

Even if the objectives of public and private organizations are different, it is clear that IT infrastructure in the public organizations can increase efficiency (to optimize the use of resources) and connectivity (to allow for better interaction with citizens and others parts of the government).

IT infrastructure in the private sector is usually a long-term investment and changes progressively. The life of the IT infrastructure in the government is longer than in the private sector. This is because procedures are more stable in government due to few demands for change from its monopolistic situation and also due to the bureaucratic, political and complex process to agree on changes. Generally the IT infrastructures of Argentina's government organizations tend to be replaced only when they become obsolete.

IT infrastructure in the government is difficult to achieve because of the political interests of the different parts of the government, and the process used in the way budgets are

negotiated [Homes, 2001]. Each department negotiates the amount of money to be used internally. Additionally, the budget process is based on projected next year's spending. All of the above create a bias against multi-agency and multi-years projects [Mechling and Sweeney, 1997], as is the case especially for IT infrastructure. The situation described for the US government is much more difficult in Argentina due to a less pragmatic culture and the economic limitations of Argentina's economy.

From the analysis above, some common objectives can be defined for Argentina's government IT infrastructure. These objectives can be defined as follows:

- Increase in efficiency from the use of IT.
- Increased coordination between large numbers of government parts.
- Greater use of the IT infrastructure for a large number of different organizations.
- Enabling communication of citizens with different parts of the government through a single point of contact.
- Use of the technology for a long period of time.
- Overcoming political obstacles.
- Overcoming budget problems.

4.2- IT Architecture and Standards in the Definition of IT Infrastructure

According to the Merriam-Webster dictionary, architecture is a unifying or coherent form or structure, and the manner in which the components of a computer or computer system are organized and integrated. IT architecture covers a number of design structures that can be ordered hierarchically.

What is the importance and the role of architecture for IT infrastructure? First, it facilitates coordination between different areas toward the goals of a vision or objective. Second, it gives a map of the interaction between the components. Third, it is a way to organize the use of resources.

Although IT architecture is used extensively in the private sector, trying to define a common IT architecture for all the government, using an enterprise approach, creates a dilemma. The investment in terms of time and resources just to describe the baseline of systems and structures used is enormous. Defining the IT architecture for the whole government and developing or acquiring applications in line with this architecture, can lead to the problem of "paralysis for analysis" [O'Looney, 2002]. The solution to this dilemma is in reducing the scope of the problem to the interfaces, allowing an easy interoperability between the different organizations and giving them the freedom to select the best architecture for the local environment and conditions. The basic idea behind this proposal is that with simple defined interfaces, based on standardization of data interchange, complexity decreases, allowing the creation of complex aggregated systems. Each basic component of the aggregated system will be the individual system at the level of a local organization.

As proposed, the IT architecture will not be a total architecture that addresses each piece of the complete government, but a well defined architecture for the connection of the individual systems to interchange information in an automated and standardized method.

The IT infrastructure for the entire Argentine government will be limited to some services toward the goal to standardize the interfaces between the systems of the different parts of the government. Weill and Broadbent [1998] have defined IT infrastructure services for the private sector that can be used in the definition of the IT infrastructure of the public sector. In my opinion, the services that can be shared across the Argentine government to create the basic IT infrastructure are:

- Provide standards and guidelines for data interchange.
- Provide standards and guidelines for data schemas in vertical domains.
- Provide standards and guidelines for connectivity among different systems.
- Provide standards and guidelines to assure security across interconnected systems.
- Provide standards and guidelines to assure privacy across interconnected systems.
- Provide implementation and technology advice for system connectivity.
- Enforce standard adoption for data schemas.
- Enforce standard adoption for system connectivity.
- Enforce standard adoption for security across systems.

4.3- Global and Local IT Infrastructure

As mentioned before, government has unique characteristics compared with business organizations. The main conclusion of the previous sections was that a global IT infrastructure would consist of a set of common services to allow and facilitate interchange of information across different parts of the government.

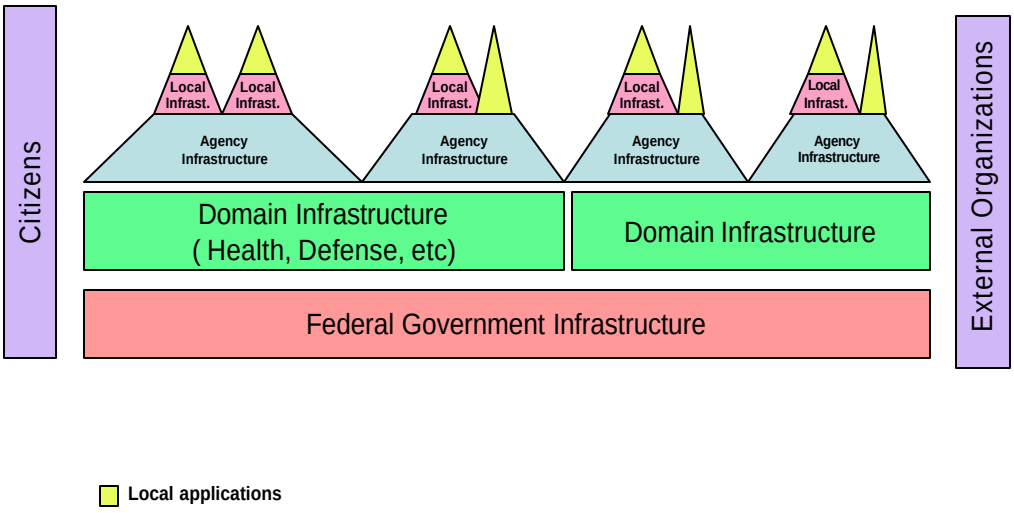
Weill and Broadbent [1998] extended the concept of IT infrastructure to multi-business-units companies. This extended concept is a multi-layered IT infrastructure. Each layer of IT infrastructure became more specific for the needs of each business unit, and is served by the layer below it, which provides the global services to the upper layer of IT infrastructure. This concept is extremely useful if it is adapted and expanded to address the needs of the public sector.

A general IT infrastructure model will consist of layers of IT infrastructure that serve the layer above and provide services to different parts of the government which can be aggregated in different forms. The number of layers of IT infrastructure will depend on the complexity of government organizations. The upper layer of IT infrastructure will provide services needed for the local applications for each specific part of the government. Each layer will *"hide"* the complexity of the services to the next level, providing common and standard services that can be evaluated for the functions and not for the internal details and technical difficulty.

An example of this concept can be Argentina's Federal Government. The lower layer will serve the needs of all the agencies and organizations of the federal government with the

characteristics defined in section 2. The next level can be “agency” wide. More specific services, like communications networks, will be part of it. If the level of complexity and size remains high, other layers of IT infrastructure can be defined to provide more specific common services (like management of data centers or development of specific applications).

Infrastructure Layer for the Government



This architecture of IT infrastructure will provide different sets of services from more general (global) to more specific (local), as more layers of IT infrastructure are added. One of the advantages of this approach is that the IT infrastructure can evolve over time. The evolution can be attained either through the aggregation of similar services to make them available to a wide part of the government, or by decompounding services when complexity and specialization are needed to address a narrow part of the government. Another advantage

of a multi-layered IT infrastructure for the Argentine government is that it can be managed at different levels, reducing the complexity of the entire problem, transforming it into a set of simpler problems linked together by defined interfaces.

In conclusion, due to the complexity and characteristics of the government, IT infrastructure should have different levels. Each level will provide common services to specific parts of government. The lower levels of IT infrastructure will provide more general services to a wider part of the government. As the IT infrastructure moves up, the services will became more specific for fewer parts of the government. The upper layer of IT infrastructure will be standard applications that can be shared across some government organizations (like human resources management or purchase management for a specific agency). These layers of IT infrastructure are dynamic and can be changed to adapt to the reality of the different parts of the government. This dynamic will be more efficient if services can be standardized and encapsulated to enable them to be moved from one level to another.

4.4- Reach and Range for IT Infrastructure in the Government

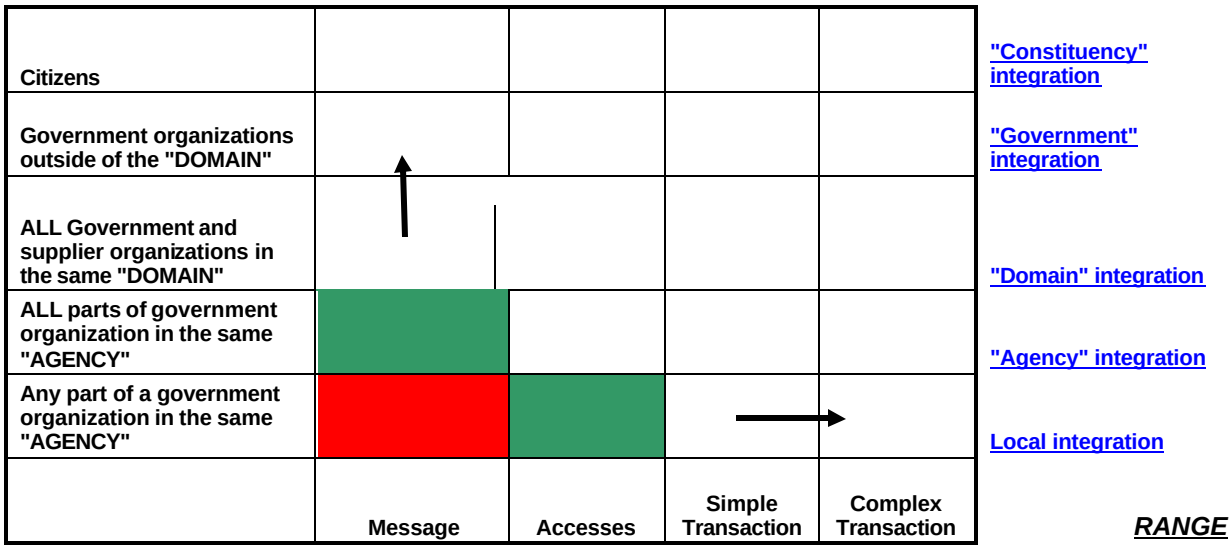
The analysis and conclusions of the previous section can be complemented with the "*reach and range*" diagram [Keen, 1991]. *Reach* refers to the location and people that the infrastructure is capable to connect. *Range* refers to the business activities that can be

completed and shared automatically and seamlessly across each level of reach [Weill and Broadbent, 1998].

This diagram can be adapted for government organizations. For the purposes of this paper the following definitions will apply: “government” is the set of all public organizations, “domain” is all the organization in a specific area (defense, health, justice, police, etc), “agency” is a big organization dedicated to a specific area (Ministry of Defense, Central Bank, Federal Courts, State Courts, State Police, etc) and an “agency-part” is an organization that belongs to an “agency” (Civil Court of Buenos Aires, Police of Mendoza city, etc).

The diagram below is useful for defining a strategy to increase connectivity and to compare the degree of connectivity and maturity of different governments. As can be inferred from the diagram, to accomplish high levels of *reach* and *range*, a high degree of integration and connectivity needs to be implemented.

REACH



An e-Government has to integrate at least up to simple transactions to the agency level; and is able to at least provide message capabilities up to the citizen level, as shown in the diagram below.

Electronically Integrated Government (e-Government)

REACH

	Message	Accesses	Simple Transaction	Complex Transaction	
Citizens	■				"Constituency" integration
Government organization outside of the "DOMAIN"	■				"Government" integration
ALL Government and supplier organizations in the same "DOMAIN"	■	■			"Domain" integration
ALL parts of government organizations in the same "AGENCY"	■	■	■		"Agency" integration
Any part of a government organization in the same "AGENCY"	■	■	■	■	Local integration
					RANGE

The complexity of the basic electronic government defined in the diagram above, can be increased over time escalating the range of the different levels of reach, for instance allowing access and transactions to other parts of the government and citizens to interact at agency part level. The changes can be addressed as progressive changes of functionality and scope both in reach and range.

4.5- Characteristics of the IT Infrastructure for the Government.

Argentine public sector can use the concept of IT infrastructure to increase the efficiency of the use of IT technology. The ideas of IT infrastructure used in the private sector can be adapted to the reality of the Argentine government. The main characteristics of such IT infrastructure can be summarized as follows.

- IT infrastructure consists of multiple layers depending of the complexity, size and aggregation of different parts of the government.
- Each layer provides a set of common services to the upper layer. The function of each IT infrastructure layer is to provide these services with economies of scale and *"hidden"* complexity to the upper layer.
- The consolidation of services at each level of IT infrastructure depends on the maturity, size and complexity of the organization and the available technology.
- Progressive evolution of the layers of IT infrastructure, allows moving services from one level to another.
- Standardization of data schemas and data interchange allows simple connectivity.
- Simple interfaces allow easy and scalable integration of different applications and systems.

4.6- Key Factors to Implementing an IT Infrastructure for Government

The success of the implementation of an IT infrastructure for the Argentine public sector depends on certain key factors. The main challenge is not technical but political. Gaining the favor or the users and the approval of government officers will be the key in the implementation of such IT infrastructure.

The benefits of this IT infrastructure may be difficult for non-technical people to understand, but the benefit of an e-Government has become obvious for all senior officers. Then the main driver for the creation of an IT infrastructure has to be the support of the most senior political officers to build an e-Government. This has been the case in both the UK and Germany.

The key factors in building the IT infrastructure are:

- The driving force has to be building the Argentine e-Government, with the support of the highest level of government officials.
- Reduce political conflicts in order to allow flexibility at local levels of government.
- Privacy and security must be assured across organizations.
- The IT infrastructure has to be built progressively, from simple to complex.
- The IT infrastructure has to be able to escalate fast.
- The IT infrastructure can be built at different layers at the same time.

4.7- Conclusions

IT infrastructure is one of the key factors to achieving the main goals of e-Government which are efficiency resulting from IT investment and direct communication with citizens.

Although the Argentine public sector is large and complex, IT infrastructure can be put in place using the concept of IT infrastructure layers. This concept allows building the IT infrastructure in different layers at the same time, and in a "step by step" approach for each layer.

The importance of IT infrastructure is not easily understood by non-technical people. The dilemma is that no success can be achieved without the support and compromise of the most senior and high-level officers, who usually have limited technical understanding. The solution is not to involve senior officers in the details of IT infrastructure but in building the overall e-Government. IT infrastructure, standardization, and connectivity will come about as a result of compromise of high-level officers in building the e-Government.

Chapter 5: Connectivity in the Government Information Systems of Developed Countries

To define a strategy for connectivity in the government of developing countries, it is important to understand the current state in more advanced economies. Because IT technology is generally adopted first in developed countries, knowing what has happened with the use of technology and what kind of policies have been used would save not only money, but also time and mistakes.

I have selected some significant countries in this respect, but I am aware that a more detailed studied would be advisable in the future.

5.1- USA

The case of the US is interesting because it is the biggest economy in the world and has lead the adoption of Internet. On the other hand, the structure the US government is similar to that of Argentina, with a federal government and 50 state Governments, and a complex organization.

The "Electronic Government" (e-Government) is one of the five key elements of the President's Management Agenda and Performance Plan. The goals for the e-Government initiatives are: to make it easy for citizens to interact with government, improve government efficiency and effectiveness, and improve government's responsiveness to citizens.

Due to the changes in technology and the level of services provided for the private sector, the Federal Government has made a decision to transform the way it does business with citizens, through the use of e-Government initiatives.

The e-Government strategy defines that the government will interact with citizens (G2C), business (G2B), other governments (states and local) (G2G), and intra-government.

The Office of Management and Budget (OMB) identified that redundant and overlapping agency activities have been major impediments for creating a citizen-centered electronic government. OMB thinks that the two major problems to achieve the objectives of a more responsive and interconnected government are security and system architecture. The OMB found that one of the four major reasons for low productivity in government is "Islands of Automation."[3] The OMB found that there is significant redundancy and overlap in the operations of the different parts of the Federal Government.[4] The OMB asserts that Government-to-Government (G2G) initiatives will enable sharing and integration of Federal, State and local data to facilitate integration of government operations.

[3] *"Agencies generally buy systems that address internal needs, and rarely are the systems able to inter-operate or communicate with those in other agencies. Consequently, citizens have to search across multiple agencies to get service, businesses have to file the same information multiple times, and agencies cannot easily share information. "*[OMB,2002].

[4] *The Task Force's major finding was that there was significant overlap and redundancy, with multiple agencies performing each of 30 major functions and business lines in the Executive branch of government. The final analysis indicated that each line of business is being performed by 19 agencies (average) and that each agency is involved in 17 business lines (average). The Task Force found that this "business architecture" redundancy creates excessive duplicative spending on staff, IT and administration. Moreover, the Task Force assessment determined that the redundancy makes it hard to get service, while generating duplicative reporting and paperwork burdens. Consequently, the Task Force focused on E-Government initiatives that provide significant opportunities to transform the way the government interacts with its citizens, through the elimination of redundancy and creating simpler ways for citizens to get service."* [OMB,2002].

To address the system architecture problem, OMB has established the Federal Enterprise Architecture (FEA[5]) to define a System Architecture for each e-Government initiative and a core set of standardized technologies model to facilitate technology solutions. The OMB has established the Federal Enterprise Architecture Program Management Office (FEAPMO) to develop the FEA. FEA is a function-driven framework for describing the business operations of the Federal Government, independent of the Agencies that perform them. To complement the FEA, a Federal Enterprise Architecture Framework (FEAF) was defined to *"provide several approaches, models and definitions for communicating the overall organization and relationships of architecture components required for the development of the FEA."* Some important principles of FEA and FEAF have been adopted by the Federal CIO Council in the E-Gov Enterprise Application Guidelines (EEAG) [Federal CIO Council, 2002]. EEAG establishes interoperability standards and claims that the Federal Government should adopt open standards and should acquire and integrate elements that comply with these standards. FEAF's final goal is to eliminate the use of proprietary software.[6] EEAG requires the use of Internet technology, especially XML in order to establish

[5] On February 6, 2002 the development of a Federal Enterprise Architecture (FEA) commenced. Led by OMB, the purpose of this effort is to identify opportunities to simplify processes and unify work across the agencies and within the lines of business of the Federal Government.

[6] *"Standards. Establish Federal interoperability standards. The Federal Government should adopt and use voluntary industry standards in which the interrelationships of components are fully defined by interface specifications available to the public and maintained by group consensus. The Federal Government should acquire and integrate preponderantly only those components conformant to these standards specifications. Non-proprietary system architectures and solutions are the goal; however, initially only partially and selectively compliant systems may be attainable. The key requirement is that records created on Agency information technology systems must be free of proprietary software dependencies.*
For E-Gov solutions the focus of interoperability is moving towards Internet and Web standards, XML, portals, new integration models such as Message Brokers and XML Web Services, and increasing use of hosting or Application Service Providers. All of these help isolate Agencies from traditional interoperability issues of the underlying hardware and software platforms. An Agency CIO performance goal to achieve this end might read." [Federal CIO Council, 2002].

interoperability. EEAG defines that standardization for data structures, including a common vocabulary, is critical to the success of interoperability.[7] EEAG also requires that is uses for XML provides a critical foundation for e-Gov data architecture.

EEAG defines that e-Gov initiatives and Lines of Business should register their XML schemas in a Federal-wide XML registry. The registry would support the development, registration and extension of XML schemas, XML data definition and naming convention for government inherent data, but only representation of data elements and schemas would be available in the repository[8]. The actual instances of data would be retained in the host systems, to allow standardization of data leaving maintenance of the actual data at the operating level. EEAG recommends taking advantage of application standardization encouraging the development of reusable software.[9]

The EEAG established the following data principles for interoperability:

---

[7] *" Data Collection: Minimize the data collection burden. Data standardization, including a common vocabulary and data definition, will be difficult to achieve but is critical. A common organization eliminates redundancy and ensures data consistency. This is particularly important for E-Gov solutions that cross traditional organizational and functional boundaries which previously represented separate islands of data. E-Gov solutions also often involve direct data collection through automated access by new constituencies, e.g., a citizen entering information on a web form or a business's or State Government's systems automatically feeding data to an E-Gov application through the Internet. Thus, the principle of "enter once, use often" must be addressed in a wider context than in the past."* [Federal CIO Council].

[8] *"E-Gov Initiatives should work with communities in the relevant Lines of Business to define Federal-wide XML standards for their Line of Business. Where possible, these standards should leverage XML data elements and schemas that have been specified by voluntary consensus bodies as commercial and industrial standards.*
E-Gov Initiatives and Lines of Business should register their XML schemas in a Federal-wide XML registry. This registry would support the development, registration and extension of XML schema, XML data element definition and naming conventions for Inherently Governmental data, and would facilitate public-private partnerships and collaboration in this critical area. Only the representations of the elements and schemas would be registered and available in the repository. The actual instances of data would be retained in the host system. This would promote standardization of data while leaving maintenance for the actual data with the appropriate Agency or Line of Business system. A Federal-wide XML.gov Registry is currently being piloted (http://xmlregistry.nist.gov/xml-gov/)." [Federal CIO Council, 2002].

[9] *"Functionality: Take advantage of standardization based on common functions and customers. Federal Agencies should develop or design reusable components, or purchase architecture components, recognizing that these items are designed to obtain a particular functionality. Standardization on common functions and customers will help Federal Agencies implement change in a timely manner. For E-Gov solutions, this applies both to components that support common E-Gov functions across Agencies, and components that are needed to support multiple E-Gov functions."* [Federal CIO Council, 2002].

- Avoid non-standard data syntaxes.
- Seek industry vocabularies prior to the development of custom schemas. Use these industry vocabularies as a starting point.
- Avoid creating a one-size-fits-all schema; divide schemas into manageable efforts with business champions focused on expansion and government-wide propagation.
- Register the semantics of shared data elements.
- Document service interfaces in a standard (consistent) way.

The main technical tools to data interchange between systems defined for EEAG, XML[10] and "Broker Message,"[11] can be used together to achieve connectivity (see references below for additional details).

Web Services is a new alternative to integrate different systems to discover and use the capabilities of other systems. The data interchange would be the product of the invocation of a Web Service that would act as a service for the application requesting it.

[10] *"The eXtensible Markup Language (XML) provides a critical foundation for E-Gov data architectures. XML is emerging as the Industry and Government standard for moving and sharing information . both among different entities and systems, and even among components of a system. XML provides an opportunity for Federal Lines of Business to define and standardize XML schemas for their functions and for interactions with other Lines of Business and external entities such as State and Local Governments or Industry. This will be particularly powerful where Lines of Business can leverage emerging industry standards such as ebXML, or join with State and Local Governments to define joint XML schemas that provide data interoperability across the tiers of government."* [Federal CIO Council, 2002].

[11] The first role of Message Broker (MB) is to simplify integration. Instead of every system being directly interfaced with every other system, each system is interfaced to the MB. This reduced the number of needed interfaces, and isolated each system from changes in the others.
The second role is to combine stovepipe applications and data into integrated applications to meet the cross function/cross organization requirements.
The Message Broker provides three key services:
• Messaging: Data Movement provides physical transport of the messages and data among the applications. XML is been using more and more for messaging.
• Intelligent Routing determines which messages should go to which applications.
• Transformation provides data mapping among the potentially different data syntax and semantics of the different applications.

Web Services are still in the early stages of development but have great potential; it is expected that they will have a large impact in the future of system connectivity.[12]

In conclusion, the US Federal Government is in the process of finishing the definition of a common data infrastructure, to allow a better interconnection with all the agencies and organizations that belong to the Federal Government. This strategy would also facilitate the data interchange with citizens, business and other governments (State and Local). The main resource for the data integration would be publicly available standard XML schemas at the semantic level, and Message Brokers at the connectivity level.

5.2- United Kingdom

The United Kingdom provides a great example of a country with a central government, a large size economy and not a big population.

The most interesting finding in my research has been the development of the process from the global needs of a more efficient government to the current state of implementation.

In March of 1999 a new strategy for the government was presented [Modernizing Government, 1999]. The strategy is centered in the service of people and was

[12] *"XML Web Services were designed from the beginning for the loosely coupled, inter-enterprise world of the Internet. Thus, they focus on 1) using Internet standard HTTP for transport through fire walls, 2) using XML as the standard data format, and 3) providing standard mechanisms for describing and finding available XML Web Services. XML Web Services are most often used to link web applications such as E-Gov solutions, portals, external web sites or e-systems. However, they can also be used to link to legacy applications and Message Brokers tying together the web world and the message broker integration of back-end applications. Unlike Message Brokers, XML Web Services generally provide direct synchronous connections between the client and server application, rather than asynchronous connection through a central hub."* [Federal CIO Council, 2002].

summarized in the introduction of this document.[13]. The strategy stated among other things that:

- Services would be available 24 hours a day, 7 days a week where there is a demand.
- All dealings with government will be performed electronically by 2005.
- Use of new technology will be applied to meet the needs of citizens and not trail behind technological developments.

It is important to note that of the e-Envoy office[14] was created to accomplish the task of putting in place the strategy of the e-Government. This is consistent with the assumption that without a high level of commitment and resources, no strategy would be efficient, even the best one.

One of the five commitments of the strategy is *"develop an IT strategy for government which will establish cross-government co-ordination machinery on issues such as use of digital signature, smart cards, web sites and call centers*" [Modernizing Government, 1999]. An important part of the problem in the use of IT technology has been identified as the non-integration of the different parts of the government.[15] As part

[13] *"Better provision of better services available from government at all levels is central to the approach of Modernizing Government – in schools, in hospitals, in doctors' surgeries, in police stations, in benefit offices, in Jobcentres, in local councils. To improve the way we provide services, we need all parts of government to work together better. We need joined-up government. We need integrated government. And we need to make sure that government services are brought forward using the best and most modern techniques, to match the best of the private sector – including one-stop shops, single contacts which link in to a range of government Departments and especially electronic information-age services."* [Modernizing Government, 1999].

[14] The Office of the e-Envoy was set up in September 1999 as part of the Cabinet Office. The OeE has responsibilities across the whole e-agenda, notably e-commerce and e-Government http://www.e-envoy.gov.uk

[15] *"But we have not developed ways of ensuring that we maximize the benefits of IT for government as a whole. As a result, we have incompatible systems and services which are not integrated."* [Modernizing Government, 1999].

of the strategy, a specific IT Strategy for the government has been developed based on the integration of local government systems.[16] Some of the policies defined in "Modernizing Government" are of direct interest of my thesis: **data standards**[17] and **government gateways.**[18] Both are directed to allow the interconnection of the government systems.

One year later, the e-Government strategy was published [UK Central IT Unit, 2000], and the e-Envoy was established as the owner of the program. The main objectives of the e-Government Strategy are to provide better services for citizens and business, and more effective use of Government's information resources. The strategy aims for the central government to provide the common infrastructure which is needed to achieve these goals. As part of the strategy, the Central IT Unit (CITU) with the counterparts in the respective administration and lead agencies will:

- support citizen-focused service integration
- lead implementation of framework policies, standards and guidelines
- promote shared infrastructure and applications
- establish a government portal

[16] *"IT systems have tended to be developed separately by different public service agencies; we need now to encourage them to converge and inter-connect. This will focus on the needs of citizens and businesses and will encourage wider choice on how public services should be provided. It will maximize the benefits to both central and local government of a more coordinated approach to information technology procurement."* [Modernizing Government, 1999].

[17] *"We will put in place on the Government Secure Intranet standard definitions and programming tools to allow Departments to develop new systems in a consistent and standardized way, and to present the data they already hold in a common way."* [Modernizing Government, 1999].

[18] *"In the longer term, we aim to link the widest possible range of government services and information through electronic government **gateways** (or portals). Government agencies and Departments hold very large amounts of data. The variety of systems, some of them now old, makes accessing that data efficiently a key problem."* [Modernizing Government, 1999].

- promote common policies on the management of information

The strategic building blocks for e-Government have 3 main components:

- access[19]
- e-business components[20]
- interoperability[21]

The policies and guidelines for interoperability have been defined in the e-Government Interoperability Framework (e-GIF)[22]. The e-GIF defines the technical policies and specifications to achieve interoperability across the public sector of UK. e-GIF is the setting of the basic infrastructure and is based in the adoption of Internet and Word Wide Web specifications for all government systems. It is a pragmatic strategy that

[19] *"The strategy envisages that services will be accessed by multiple technologies, including web sites accessible from PCs, kiosks, mobile phone and digital TV, and call and contact centers."* [UK Central IT Unit,2000].

[20] *"There are structural components which can effectively be provided according to centrally determined standards, thereby saving work for service providers and creating a familiar and trusted experience for users. CITU has published and will maintain framework policies and standards on: third party service delivery channels, security of transactions and information, authentication and smart cards."* [UK Central IT Unit,2000].

[21] *"CITU is establishing common standards and infrastructure to enable interoperability across government departments and the wider public sector. The policies and standards will also ensure that government organizations can communicate electronically with citizens and businesses. This has been achieved through wide adoption of Internet and World Wide Web technologies for all government information systems."* [UK Central IT Unit,2000].

"The ultimate test for interoperability is: "the coherent exchange of information and services between systems." If this is achieved then the system can be regarded as truly interoperable. Furthermore it must be possible for " any component or product used within an interface to be replaced by another of a similar specification and the functionality of the system still be maintained." To be e-GIF compliant, a system should satisfy both these requirements." [Office of the e-Envoy,2003].

[22] The e-Government Interoperability Framework (e-GIF) is an essential component of e-Government Strategy and sets out the policy and standards for interoperability across the public sector. It sets the architecture for joined-up and web-enabled government, for the UK online portal and Gateway, and for Electronic Service Delivery (ESD). [Office of the e-Envoy,2003].

aims to reduce cost and risk for government systems and align them to the global Internet revolution.

The most important characteristics of e-GIF are:

- Is mandatory for all the public sector of the UK.
- Defines the minimum set of technical policies and specifications governing information flows across the public sector[23].
- Has adopted XML and XSL as the core standards for data integration[24].
- XML schemas are defined and distributed centrally to all the public sector[25].
- E-GIF only adopts specifications that are well supported in the market place.
- Provides support, best practices guidance, and centrally agreed schemas through the www.GovTalk.gov.uk web site[26].

---

[23] *At the highest level complying with the e-GIF means:*
· providing a browser interface for access
· using XML as the primary means for data integration
· using Internet and World Wide Web standards
· using metadata for content management.
[Office of the e-Envoy,2003]

[24] *"Systems are expected to use agreed XML schemas and agreed data standards listed in the Government Data Standards Catalogue, both of which are available on GovTalk. Should suitable schemas or data standards not be available, or those available deemed inadequate in some way, the system purchaser/sponsor should invoke the RFP/RFC processes immediately.* [Office of the e-Envoy,2003].

[25] *"XML schemas will be developed by specialist groups (see Government Schemas Group below), or by open submission to the GovTalk web. The Government Schemas Group will manage the acceptance, publication, and any subsequent change requests for the schema. XML schemas that have been accepted by the group will be published at http://www.govtalk.gov.uk/interoperability/agreedschema.asp and are open for anyone to make comments."*
"Although the Office of the e-Envoy will eventually provide XML schemas for all services, the program for delivering schemas and agreeing further interoperability specifications will be primarily driven by the needs of citizen and business facing services. Priority will be given to schemas that serve the requirements of services or processes that are generic across many public sector organizations. Facilitation of new, joined-up services and inter-organizational process developments will also be given precedence." [Office of the e-Envoy,2003].

[26] *"The GovTalk(TM) web site http://www.govtalk.gov.uk forms a fundamental part of the e-GIF implementation strategy. It supports the whole initiative and incorporates the management processes so that government can consult and take decisions using the power and speed of the Internet. GovTalk provides implementation support through the production of centrally agreed, freely available XML schemas that can be reused throughout the public sector to reduce the costs and risks of developing data interchange systems. The web site will be used to seek proposals for schemas, publish them for comments and receive requests for changes to them. The site is designed to encourage widespread particip ation in the*

- Sets up policies for establishing and implementing metadata across public sector[27].
- The office of the e-Envoy and the Cabinet Office is the lead authority in implementing and maintaining the e-GIF.
- States that all the implementation actions and details will take place in the individual public sector organizations.
- Establishes the management process to assure the implementation of e-GIF.
- Defines the Change Management process for e-GIF specifications[28].
- Defines compliances procedures with the e-GIF[29]

In summary, UK has started for defining the need of a Modern Government, and to accomplish this, it has defined a strategy for an "Electronic Government" (e-Government) that would allow a better service based on a strategy to serve its citizens.

---

development of the schema set and is completely open for the submission of proposals and comments to encourage innovation from the public sector and industry. The web site will also be used to provide help and guidance for XML schema developers. This will include best practice guidance, case study material, and advice on toolkits to support the production of XML schemas, and specifically to help with the conversion of legacy system data. It is also now being used for wide consultation on a number of other e-Government frameworks and documents. It is intended to make adoption of the e-GIF policies and specifications simple, attractive and cost effective.." [Office of the e-Envoy,2003].

[27] *The e-GMS (e-Government Metadata Standard) is based on the internationally recognized Dublin Core standard, but has additional elements and refinements to meet the specialist needs of the public sector. It will be further developed as needs arise and encoding schemes become available. It can be found at http://www.govtalk.gov.uk/interoperability/metadata.asp?order=title.* [Office of the e-Envoy,2003].

[28] **"***The e-GIF specifications will inevitably change and will have the capability to change quickly when required. The change management process must ensure that the e-GIF remains up to date and is aligned to the requirements of all stakeholders and to the potential of new technology and market developments. The e-GIF describes an inclusive Internet based consultation process that will encourage participation and innovation. They also describe how changes to e-Government resources specifications will be managed.."* [Office of the e-Envoy,2003].

[29] *"The ultimate responsibility for compliance rests with the system's Senior Responsible Owner or Sponsor. Compliance is by self-regulation using normal departmental checking arrangements throughout the system's development life-cycle. It will be for service organizations themselves to consider how their business processes can be changed to be more effective by taking advantage of the opportunities provided by increased interoperability."*

"All new systems that fall within the mandate will provide interfaces that conform to the specifications, or equivalents, in the e-GIF by default. They may also provide additional interfaces. New systems should be developed to comply with the e-GIF specifications in force on the day approval is given to the business case (i.e. the latest versions of Part One and Part Two). Should changes be made to the e-GIF thereafter which impact the system development, then a full assessment should be made of the cost and benefit of accommodating the changes before the system goes live or subsequently. Legacy systems that fall within the mandate will need to provide interfaces that comply with the specifications or equivalents." [Office of the e-Envoy,2003].

A key part to delivering an e-Government is to allow the interconnectivity of the different parts of the public sector. The interoperability has been defined in e-GIF (e-Government Interoperability Framework). The characteristics of the e-GIF are the use of XML and Internet standards, through a centralization of XML schemas and the decentralization of the actual implementation of IT applications.

The strategy defined in the e-GIF is in the process of implementation, and the results would be available in the next two years. I believe it is essential to monitor the progress of this initiative with regards to the success of the use of XML for standard data interfaces.

5.3- Germany

Germany is an example of a very well defined standard for interoperability. The Standard and Architecture for Government Applications (SAGA) [KBSt, 2003] is the main document for all the standardization of data, architecture, applications, interoperability, and security.

The goal of SAGA is to contribute toward a modern and service-oriented administration. In September 2000, the Chancellor Gerhard Schröder launched the BundOnline 2005, which obligated the Federal Administration to provide its more than 350 services online by 2005.

The basic principles of BundOnline 2005 are: **operating system neutrality, interoperability and portability.** One of the main principles is the "one-for-all" that demands the standardization of components and applications to allow the reuse of data and applications throughout the public sector. SAGA states that "*simple and clear-cut standards and specifications help to achieve interoperability for information and communication systems.*"

The main objectives of SAGA are:

- To ensure ongoing flows of information between citizens, the Federal Government and its partners (interoperability).
- To establish comparable procedures for the provision of services and for the definition of data models (re-usability).
- To provide specifications in the form of publicly accessible documentation (openness).
- To consider developments on the market and in the field of standardization (cost and risk reduction).
- To ensure the applicability of solutions against the background of changing requirements in terms of volume and transaction frequencies (scalability).

I found the principle of SAGA, *"a uniform and standardized process and data definition is a precondition for uniformed standardized hardware, applications and interfaces*" [KBSt,2003], coherent with the proposal of data standardization of my thesis.

SAGA defines the need of Data Modeling to ensure interoperability of applications and the reusability of process and systems.

A web site for public discussion of related issues, Requests for Comments (RFC) and Requests for Proposal (RFP), has been established.

Conformity with SAGA is a general prerequisite for all the processes and systems that provide e-Government services in Germany. In the case of systems without direct interfaces with e-Government, migration is recommended on condition of a positive outcome of the cost-benefit analysis. SAGA also establishes the conditions and responsibilities for conformity with SAGA specifications. SAGA states that is necessary the use of "*general data definitions for major data identities and for the data to be exchanged between processes or applications.*" The following guidelines have to be considered in the definition of data models:

- Re-usability
- Simplicity
- Possibility of data models to be described by existing data definitions

The standardization work would be done for a steering unit with work groups. The tools for data schemas definitions are mandatory and based in the Extensible Markup Language Schema Definition (XSD) and will be implemented as a XML schema. XML is mandatory as the standard for data interchange between the government systems.[30]

[30] *"XML (Extensible Markup Language) is to serve as the universal and primary standard for the exchange of data between all the information systems relevant for administrative purposes. New systems to be installed should be capable of interchanging data using XML. Existing systems do not necessarily have to be XML-enabled. If necessary, it is also possible to use middleware which interprets incoming XML information and transforms or converts such information to the data format required by legacy*

For the middleware, the integration of different applications is mandatory the use of Java 2 Enterprise Edition (J2EE). For server-to-server communications is mandatory the use of Remote Method Invocation (RMI) and Simple Object Application Protocol (SOAP), in the last case for interchange of structured data as XML objects. For the definition of Web Services the mandatory Standard is Web Services Description Language (WSDL).

In the case of legacy systems, the program-to-program integration is recommended to migrate to a XML interface[31] or use Web Services.

One of the unique characteristics of BundOnline 2005 is the use of "Basic Components"[32] (BC) that offer technical functionalities which can be used by different public organizations. The "Basic Components" are developed for the "Component Centers" (CC) and support the public organization in the use and implantation of the BC.

In conclusion, Germany has defined a plan for an electronic government, which demands the interconnection of different public organizations. The main elements are standardization of data using XML, the creation of standardized components to simplify

---

and/or external systems. This process can take place in either direction. The performance and execution of a transaction can be monitored by workflow and transaction mechanisms.
If applications use different XML schemas, conversion from one format to another may become necessary for data interchanging purposes. This format conversion is performed by the W3C-defined XSLT (http://www.w3.org/TR/xslt) language as part of XSL (Extensible Stylesheet Language).
XML schemas according to W3C definitions (www.w3.org) are to be generated using the Extensible Markup Language Schema Definition (XSD) for the structured description of data." [KBSt, 2003].

[31] *Information interchange via XML documents has become the established procedure when it comes to adapting processing interfaces of this kind which are still based on proprietary protocols to advanced technologies. Today, many manufacturers offer the interfaces necessary for converting data to XML formats, so that development requirements are reduced and that the development of separate connector functionality may no longer be necessary.* [KBSt, 2003].

[32] *"The basic components provide function blocks which form part of many services and which are integrated as services or modules into the e-Government applications. The basic components are implemented in several stages, so that new versions of the basic components with a gradually enhanced functionality will be made available during the course of time."* [KBSt, 2003].

the process of building applications and the use of standardized applications across the government.

5.4– Key Variables for Connecting the Public Sector

From the analysis of the US, the UK and Germany, I identified the following major forces that are driving the process of connectivity in developed countries:

- The need to provide integrated electronic services to citizens.
- The need to interconnect different "silos-of-information" throughout the public sector to allow integrated information and improve efficiency.
- The emergence of the Internet and "Internet standards" that provide the capabilities to interconnect, and on the other hand the demands of Internet users for those services.
- The adoption of XML for data schemas definition and data interfaces.
- The use of a centralized organization for definition of data schemas and standard interfaces.
- The use of the standards for all the government organizations will be mandatory.
- The use of standard applications across the government is recommended and encouraged.

5.5- Conclusions

The only way to provide more services to citizens and improve overall efficiency is through interoperation of the different parts of government. Redundancy and overlapping is the major impediment to providing fast and coherent services for the citizens. Redundancy also ends up generating more investment than necessary.

Removing the barriers to interconnection will result in more efficiency, faster and better services for the citizens, and a reduction of investment. The use of technology to integrate processes and facilitate communication of information would allow savings if the structures of the organizations are changed accordingly. At the same time, connectivity will reduce duplication and overlapping, as well as decrease or eliminate paperwork and errors from multiple inputs.

The government needs to define standards centrally for system interfaces and data schemas for vertical domains. The better technology for the interface definition and data schemas definition is XML. XML will provide the path for the use of Web Services in the future.

The three developed countries analyzed in this thesis have the common goal of achieving an integrated and interconnected e-Government by 2005. Argentina should start now to define a plan in order to achieve the same level of integration. I believe that the experiences from these countries can be used and the lessons from these processes will be crucial to avoid mistakes and save time in the implementation of Argentina's e-Government.

Chapter 6: Building Argentina's e-Government

Argentina is behind the developed countries in building an e-Government. As described in Chapter 5, e-Government in developed countries is evolving very quickly, especially since 1999. Germany and the UK have each set an objective to build a fully electronic integrated government by 2005. Due to the financial crisis in Argentina during 2001 and 2002, and the recession since 1998, no significant advance has been made in building an e-Government thus far. Technology is maturing and experience from developed countries can be used to start the building of an e-Government in Argentina.

Today Argentina's public sector is in the first stages of e-Government, with Internet technology used mainly to publish information through the different parts of the public sector. Except for a few exceptions like AFIP (Administracion Federal de Ingresos Publicos), the Internet is not used for interactions or transactions. As an example, XML is not used in almost any part of the government and integration on a large scale is not yet available.

The first task to build an e-Government is to explain to political leaders at the high levels of government what e-Government is and what implications such a transformation would have. Once senior political leaders and public officers realize the need for e-Government, the first battle will be over, but this would be only the beginning of a continuing and progressive indefinite process for building the e-Government.

To establish the basis of e-Government, four major foundation steps have to be completed. First, standardize data schemas and systems interfaces to facilitate connectivity, as described in Chapter 3. Second, define an IT infrastructure (ITI) to allow interoperability, as

described in Chapter 4. Third, based on a common infrastructure and standards, start to interconnect the different parts of Argentine public organizations in an incremental way. Forth, build on the IT infrastructure the applications to work across government organizations to interact with the citizens and the private sector electronically.

The size of the task is enormous, but there is no alternative if Argentina wants to be part of the developed world in the future.

6.1- Economic Limitations and Needs in Argentina

Argentina has had a chronic low growth in the last 50 years. As the result, the economy has serious limitations and resources are scarce. Additionally, the financial crisis of 2002 has drastically reduced the value of the local currency, making it very expensive to invest in Information Technology (IT) priced in dollars. These limitations are going to persist for at least several more years.

Argentina needs to improve the efficiency of government. One of the key tools will be the use of information technology. Due to the economic limitations and the great need to revert a long period of decline, creativity in the use of scarce resources are demanded. If resources are wasted in isolated projects that only increase local productivity of government, and preclude the development of an interconnected government, results would remain the same as for the last 50 years, and another opportunity would be lost. Efficient use of resources will allow the leverage of the IT

investment for a more efficient public sector. These will contribute to the process of development which Argentina needs in order to give its inhabitants the standard of living consistent with its resources and historic evolution.

The implementation of IT cannot go alone; it must be integrated with the transformation of the public sector to facilitate economic activity. Without an effective government that facilitates the activities of the private sector and allows the citizen to interact efficiently with the government, the task would be much more difficult.

Furthermore, an interconnected government would be a key element to provide the needed coordination of social benefits for the low-income population. A good interconnected government would be able to better control and distribute limited resources and to assure they arrive to the correct people at the smallest possible cost. At the same time an interconnected government will provide the control to assure a fair assignment of the limited aid for the most unprotected part of the population.

6.2- Using "Technology Lag" to Reduce Risk of Failure

Being a developing country generates a lag in time between the moment technologies start to be used in more advanced economies and the time where technology is used in a less developed country. This lag is created because the cost of the technology, the skills needed to manage and implement it, and the specific needs that less developed countries have.

The “technology lag” phenomenon creates at the same time an opportunity: technology can be studied and understood much better from the experience of the countries that have already used it.

Using this “technology gap” wisely implies:

- Learning from the experience of countries that have been using the technology.
- Taking advantage of the reduction of cost that occurs as technology matures.
- Reducing the risk of using immature technology.
- Selecting the right standards.

Advantages and disadvantages have a tradeoff that can be synthesized in two key variables: time and cost. The more time progresses, the cheaper the technology is; but on the other hand it also becomes obsolete. Therefore correct timing is a key for technology adoption in Argentina. Management of information technology based on this principle can save not only resources but increase the success in the use of IT.

In order to minimize the risk and accelerate the process, I suggest an active approach. It consists of the study of the state and evolution of technology used in developed countries, and the implementation of technology as fast as possible, using pilot cases to develop skills and learn by doing. If the government defines this as a policy, different groups can be coordinated to share results and experience in different types of IT

technology. This would allow the escalation of the process and a better use of resources, sharing risk and skills among the whole public sector.

6.3- Building Connectivity as the Foundation of e-Government

An "electronic government" (e-Government) refers to the use of information technology (especially Internet technology) by the government to give access to and deliver government information to the different parts of the government, citizens, business, employees, suppliers, and other agencies and governments [O'Looney, 2002].

It is possible to think of the relationship between e-Government and connectivity as two faces of the same coin. E-Government is the set of services delivered electronically. Connectivity is the enabling instrument to deliver services. To achieve a full-scale e-Government, connectivity must be built first.

From the analysis in previous chapters, building an e-Government is not a simple task due to the size of the problem, the complexity and the political stress generated when organizations are changed.

The final objective of e-Government is to allow the interchange of information and the use of the information across different parts of the government. This will enable the delivery of more efficient and coherent services to facilitate the communication with the private sector and the inhabitants of Argentina.

If the final task has any chance to be accomplished, a systematic approach has to be defined. This approach must be based on the simplification of the problem, the standardization of as many components of the e-Government as possible, the sharing of resources, the automation of functions and processes, and the use of standardized applications across the government.

The foundation of e-Government has to be built upon a standardized IT infrastructure and the definition of standards to allow an economical and simple way to connect one system to the other as explained in Chapter 2. Connectivity has to be independent of the complexity of the systems and the organizations, to minimize cost and maximize the probability of value creation. These concepts have been discussed in the previous chapters, and the theoretical foundations have been defined.

To achieve Argentina's e-Government, the following sequence of tasks is proposed in this thesis:

1- The importance and functions of e-Government has to be understood by senior political leaders. They need to compromise in order to build Argentina's e-Government. Given our history, that would be the most important and difficult part of the building of e-Government.
2- Standardization of systems interfaces and data schemas in the different domains of government must be defined, as described in Chapter 3.
3- An IT infrastructure has to be defined as described in Chapter 4.

4- Architecture for IT infrastructure must be defined and security of information systems established.
5- Incentives, policies and financing need to be a part of this connectivity process.

Once the connectivity foundation has been defined and the first stages are put in place, e-Government should evolve in parallel with connectivity capabilities in the following 3 phases:

1- Phase 1: PUBLISHING. Expand the access to government information by publishing it. This phase is coherent with the first stages of connectivity, where no real on-line connectivity would be available. Argentina's public sector is in general in this stage, and information published is incomplete and not updated systematically. The time frame to finish the implementation of this phase would be 1 to 2 years after policies are defined and communicated.
2- Phase 2: INTERACTION. Provide two-way communications across government and with business and citizens. This phase is consistent with the initial development of connectivity, where a simple infrastructure and standardization allow the interchange of information using e-mail, simple forms and limited to clusters of connected organizations. The time frame to

finish the implementation of this phase frame would be 3 to 5 years after policies are defined and communicated.

3- Phase 3: TRANSACTION. Make government services available on-line. This phase will evolve from simple services (e.g. pay traffic fines, obtain a duplicate driver license, file a tax declaration, etc) to more complex and integrated (e.g. imports and exports of goods, reimbursement of taxes, payments, contracting, billing, etc). This final phase is an evolving one. Transaction services will evolve from simple to complex, from more local to more interagency as connectivity evolves.

A time frame between 4 to 7 years is expected once policies have been defined to achieve the TRANSACTION phase to a scale where most parts of the government would achieve this phase. I believe that if standardization and IT infrastructure lead to economies of scale and reductions of cost, the third phase for all the government will reach a critical mass in the time frame defined, driving the rest of the government toward the goal of a complete and integrated e-Government.

6.4- Architecture and Security

To build connectivity in the government, the definition of the architecture for IT is the foundation for an interconnected government. On the other hand security and privacy

has to be assured to allow the use of IT across organizations. The definition of architectures has to be done by a very competent, centralized and small organization in order to allow the use of the same architecture across the entire public sector.

1- Architecture

The first task in building connectivity is to define a "Connectivity Architecture". This architecture is a set of definitions of the components of the different layers that will facilitate the final infrastructure. In this infrastructure any government information system can be "plugged in" to interchange information with any other system connected to such infrastructure. This interconnection has to follow the standards in a structured way that would be shared by all information systems, allowing the interchange of information in a "common language" regardless of the local semantic and syntaxes of the information system.

There are several possible ways to define such architecture but the following are the most significant.

a- Application Architecture (AA)

AA is the definition of how the IT infrastructure interchanges information with the applications of the different parts of the government. The main characteristics of the AA are:

- The AA will establish a common definition of functions and interfaces needed to allow the data interchange.

- The AA will define the applications and components that are needed to allow the IT infrastructure to be used as a common "backbone" where any applications can be "plugged in" using a standard interfaces.
- The AA will allow the standardization of applications and common functions that can be shared and reused throughout the public sector.

b- Data Architecture (DA)

The DA will standardize the semantic for data interchange in the different domains where the public sector acts. It will consist in publicly available "data vocabulary" and "data definitions" that will allow the interchange of information across the public sector.

c- Technology Architecture (TA)

TA will define the software, hardware and communications to provide the actual system connectivity at the logical and physical level.

2- Security

Another important condition in achieving connectivity across the public sector is the creation of a reliable level of security. Without a good level of security, it would be impossible to use connectivity in a large scale to build an e-Government.

Security at a large scale of the interconnected government has to assure:

- Access of information only by authorized persons
- Interchange of information that assures that no third parties could tap the content.
- Transactions will be done only for authorized parties and processes.

All of the above needs to be secured in a large, highly interlinked and dynamic environment. The correct technology and policy has to be defined and changed when needed to assure the principles defined.

Finally, privacy of information must be assured, to give citizens and business the confidence that their information will remain out the reach of third parties, including their own government.

6.5- Using Standardization to Reduce Cost and Maximize Value

Standardization was analyzed in detail in Chapter 3. Based on those concepts I propose the use of standardization as one of the tools to facilitate connectivity in the public sector.

From the analysis of the experience and initiatives in more developed countries described in Chapter 5, I concluded that the following common trends exist:

- Standardization of data semantics is needed for efficient connectivity on a large scale.
- Use of public domain standards is mandatory in all the analyzed countries.
- Use of standard applications software, whenever possible, to simplify connectivity and reduce cost is necessary and mandatory.
- Use of open technology to avoid customer "lock in," and assure migration in the future is strongly recommended.

The strategy to use standardization will provide the following benefits:

- Standardization will allow a more simple process for connecting systems. As I described in Chapter 3, not only is connectivity facilitated, but the aggregated system becomes scalable and manageable.
- Standardization will reduce the cost of acquisition, maintenance and replacement. The reduction in cost comes from economies of scale and scope, but also in the simplification of the interfaces with other systems.
- As described in Chapter 2, a strategy that minimizes cost will allow the best probability to increase value. It is impossible to define all future alternatives for the use of information when the infrastructure investment is done. However, as

new needs will arise in each individual organization, the hurdle will be lower in the feasibility analysis of each project.

6.6- Building an IT Infrastructure (ITI) to Allow Escalation of System Connectivity

One of the key parts of the strategy suggested in this thesis is to build a common IT infrastructure across Argentina's public sector, to facilitate connectivity and enable the emergence of the e-Government.

As described in Chapter 4, an IT infrastructure is a new kind of infrastructure composed for computing and communications hardware, software and the people that operate it. IT infrastructure is delivered in the form of standard and shared services for the different parts of the government.

The importance of IT infrastructure is reflected in:

- Economies of scale originate when basic functions are shared for more specific applications at the organizations level (system security, network operations, processing and storage capabilities, etc).
- Integration of systems: through the IT infrastructure, systems communicate and interchange information, providing an aggregated system where the needs for cross-coordination can be achieved (nationwide tax control systems, unified point

of access for citizens, unified import and export systems, integrated police and security, etc.).

Because investment in IT infrastructure is the larger part of IT cost [Weill and Broadbent, 1998] and due to the relatively long usage of this investment, the decisions in the type, scope and technology for IT infrastructure are critical in the success of e-Government.

Using the concept of "Technology Lag" described earlier, the risk associated with these decisions can be reduced, based on the experience of more developed countries. This implies the active approach suggested in 6.2, and the creation of a well-qualified group to analyze and define the IT infrastructure over the time.

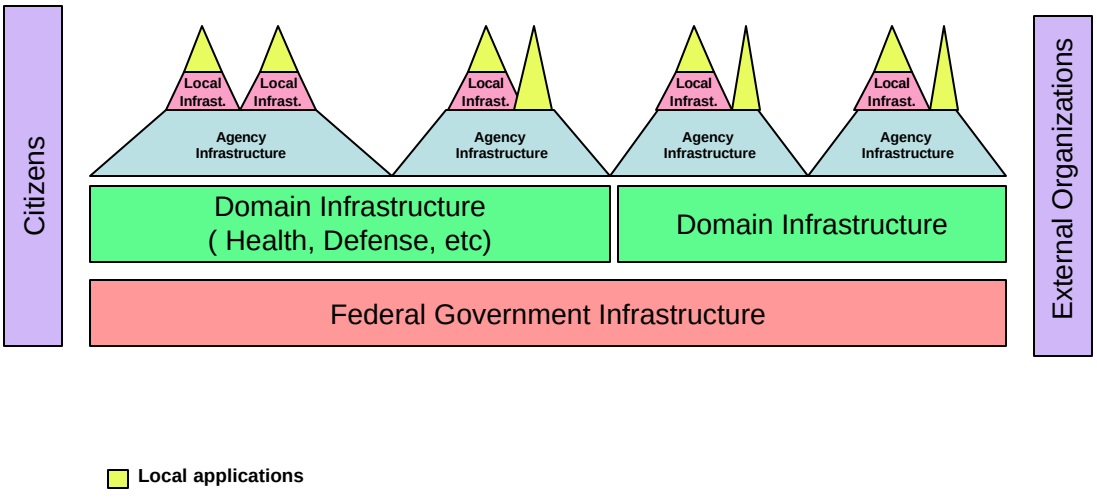
According to the previous analysis, Argentina's IT infrastructure for the public sector has to be based on the following policies:

- Use of Internet standard technology at the communications layer (TCP/IP).
- Use of Internet standard technology as the interface with end users (HTML).
- Use of standard operating systems (UNIX, Linux) whenever possible.
- Use of standard XML data schemas for each domain of government.
- Use of standardized XML interfaces.

The IT infrastructure will consist of several layers of infrastructure that will be delivered as services as described in Chapter 4. Each layer will interact with the other and will differ in the scope, from more general (government wide) to more local (agency wide). The services will be encapsulated to allow the movement of them from one layer to another when needed.

6.7- Creating a Market for Standard Applications

E-Government will demand implementing new specific applications. The applications will have the capability to interact with the IT Infrastructure in the layer below them to deliver new services and to allow government organizations to work across the public sector, as mapped in the figure below.



If IT infrastructure has to be built using standardization, the same must apply to for applications that perform similar functions in different parts of the government. Across Argentina, there are a large number of government organizations such as municipalities that can use standard applications and benefit not only from lower cost but also from better quality and functionality. The idea of standard package applications will be extremely important if the goal is to achieve a complete integration and connectivity of government toward the objective of creating e-Government. If access to affordable and full e-Government enabled applications is limited, not only e-Government will be limited but the digital divide will increase between big government organization and smaller or poorer government organizations that cannot afford new applications if they are made individually for each one of them.

The market of suppliers of Argentina's government applications is very fragmented. The result is high cost of applications due to low economies of scale. As part of the definition of standards and IT infrastructure, some policies must be defined to facilitate the emergence of a better market for government applications.

An active intervention of the government to define standards and simplify the functional requirements is needed. Once common characteristics are defined and a basic IT infrastructure is established, then market fragmentation will be reduced. A bigger market for more standard applications will allow a greater supply of standard application packages for the entire public sector.

6.8- Creating the Policies and Organizations to Achieve a Connected Government

To achieve a connected public sector common policies and organizations have to be developed. The goal is to establish a few, but clear and precise policies that can guide the development of a standard IT infrastructure where specific public organizations can connect their applications to provide electronic services and interconnect their systems across the government. At the same time an organization to facilitate and manage the process would be needed.

a- Suggested Policies

- Adopt standard Internet technology across the government to access and connect information systems.
- The integration of the different information systems must be accomplished using standard XML interfaces.
- Data schemas have to be based on XML standards.
- Build the IT infrastructure in several layers where common services can be shared across the government.
- Simplify and standardize the functions of government organizations to facilitate the use of standard package applications.

b- Suggested organization and structure

- A small centralized group to define XML data schemas for the different domains of government.
- A centralized group to train and support the use of data schemas, the development of XML interfaces and the implementation of connectivity.
- A centralized organization to facilitate the implementation and emergence of e-Government.

d- Suggested financing for e-Government

- Create centrally funded organizations for standard definitions and e-Government facilitation using Federal Government resources.
- Create a program to finance the infrastructure with long term borrowing using assistance from international organizations such as the World Bank.
- Create a program to finance the purchase of applications using mid term borrowing from Federal Government.

6.9- Developing the Human Resources Necessary to Manage an Interconnected Government

The strategy to interconnect the Argentine public sector and deploy the e-Government would depend on the people that push and support it. Without a capable and motivated group of people behind these ideas, any success would be impossible.

I suggest the formation of a core group of young and intelligent people, led by a few experienced managers, with experience in long-run projects and with strong political skills. This group will form the centralized organizations proposed in 6.8.

In addition to that, I suggest building a formal association to gather CIOs and the persons in charge of building the e-Government applications to promote the use and development of connectivity across the public sector. This association will be open to all level of government CIOs from the whole country and from all government areas (Federal, agency, State, local municipalities).

6.10- Conclusion

Argentina is far behind developed countries in the use of IT for the government. The world is moving toward the integration of government organizations using the new information technology available. If wise steps are taken now, the gap between Argentina and the developed countries can be closed in less than 10 years. The key is to understand what these more advanced countries are doing, and adapt this experience to Argentina as soon as possible. Technology will continue in a trend of decreasing prices. The risk of adoption of incorrect technology and standards can be reduced based on the experiences

of the countries that already have implemented integration on a large scale for the government. This can be done with few resources consisting of a small group of capable experts in the information technology and government organization areas.

My proposal is the use of standard XML system interfaces and domain XML data schemas, centrally defined and maintained. These standards will be the foundation for building a common IT infrastructure in different layers. This IT infrastructure will facilitate the integration of Argentina's government systems and will reach economies of scale to making possible the process of integration.

The third part of the proposal is an active participation of the government to facilitate the emergence of a market of standard applications. These applications will cover the needs of different parts and functions across the government in all its levels.

The success of this proposal will depend on the support of the most senior political leaders at the highest levels of the government. They will need to understand the importance of the e-Government in the future in order to create the structures and policies proposed in this chapter.

Chapter 7: A Framework to Build e-Government using Connectivity

As described in the previous chapters, there are enormous benefits in the use of information technology by the government: increasing efficiency, providing integrated services using information across organizations, achieving better internal and external coordination and providing citizens and the private sector with better services and real time information.

Connectivity is an enabling tool that increases potential value, lowering the cost to aggregate systems (see Chapter 2). Several steps are required to build an e-Government, but as showed before, some of them will have a greater impact.

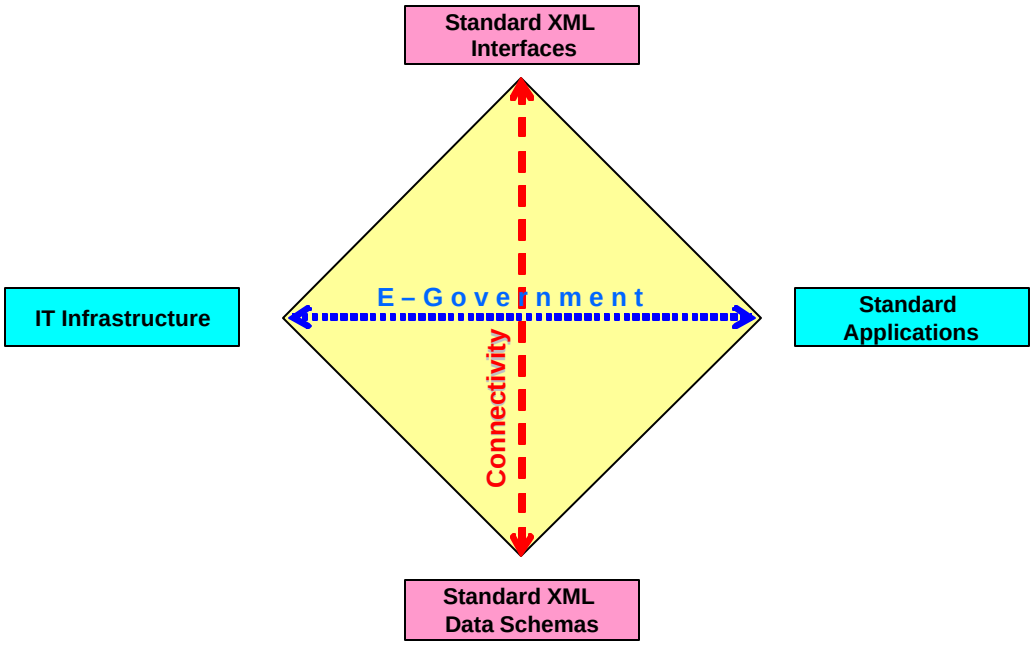
E-Government should be based on a common IT infrastructure at different levels of public organizations (see Chapter 4) to share common services across entire clusters of organizations. The other important component of e-Government is the applications that deliver the information and facilitate the interaction across government and with the private sector and the citizens. As described in Chapter 6, standardized applications will maximize the spread of e-Government across all the public sector.

Connectivity is the key factor for system integration as explained in Chapter 2. At the same time connectivity can be facilitated with the use of standardization (see Chapter 3). The definition of standard interfaces to connect government systems not only will reduce the cost, but will allow the aggregation of larger number of systems and organizations. At the same time, the standardization of data schemas for the different domains, where government are present, will increase integrations across public sectors, and facilitate connectivity (see Chapter 3 and 5).

These concepts can be mapped as shown in the figure below. The two most important elements for building e-Government are IT infrastructure and standard applications. They depend of connectivity to be effective, efficient and scalable, and this can be done only if standardization of interfaces and data is accomplished.

E- Government and Connectivity

.



7.1- Building e-Government

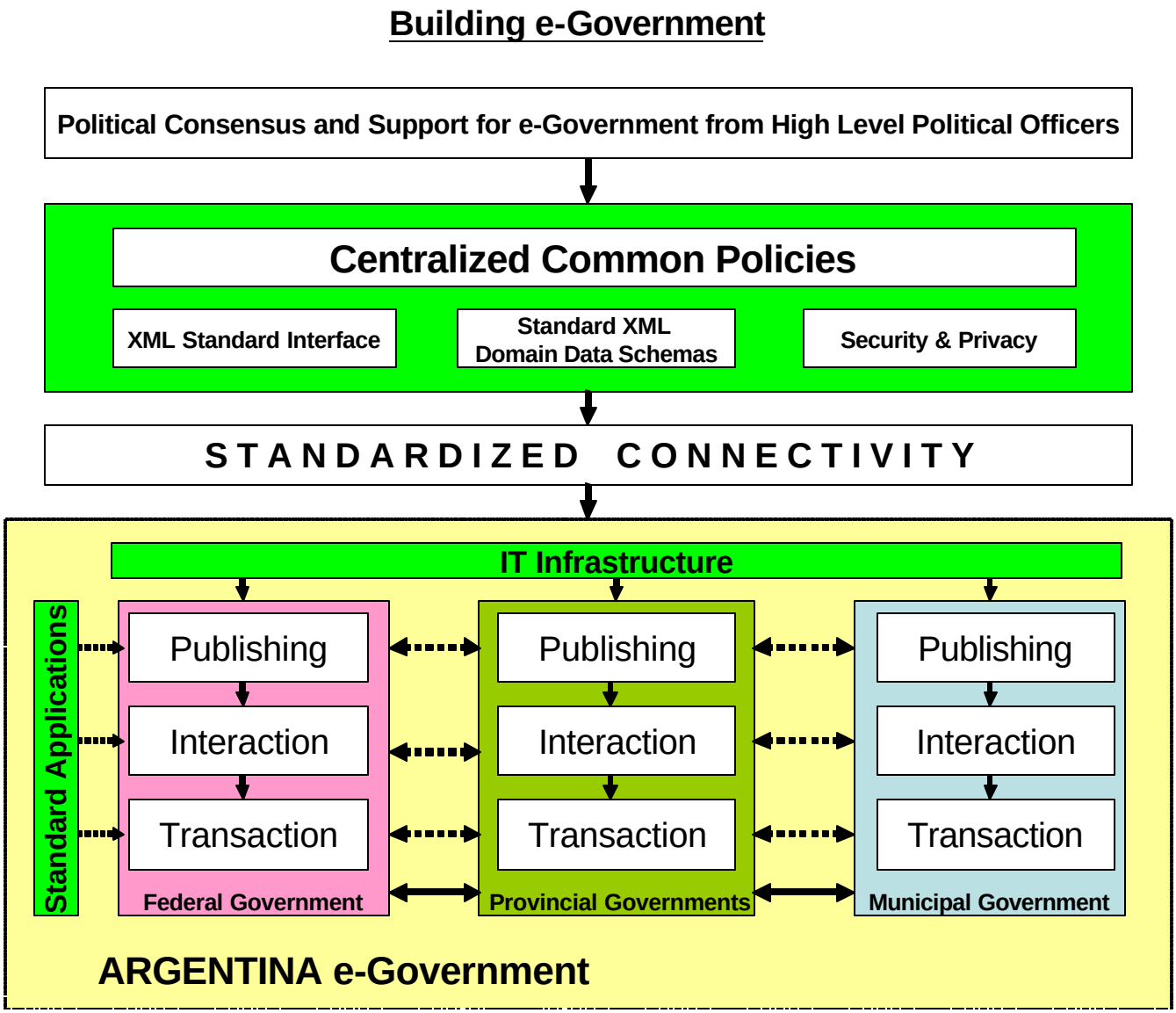
The critical factors in building Argentina's e-Government are the support from the highest level of government officers, and the definition of a standardized connectivity.

I argue that the standardized connectivity has to be based on XML interfaces, as well as on the definition of XML data schemas for the different domains of the government and on the correct level of security and privacy. As I found from the study of developed countries, this task has to be accomplished centrally for all the public sector (see Chapters 3, 5 and 6).

Once support and centralized standardization is achieved, the next step will be to build the IT infrastructure at different levels of government organizations as described in Chapter 4.

Finally, the applications that will enable the functioning of an e-Government will be standardized applications that would follow the phases from publishing to transaction (see Chapter 6). Such evolution will not be uniform across all the public organizations but the path toward transaction is the clear choice for e-Government evolution. As the systems evolve, the IT infrastructure will evolve too, and the interactions of the systems will change over time. The latter will be allowed for the connectivity facilitated for the standard interfaces and the standardized data schemas.

The process to build the e-Government has to follow the logic showed in the next figure.



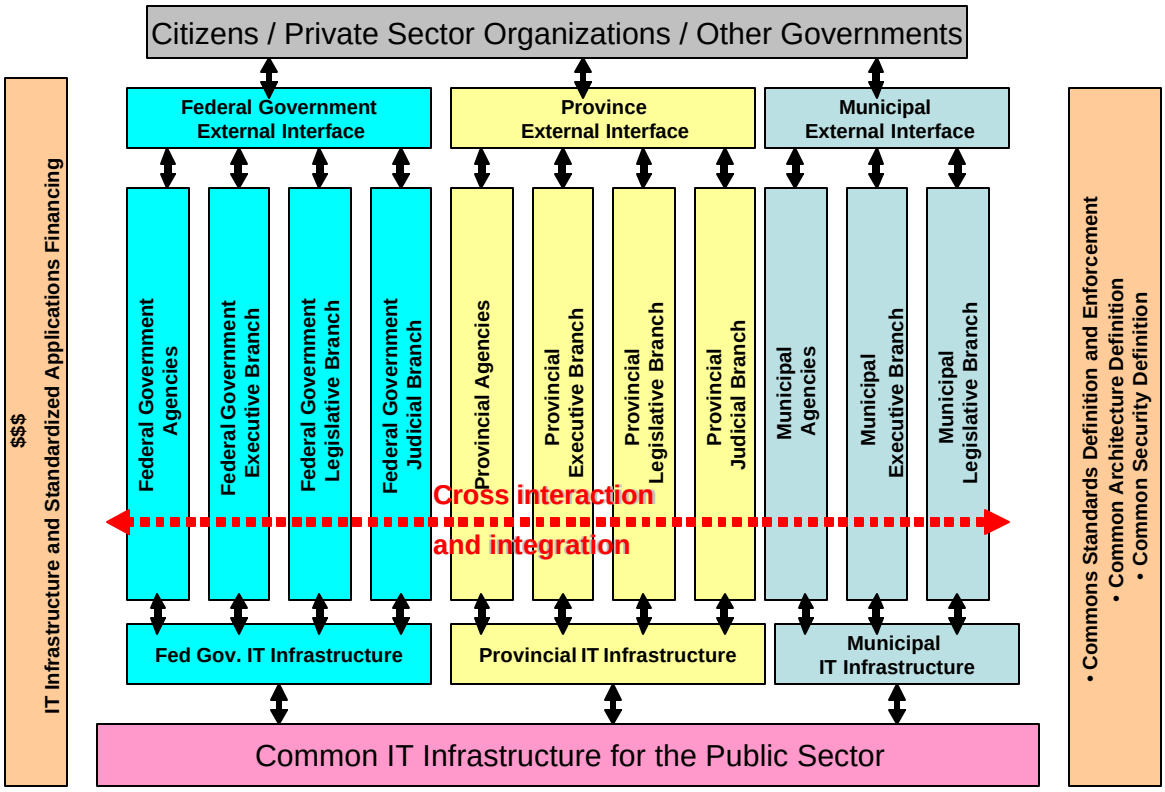
7.2- Argentina's e-Government Components

E-Government is formed by tangible, logical, and policy components. The tangible components are the applications. The logical components are the standard interfaces and data structures. The policy components are the rules that organize the components and their financing.

The objective of e-Government is the efficient use of information to allow the delivery of services across government organizations, to citizens and to the private sector. This is can be accomplished with the interconnection of the information systems using standard interfaces and common data schemas as defined in Chapter 3, by using a common infrastructure across the government as explained in Chapter 4, and with a set of policies defined in Chapter 6

In the following figure, the interrelations of all the components are defined. Information flows electronically across all the different parts of the government, and also from the different parts of the government to external organizations or persons. The most important characteristic is that information is delivered in an integrated way, allowing efficiencies and providing greater value for users.

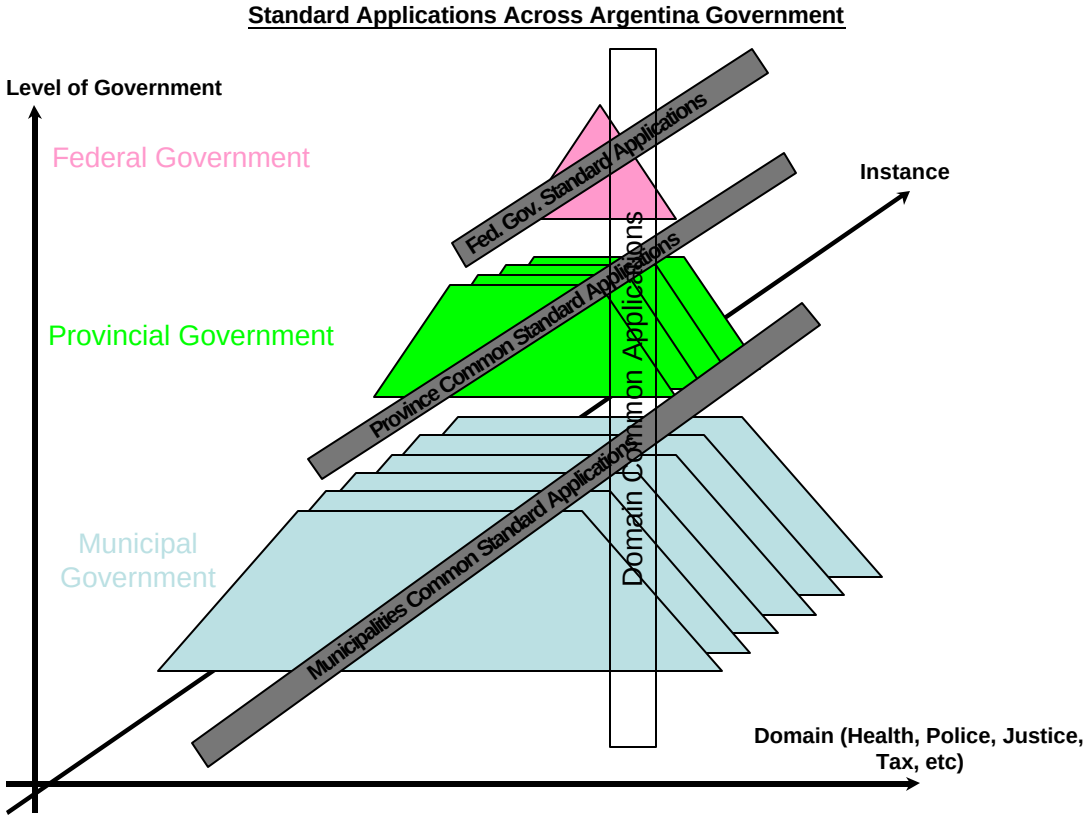
Composition of e-Government



Finally, e-Government will be delivered through specific applications that should be as much standardized as possible, as explained in Chapter 6. These applications will have different characteristics. The most important dimensions defining these applications are: the level of government where the application is used (Federal government, Province, etc); real instances where the applications are used (one of the many possible different governments across Argentina); and the domain that these applications are used for (hospital management, police administration, etc).

Based on these three dimensions there will be standard applications that can be shared across the public sector depending of the specific situations.

The figure below represents the possible different standard applications. It is clear that the scope and variety of these are enormous, and the impact to have standardized applications is very large as explained in Chapter 6.



Conclusions

E-Government in Argentina will be inevitable, as was inevitable for the government to use electricity and phones. The question is not *if* e-Government will happen or not, but *how* it will happen and what kind of e-Government will Argentina have. The answer will depend on three key variables: the quality of the e-Government, the cost of the e-Government, and the time needed for the implementation of the e-Government. I expect that this thesis will help the decision process in building Argentina's e-Government.

I argue that a centralized definition of system interfaces and data schemas will allow the construction of the e-Government from the bottom (local and specialized applications and functions) to the top (global and cross functional applications and functions). The bottom-up construction of e-Government would have the benefits of starting in the peripheral systems and focus on small and specific projects where value can be extracted more easily and with less investment. This course would allow the learning process across the government and permit larger and more across organizational projects, to deliver more transactional applications over time. Finally this approach would have the needed flexibility to adapt to the evolving circumstances without delays created in large-scale projects. At the end of the day, e-Government will arise from the bottom, as an integration of systems enabled for the centralized standardization.

To optimize the creation of e-Government, government will have to build an IT infrastructure. This endeavor is easier to explain than execute. However, the IT infrastructure

will provide the e-Government the needed economies of scale and required specialization. This shared infrastructure will be delivered as services in different layers (as explained in Chapter 4), and evolve with the creation of an e-Government from bottom and local domains.

The last building block for the e-Government will be the creation of standard applications for the different functions of the government in its different levels. I believe that this will demand active policies toward the creation of a market for such applications. These policies will provide the stability and the financing that private companies will need to invest in the development of standard applications for government organizations.

Argentina is in a position to learn from the experiences of more advanced countries. To take advantage of this experience, a group of a few very capable experts is required. The potential rewards from selecting the right technology, standards, and implementation process will be enormous. By learning, adapting, and improving from real implementations, e-Government will reduce the risk of failure in a large proportion. The correct use of XML, and in the future of Web Services, will not be a trivial matter; but as a late adopter Argentina will benefit from them if they are executed in the proper way.

The key to success in e-Government implementation will be the support from high-level political leaders, as is the case for the countries that I have studied. Without this support, no real cross-organization integration will be achieved, and only a limited e-Government will be delivered. This is because the changes that e-Government will produce in the government organization will be enormous, changing the nature of the government itself from an organization centered in bureaucracy to an organization centered on client services. Any political

officer has to be aware of the profound changes that the use of IT technology will bring, and be prepared to assume the challenge. As I mentioned before, this evolution is inevitable and the difference will be the cost and the quality of the outcome.

To implement the findings of this thesis it is important to create a group in charge of standard definitions and the study of the e-government experiences and technology of more advanced countries. The other important aspect of the implementation will be the development of a market (both supply and demand sides) for standard government applications. Finally, the existence of financing for the standard applications and the IT infrastructure will be necessary for success in building the e-Government.

While this thesis has covered some of the more tangible challenges to building an e-Government, several important questions, though outside the scope of this thesis, remain unanswered:

- Will political leaders understand the needs and benefits to building an e-Government?
- What will be the implications of a mediocre e-Government implementation for Argentina as a country? On the other hand, what will it imply for Argentina to have a world-class e-Government?
- What would be the cost of building a transaction level e-Government?
- What degree of digital divide will result from the implementation of e-Government?
- What policies will be needed to reduce the digital divide, both for people and organizations?
- What would be the role of the private sector in the construction of the e-Government?

- What would be the sources of resources and financing for e-Government?

I also have found some areas for additional research. I encourage the reader to consider continuing the research in these areas:

- Best practices for system integration across government organizations.
- Collaboration with developed and developing countries in the building of e-Government.
- Outsourcing of IT infrastructure by the government.
- Development of the human resources for delivering e-Government.
- Minimizing the digital divide between the population and the government organizations.
- Privacy of information in the e-Government environment.
- The use of Web Services in the e-Government.
- Cross-government organization for e-Government .

E-Government in developed countries is a reality. Argentina is lagging behind these countries in the implementation of e-Government. If Argentina wants to build an effective e-Government, a proactive approach has to be taken. A plan based on the findings of this thesis will accelerate the deployment of e-Government and a complete transaction oriented e-Government can be achieved by 2010, if action is taken now.

What the future will bring depends more in the leadership and management in the building of the e-Government than on the technology or the knowledge available. As always the success will depend greatly on the leadership, and Argentina will not be able to blame others if a full and capable e-Government is not fully implemented in the next 10 years.

While I was researching and studying this last year, Argentina has passed through the worst economic crisis in its history, and after an unusual election last April, with high participation of the population, it is preparing for the first "*run off*" election of its history. I hope that the new generation of leaders that emerges will realize the importance of a modern government in the development of our country, and assume the task to build the e-Government that I have described in this thesis.

Bibliography

1- Egyedi, T.M., Institutional Dilemma in ICT Standardization: Coordinating the Diffusion of Technology, *"IT Standards and Standardization,"* IDEA Group Publishing, 2000

2- Federal CIO Council of the USA, *"E-Gov Enterprise Architecture Guidance. Common Reference Model."* Draft version 2.0, July 25, 2002.

3- Foster Ian, *"The Grid: Computing without Bounds,"* Scientific American, April 2003.

4- Galbraith Jay R., *"Designing Complex Organizations,"* Addison Wesley, 1973.

5- Gandal, Neil, *"Compatibility Standardization and Network Effects,"* Oxford Review of Economic Policy, Vol.18 No 1, 2002.

6- Goodhue, D., Kirsch, L., Quillard, J. and Wybo, M., *"Strategic Data Planning: Lessons from the field,"* MIS Quarterly/March 1992.

7- Goodhue Dale L., Wybo Michel D. and Kirsch Laurie, *"The Impact of data integration on the Costs and Benefits of Information Systems,"* MIS Quarterly/September 1992.

8- Hasselbring, Wihelm, "The Role of Standards for Interoperating Information Systems, IT Standards and Standardization," IDEA Group Publishing, 2000.

9- Heimbigner, D and McLeod, D., *"A Federated Architecture for Information Management,"* ACM Transactions on Office Information Systems, July 1985, pp 253-278.

10- Homes, Douglas. *"e-Gov, e-business strategies for government."* Brealey Publishing, 2001.

11- Katz, Michael and Shapiro, Carl, *"Network Externalities Competition and Compatibility,"* The American Economic Review, June 1985

12- Katz, Michael and Shapiro, Carl, *"Technology Adoption in Presence of Network Externalities,"* Journal of Politics Economics, vol. 94 no. 4, 1986.

13- KBSt, German Federal Ministry of the Interior Unit IT2, "Standards and Architecture for e-Government Applications v1.1," KBSt series, Bundesministerium des Innern, February 2003. www.kbst.bund.de/saga.

14- Keen, Peter, *"Shaping the Future: Business Redesign through Information Technology,"* HBS Press, 1991.
15- Krechner, K., "Technical Standards: Foundations for the Future," IEEE Comm. Magazine. August 1996.

16- Mahonen, Petri, *"The Standardization Process in IT, IT Standards and Standardization,"* IDEA Group Publishing, 2000.

17- Melching, Jerry and Sweeney, Victoria. *"Overcoming Budget Barriers: Funding IT Projects in the Public Sector."* Kennedy School of Government, Harvard University, 1997.

18- Modernizing Government, presented to Parliament by the UK Prime Minister and the Minister for the Cabinet Office, March 1999.

19- Moreton, Robert, *"Standards Strategy and Evaluation, IT Standards and Standardization,"* IDEA Group Publishing, 2000.

20- Office of Management and Budget of the USA (OMB), *"E-Government Strategy,"* 2002.

21- Office of the e-Envoy of the UK, *"e-Government Interoperability Framework" v5,* 2003.

22- O'Looney , John, *"Wiring Governments: Challenges and Opportunities for Public Managers,"* Quorum Books, 2002.

23- Rada, Roy, Consensus Versus Speed, IT Standard and Standardization, IDEA Group Publishing, 2000.

24- Shapiro, Carl and Varian, Hal, *"The Art of Standard Wars,"* California Management Review, winter 1999.

25- UK Central IT Unit, "e-Government a Strategic Framework for the public service in the Information Age," April 2000. www.iachampions.gov.uk/strategy.hml

26- Utterback, James M., Mastering the Dynamic of Innovation, HBS Pres, 1994

27- Van Alstyne, Marshall W., "*Managing Information: Networks, Value, Policy and Principles*," MIT Thesis, 1997.

28- Weill, Peter and Broadbent, Marianne. *"Leveraging the New Infrastructure: How Market Leaders Capitalize on Information Technology."* HBS Press, 1998.