Universidad de San Carlos de Guatemala
Facultad de Ingeniería
Escuela de Estudios de Postgrado
Maestría en Tecnologías de la Información y la Comunicación

EIR – ENTERPRISE INFORMATION RESOURCE (A DESIGN PROPOSAL)

Sergio José Rodríguez Méndez

Guatemala, octubre de 2009

UNIVERSIDAD DE SAN CARLOS DE GUATEMALA

FACULTAD DE INGENIERÍA

EIR – ENTERPRISE INFORMATION RESOURCE (A DESIGN PROPOSAL)

ESTUDIO ESPECIAL DE GRADUACIÓN

PRESENTADO A LA JUNTA DIRECTIVA DE LA
FACULTAD DE INGENIERÍA

POR

SERGIO JOSÉ RODRÍGUEZ MÉNDEZ

AL CONFERÍRSELE EL TÍTUO DE
MAESTRO EN
TECNOLOGÍAS DE LA INFORMACIÓN Y LA COMUNICACIÓN

GUATEMALA, OCTUBRE DE 2009

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ABSTRACT

Nowadays it's usual for organizations to build *Information Systems* (*IS*) that process data from a number of sources. In some cases, that information is part of world standardized catalogs, i.e., a set of structured data tables that holds basic business concepts or entities used in a wide range of industries, such as, countries, currencies, languages, measure/conversion units, etc. In other cases, systems require information from diverse financial, governmental and specialized institutions.

Required information can be quite dynamic, and the organization must constantly keep it up to date, preferable on line. For companies is usually complicated to manage multiples sources of information for their catalogs.

This need of fresh, categorized, consolidated and easy-accessible information by user companies represents an important business opportunity for *Information Technology* (*IT*) providers, through a set of computer data services release. Such *IT* providers must design a proper system's architecture to build the require infrastructure, carefully choosing the kind of clients whom the company will serve and the availability of existing and custom-made technology, in order to deliver the services that are demanded.

The author of this special graduation project has actively participated in the conception of an innovating business start-up idea called "***IL Technologies***" (*ILTECH*), which aims at becoming a leading provider of IT consultancy and services. *IL Technologies* will focus on developing a number of products and

services lines that will offer solutions to different market niches, ranging from personal to organizational consumers.

One strategic enterprise service that currently is in its inception phase is a platform that enables a discrete set of data and business logic operations. These operations will be exposed via a rich and sophisticated service interface, to be consumed by those organizational *OLTP*[1] systems that need "fresh" and standardized information in its daily tasks.

This enterprise service proposal is the baseline of the present work, which describes its general definition and its corresponding technical and economical context. The design proposal offers an innovative solution model for a daily problem that has many organizations today in different industries.

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[1] *On-Line Transactional Processing.*

CATEGORIES AND SUBJECT DESCRIPTORS

The following categories and subject descriptors are based on the ACM Computing Classification Scheme: http://www.acm.org/about/class/ccs98-html.

D.2.11 [**Software**]: Software Architectures – *data abstraction, domain-specific architectures.*

H.5.3 [**Information Systems**]: Group and Organization Interfaces – *asynchronous interaction, organizational design, synchronous interaction, theory and models, web-based interaction.*

GENERAL TERMS

Documentation, Design, Economics, Standardization, Theory.

KEYWORDS

Representational State Transfer (REST), Service-Oriented Architecture (SOA), Software + Services, Enterprise Mashup, Data as a Service (DAAS), Financial sensitivity analysis.

OBJECTIVES

General objective

To define the leading strategies and technical issues for designing an innovative service proposal with a high level of market differentiation.

This will focus on a general description of the architecture and technical information about the main identified components of a proposed enterprise service that is a recent idea in development.

Specific objectives

Perform a Design Proposal in the Solution Development Life Cycle (SDLC)[2] for the *EIR service*, based in a specific set of technical characteristics[3] and referential development methodologies, using a high level development and application tool platform based on Object Oriented Programming (OOP) and safe execution context.

Perform a basic market analysis and field research as a complement tool that will help to define the *EIR service* feasibility, scope and market structure.

---

[2]According to the Microsoft Solution Framework guidelines.

[3]The main characteristics to consider are: a Service-Oriented Architecture implementation, a Representational State Transfer architectonic style, a Software and Services integration model and an Enterprise Mashup interface building technique.

INTRODUCTION

Currently, the globalization process is generating many business opportunities. With this phenomenon, the entry barriers for enterprise competition had decreased and it is harder to achieve a sustainable competitive advantage. It is very interesting to analyze that this worldwide phenomenon is occurring in the information age. This makes evident the narrow relationship between both situations: the globalization and the information revolution. In some sense, the information revolution has catalyzed the globalization growth due to the advantages for the businesses. The information revolution relies upon the Information Technology and Communications.

The Information Technology (*IT*), as defined by the Information Technology Association of America (*ITAA*), is *the study, design, development, implementation, support or management of computer-based information systems, particularly software applications and computer hardware*. IT deals with the use of electronic computers and computer software to convert, store, protect, process, transmit and retrieve information, securely[4]. The exponential progress in the communications field has established a reliable and fast infrastructure for networking. The communications has pull down the geographical barriers, thus accelerating the innovation process. This important issue, demands that any company who wants to be successful in the market, needs to get a higher level of differentiation on its IT services platform to offer a better degree of business quality response. The differentiation allows a bigger

[4]Wikipedia, http://en.wikipedia.org/wiki/Information_technology.

negotiation power in the market and, at the same time, it creates competitive advantages.

At this time, acquiring differentiation is a very complex process that necessary involves innovation. Every entrepreneur must be able to develop the innovation capability of the organization. There are many types of innovation: process innovation, service innovation, IT innovation, etc. According to Burgelman and Mandique, the success criterion of the IT innovation is commercial rather than technical[5]. That is, one successful innovation returns the invested capital and additional revenue. To achieve that is necessary to develop a big enough market for the innovation. The best way to develop a market of that size is through the designing of a worldwide product or service.

The innovation is the result of a process described as the combination of tasks that take new products, services, and production or distribution systems to the market. To the proper operation of the innovation process, an appropriate organizational and technological operation must be performed. This includes all the tasks that create the new resources combination to make the innovation possible. At the same time, these tasks integrate the commercial and technical world in a beneficial way. However, to make it possible, the administrative capabilities must be developed in an effective and efficient manner.

As it was exposed before, the innovation process requires a strong administrative framework that allows the proper positioning of the product or service in the market.

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[5]Burgelman and Mandique, (Strategic Management of Technology and Innovation).

The present graduation project focuses on one specific issue:

The business and technical definition of a Primer Service, the *EIR service*: a proposed enterprise service that offers an innovative alternative as an on-line data and operations source for information systems for different industries.

1. BACKGROUND

1.1 Problem definition and justification

In the actual context, it is common to see IT enterprise startups cases that have a short life in the market. These companies are created, start operational activities and achieve to work some projects with some customers. However, at the end, they do not get to perform the "*Quantum Step*" needed to take the company to next level of evolution. Instead, they continuously operate in a marginal manner with little or no earnings. Thus, is more likely that these companies, over time, will end its participation in the market.

Many times this happened because of two main identified reasons:

- In its startup activities, the companies were not able to operate in a well-defined and clear business model.
- The companies enter in a highly competitive market without a proper product or service differentiation.

The main focus of an IT enterprise, regardless its target market, must be the constantly search of its product and service **differentiation**. With it, it is much likely for the company to achieve a long term relationship with its customers. Thus, the company has a higher probability to operate in a stable position in the market.

IL Technologies is an IT professional's initiative to build a proper organization dedicated to offer highly differentiated technological products and services, mainly, in the Software Engineering industry. As a co-founder of the *IL Technologies* partnership, the author of this paper has dedicated the necessary

effort to initially define a strategic service: ***The EIR Service***. This IT service emblematically represents the enterprise and business platform to enter in a local market niche that, as for now, it has not been yet explored.

The *IL Technologies* partnership wants to achieve a discrete operational enterprise activity in an emerging economical environment, with a strong administrative framework to support a set of innovations.

1.2 Project scope

In a general approach, the *EIR service* will have the following orientation:

- Clients: according to the information that the *EIR service* will provide, the clients must be big-sized enterprises. These enterprises can be for-profit or government organizations.
- Geography: the *EIR service* will integrate information of global Standard catalogs. This property allows designing a service to be market and sold worldwide. However, at the beginning the focus will be regional.
- Strategic product design: As one of the *IL Technologies*' strategic enterprise services, the *EIR service* builds a platform that enables a set of data and logic operations. These operations will provide rich and sophisticated interfaces to access fresh and standardized information useful for specific businesses. The present academic work defines is general technical design.

In a free market economy, the supply and demand forces determine the prices of products (assets) and services. Depending on the product or service, one can find different competency structures. Generally, the add-value characteristics set of the offered product or service, emphasize the

differentiation in comparison to the other competitor's products or services of the same industry.

To perform the demand and market structure analysis for a specific product or service is necessary to do a detail market study or research. Before the technical building of the *EIR service*[6], the market study will be one of the initial project activities, serving as an input for the analysis phase.

[6]The technical building is not part of this academic project.

2. IL TECHNOLOGIES: BUSINESS OVERVIEW

This section presents a brief description about the business start-up initiative. *IL Technologies* is an I.T. consultancy firm. Its main business activities are focused on the following topics:

- *Business Intelligence* consultancy: consists in offer various consultancy activities about the planning and life cycle for the construction of Data Warehousing models, software and related infrastructure. Also, includes the support for the planning, designing and implementation of Data Mining based analysis processes in the enterprise.

- Diverse strategic products and services lines: consists in building a corporate portfolio of software products and software services for different market niches, ranging from personal to organizational consumers.

As a part of the business model definition, we present the following statements:

Vision

To be known as the main strategic partner of every organization that looks for the processes and resources optimization by using business intelligence tools and the implementation of strategic Information Technology related projects.

Mission

We are an Information Technology consultancy firm dedicated to be an organizations strategic partner, through the empowerment of their main strategies by giving high quality products and services oriented to the business intelligence and strategic projects for the business model, first in the Central America region.

Enterprise Value Chain.

- Accountability.
- Quality.
- Service.
- Innovation.
- High-level intellectual assets.

3. TECHNICAL INFORMATION OF THE *"EIR Service"*

3.1 *EIR service* description

- Name: <***EIR**, Enterprise Information Resource*>[7].

- General objective:

To be a high-quality information complement as a sophisticated data and operations services bureau for the daily OLTP tasks of any organizational information system, build as an integrated outsourced component.

- Description:

A set of independent services based on generated interfaces publicly exposed, that offers useful data and operations encapsulated in discrete units of business logic that can be consumed or accessed through out a planning model of temporal o transactional subscription for the organizational client (government or enterprise).

- Main technological characteristics and aspects:
    - **Service-Oriented Architecture (SOA)** → base implementation: *Web Services*.
    - Architectonic style of the interfaces and resources publication: **Representational State Transfer (REST)**.
    - Integration model: **Software + Services**.
    - Building technique: **Enterprise Mashup**.

[7] The enterprise name of the service is subject to change in the near future.

- Innovation characteristics:
    - Data Services:
        - It will provide general information based on international standards for the building of catalogs of transactional information. Example of possible catalogs: countries, currencies, languages, etc. with standard ISO data codification.
        - It will provide updated, specific and variable information. Examples: Exchange currency, interest rates, etc.
    - Operations Services: discrete units of business logic for specific validation.
        - Data validation connected to disperse sources. Example: ITINs (Individual Taxpayer Identification Number) validation.
        - Data validation with disperse sources integration.
        - Calculations perform based on complex logic.

3.2 System architecture description

The *EIR service* will be design as an "N-Tier System Architecture". The main reasons are:

A. Scalability

Currently the company is in the inception phase; that's why, all the partners agree in keeping the costs as low as is possible, and the main aspect of this cost is the investment in hardware. For that reason, the System must be designed with an architecture that allows the vertical and horizontal growing.

B. Security

Some of the information that will be published through the system must be retrieved from third-party organizations, and some other data will be stored in the system data base. For those reasons is necessary to publish the services in a layer that guarantee the security of the local data and the access to the third-party services.

The following sections describe in more detailed all the concepts used for achieving the main scalability and security objectives.

3.2.1 Representational State Transfer (REST).

The term REST stands for "Representational State Transfer" and was initially introduced by Roy Fielding. It refers loosely to an "architectural style" where systems present a very simple, resource oriented abstraction for application state, and a uniform interface to act on those resources.

The software architecture of a distributed system has a considerable impact on its performance, both in terms of network efficiency and application-user perception. The architecture determines how system components are allocated and identified, how the components interact to form a system, and the amount and granularity of communication needed for interaction. Many different architectural styles have been used in the composition of distributed systems, including pipe-and-filter, remote sessions, event-based integration (implicit invocation), client/server (explicit invocation), distributed objects, and a variety of distributed process paradigms. Each of these styles is intended to optimize a particular pattern of communication among the components. There are also

aspects such as layering and caching that fit very naturally in the model and enables the creation of large, highly-scalable systems. [4]

REST is a coordinated set of architectural constraints that attempts to minimize latency and network communication while at the same time maximizing the independence and scalability of component implementations. This is achieved by placing constraints on connector semantics where other styles have focused on component semantics. REST enables the caching and reuse of interactions, dynamic substitutability of components, and processing of actions by intermediaries, thereby meeting the needs of an Internetscale distributed hypermedia system.

The modern World Wide Web is one instance of a REST-style architecture, thus, is often cited as an example of a REST application and the level of scalability that it enables. Using elements of the client/server, pipe-and-filter, and distributed objects paradigms, this style optimizes the network transfer of representations of a resource (World Wide Web semantics). A Web-based application can be viewed as a dynamic graph of state representations (pages) and the potential transitions (links) between states. The result is an architecture that separates server implementation from the client's perception of resources, scales well with large numbers of clients, enables transfer of data in streams of unlimited size and type, supports intermediaries (proxies and gateways) as data transformation and caching components, and concentrates the application state within the user agent components. [4]

Although Web-based applications can include access to other styles of interaction, the central focus of its protocol and performance concerns is distributed hypermedia. REST elaborates only those portions of the architecture

that are considered essential for Internet-scale distributed hypermedia interaction. Areas for improvement of the Web architecture can be seen where existing protocols fail to express all of the potential semantics for component interaction, and where the details of syntax can be replaced with more efficient forms without changing the architecture capabilities. Likewise, proposed extensions can be compared to REST to see if they fit within the architecture; if not, it is more efficient to redirect that functionality to a system running in parallel with a more applicable architectural style. [5]

The functionality of the *EIR Service* is focused on a REST-full platform, where the data and operations services would be exposed as Web-based resources (distributed hypermedia) and the clients (organizational systems) can interact with them through Web-based protocols and semantics for component interaction.

3.2.2 Microsoft Solutions Framework Application Model: Services Model.

The Microsoft Solution Framework (MSF) provides a set of principles, guidelines and building models (seven different models) to align the software projects with the organizational goals. The MSF Application Model helps in building flexible solutions by providing a different view to the solution. The model sees the application to be made up of three components: the user services, business services and data services.

The Services Model: this model divides application tasks into different services, which in turn can be applied to different tiers in the architecture. The MSF Services Model defines three services:

1. **User Services**: the tasks relating to the interface between the user and the application are known as user services. In this case, the *EIR service* will provide information to transactional or OLTP systems of various organizations; thus, the users of the *EIR service* are not humans but systems. This consideration implies that the "usability" level and user interface must be design under the primary notion that the users are, actually, systems. Thus, some of the tasks that fall under the user services are:
   - Receiving data input from the user (system that consumes the set of operations).
   - Packaging user input for validation.
   - Data formatting.
   - Reporting.
   - Managing the systems user preferences, according to the arguments of the operations and enterprise configuration.

   The User Services of the *EIR service* will consist of the two main interfaces that were explained in the "*EIR service* Description" section:
   - Data Services.
   - Operations Services.

2. **Business Services**: these are the tasks relating to the application logic or business rules that link the user services and the data services. The tasks include:
   - Business rule and logic implementation: this is a main task of the Operations Services interfaces of the *EIR service*.

- Data validation: one of the main validation tasks will be the enterprise access key validation, which will be designed according to the resource address REST scheme.
- Data access logic.
- System administration logic.
- Transaction support.

The Business Services of the *EIR service* will provide the necessary and functional logic that requires the expected performance of the Data and Operations Services that the systems users will consume.

3. **Data Services**: these tasks are directly related to the actual data source: data manipulation and data integrity; and are implemented at the data engine level. The tasks include:
   - Retrieving data and building result sets.
   - Inserting data.
   - Updating data.
   - Deleting data.

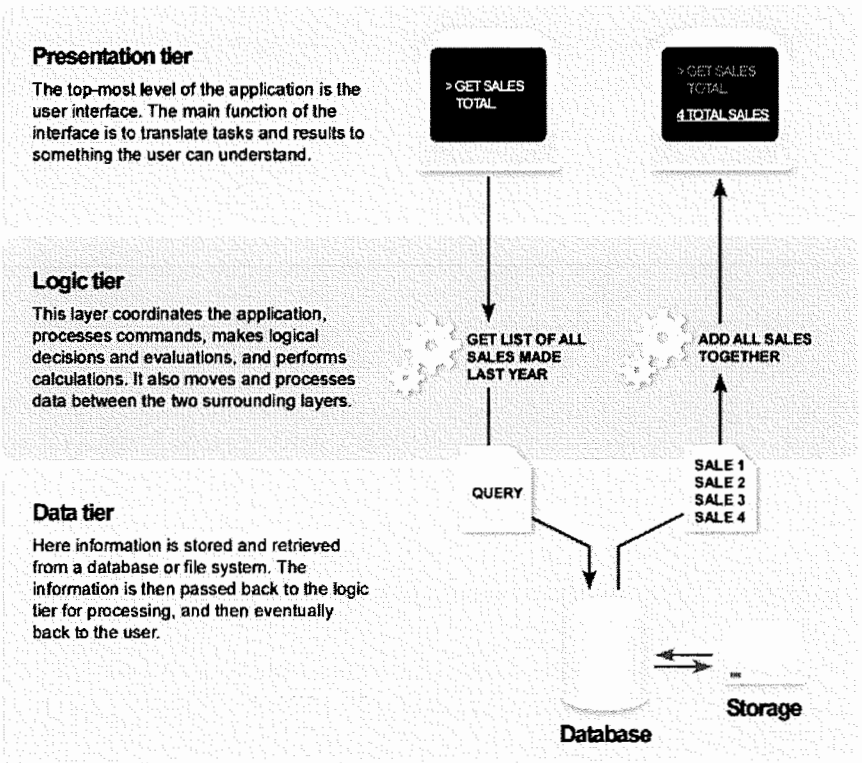
3.2.3 Tiered Architecture

Based on the Service Model, this kind of architectures offers many benefits, such as:

- Independent UI, logic and storage.
- Concurrent data access via transactions.
- Efficient data access.

In this context, we can have as a start-up point for the architecture design of the *EIR service*, the three components of the Service Model. This representation is conceptually described in the following figure[8].

Figure 1. Service Model Architecture.



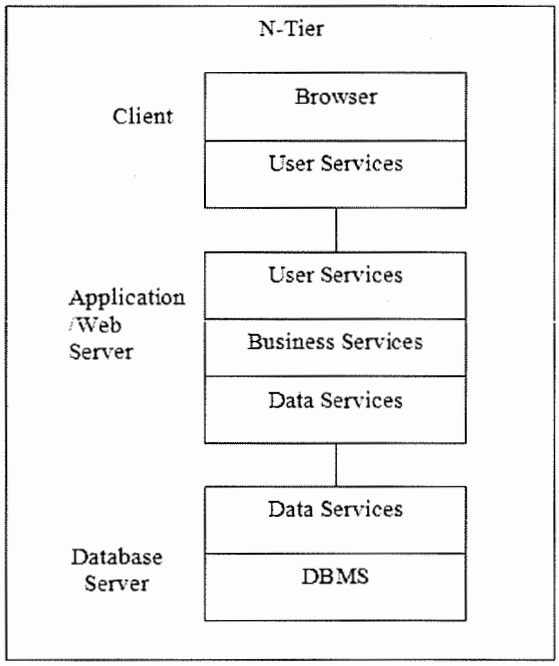
The *EIR service* will be designed as multiple-tier architecture. A tier, in this context, is a layer of software that accepts requests and offers services to an application.

[8] As explained in the "Service Model" section, the "user" refers to any OLTP system that will consume the Data and Operations Services or the EIR Service.

N-tier applications are one step ahead of the three-tier applications. Commonly, whereas three-tier architecture is about placing the three services on one to three different computers, N-tier applications are Internet or intranet applications that provide the three services on three or more computers. However, the main issue of this kind of architecture in the componentization of each of one of the layers, so that it can be easily expanded or extended in a horizontal and/or vertical growth. In this architecture, each layer is connected through out a carefully defined set of interfaces, which can be modeled individually as a *MVC* (*Model-View-Control*) design pattern.

The base design for the *EIR service* is presented in the following figure.

Figure 2. Tiered Architecture for the EIR Service.



As described earlier, the main technological characteristics of the *EIR service* are based in the following models:

- Service-Oriented Architecture (SOA).
- Enterprise Mashup.

- Software+Service Model.

These design aspects are generally described in the following sections.

3.2.4 Service-Oriented Architecture (SOA) Characteristic

SOA is a component model that inter-relates the different functional units of various applications build in different architectures, called services, through out a set of well-defined interfaces and contracts (*Software Level Agreements*, SLA) between these services. This is a form of technology architecture that adheres to the principles of service-orientation. When realized through the Web services technology platform, SOA establishes the potential to support and promote these principles throughout the business process and automation domains of an enterprise.

The interfaces are defined in a neutral manner which must be platform-independent, including the hardware, operating system and programming language on which the service is implemented. This allows building the services in heterogeneous contexts, which can interact in a uniform and universal way.

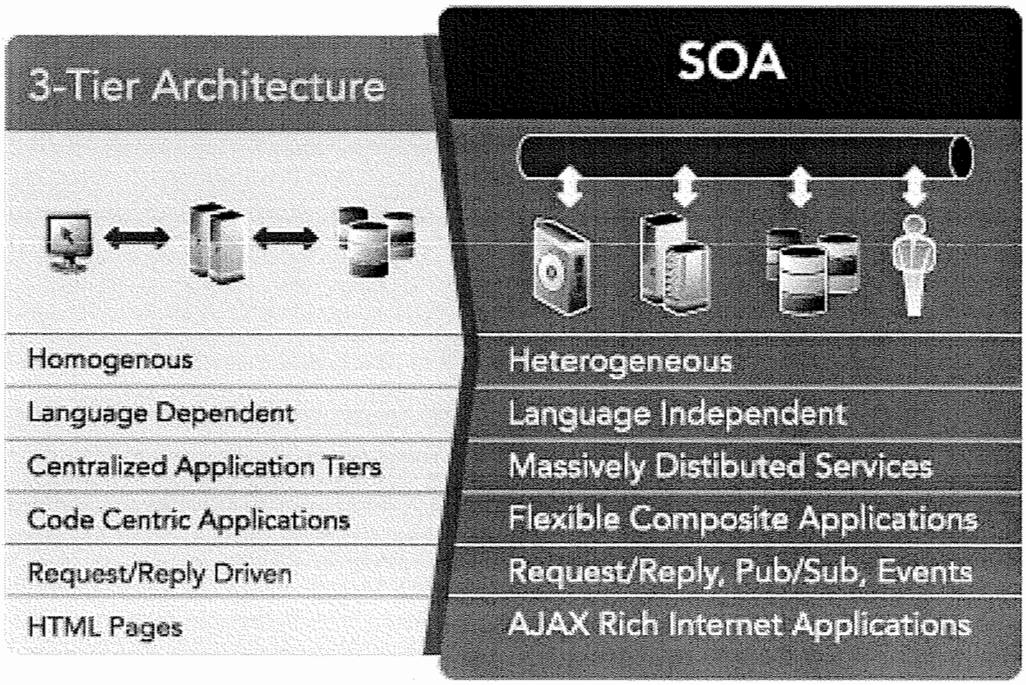
The principles of Service-Orientation are:

- Reusable logic is divided into services.
- Services abstract underlying logic.
- Services are composable.
- Services are autonomous.

- Services share a formal contract.
- Services are loosely coupled.
- Services are stateless.
- Services are discoverable.

The main characteristics of having a neutral interface definition that doesn't depend on a specific implementation is know as loose coupling, which is a "must" in SOA components. The following figure presents a brief comparison between a 3-tiered architecture and a SOA.

Figure 3. Comparison between a 3-tiered architecture and a SOA.



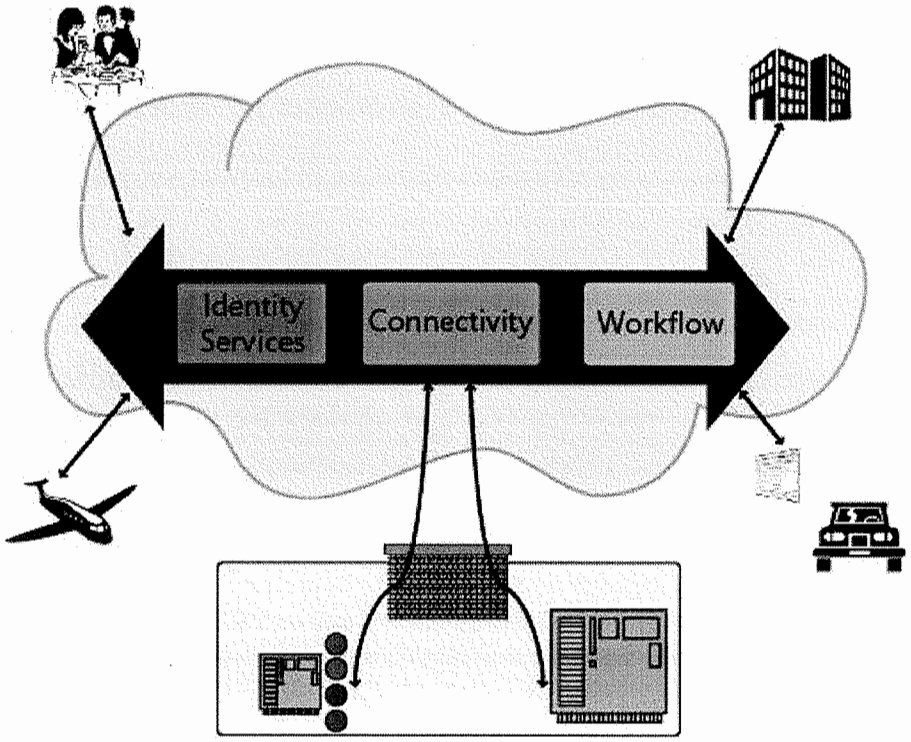
In this case, the *EIR service* will be build as a SOA component based on a REST Web Service implementation, which will deliver data in XML documents based on a set of defined schemes.

The *EIR service* will offer different data and operations services to the OLTP organizational systems. Some of these functional tasks are:

1. Identity Services for the enterprise.
2. Data Connectivity: data catalogs.
3. Workflow support in different transactions.

These functional tasks are conceptually described in the following figure.

Figure 4. Data and operations services model.



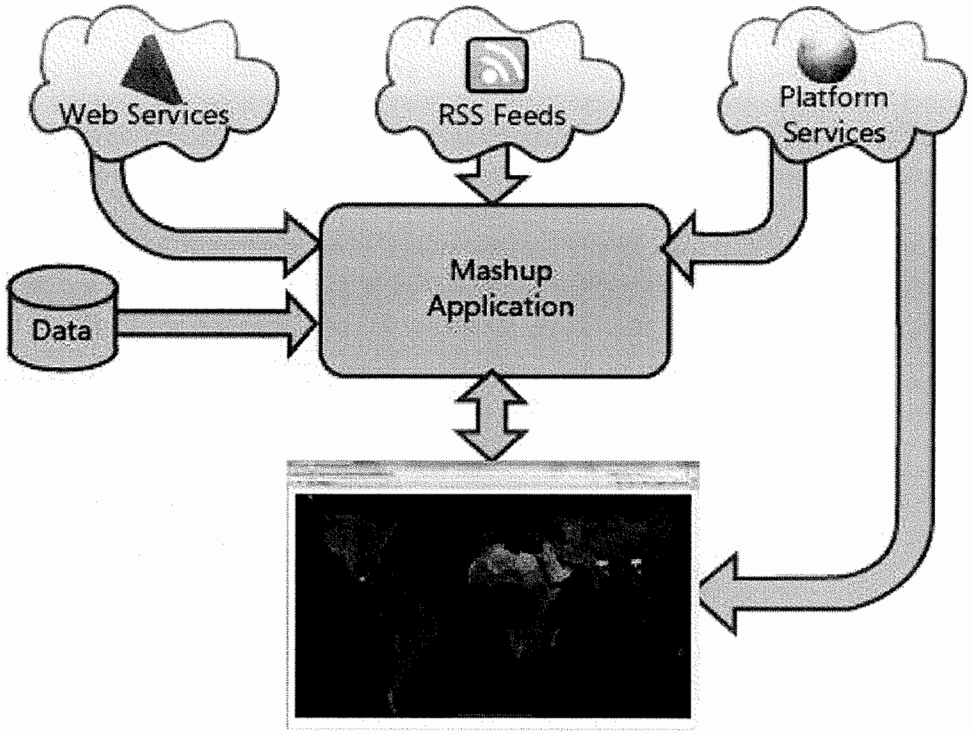
3.2.5 Enterprise Mashup Characteristic

An Enterprise Mashup is a technique for building applications that combine data from multiple sources to create an integrated experience. Many mashups available today are hosted as sites on the Internet, providing visual representations of publicly available data.

Differently, the *EIR service* will function as an information provider for the Enterprise that integrates multiple sources and applies specific business rules to generate useful data for the enterprise.

The following figure presents a conceptual design of a Mashup Application. The *EIR service* will be design to work as a Mashup for the enterprise.

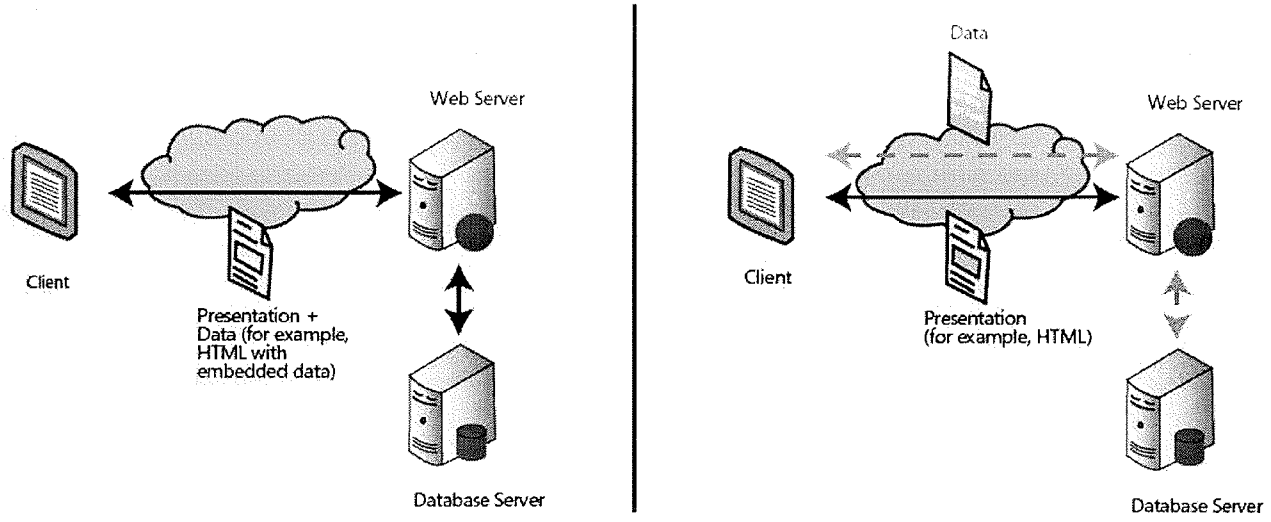
Figure 5. Conceptual design of a Mashup Application.



3.2.6 Software+Service (S+S) Characteristic

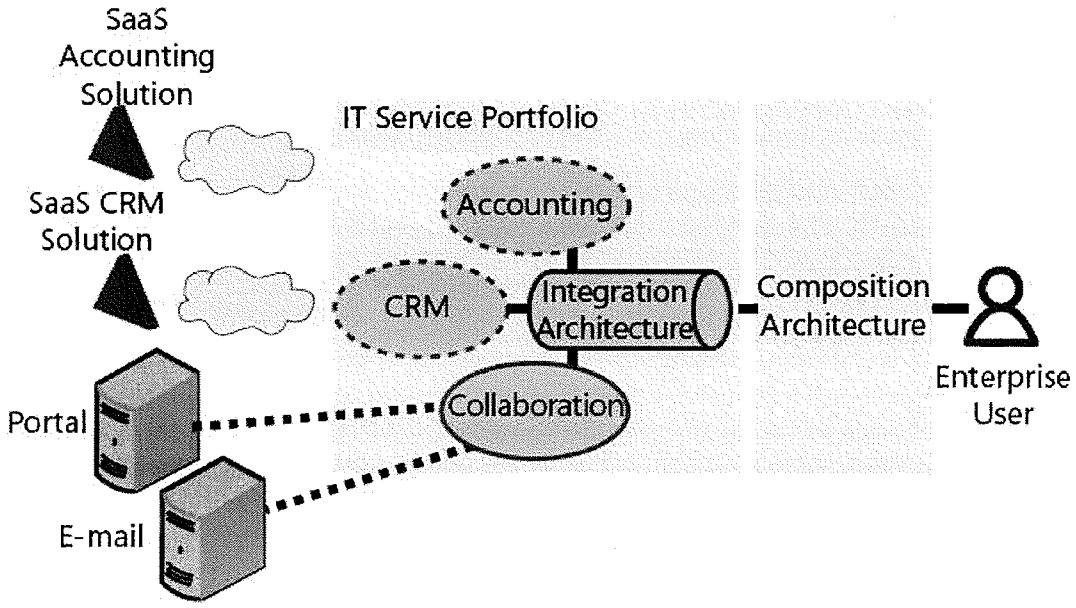
The *EIR service* will provide useful information for the enterprise. Its core functions will be exposed as a set of data and operations interfaces for delivering useful information. Instead of delivering HTML to a browser-based client, the *EIR service* will deliver information based on well-defined data schemes in XML.

Figure 6. Information delivery based on XML data schemes.



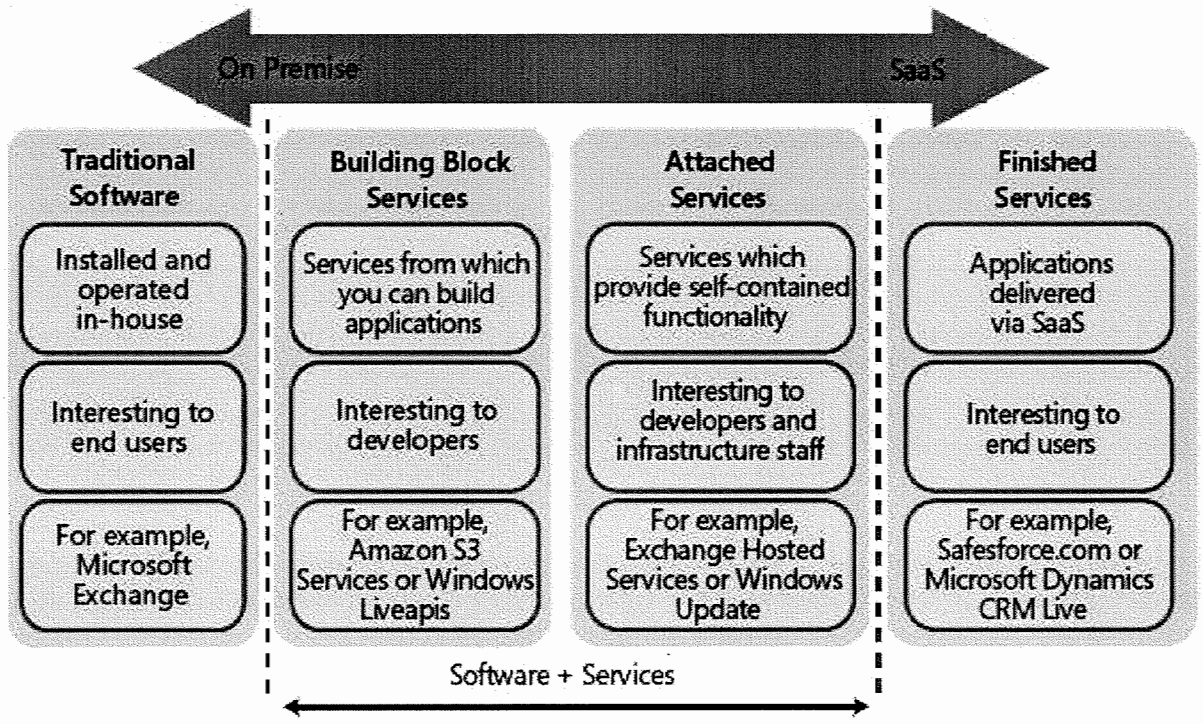
Additionally, the *EIR service* Operations Interface will offer a mechanism for integration architecture of different systems. This is presented in the following figure.

Figure 7. Integration architecture of different systems.



The Software + Services Model varies in different perspectives according to the nature of the applications. The following figure presents these variations of services implementations.

Figure 8. Software + Services Model.



A large number of scenarios are possible under the Software + Services umbrella. Three most frequent realizations (at least initially) will be:

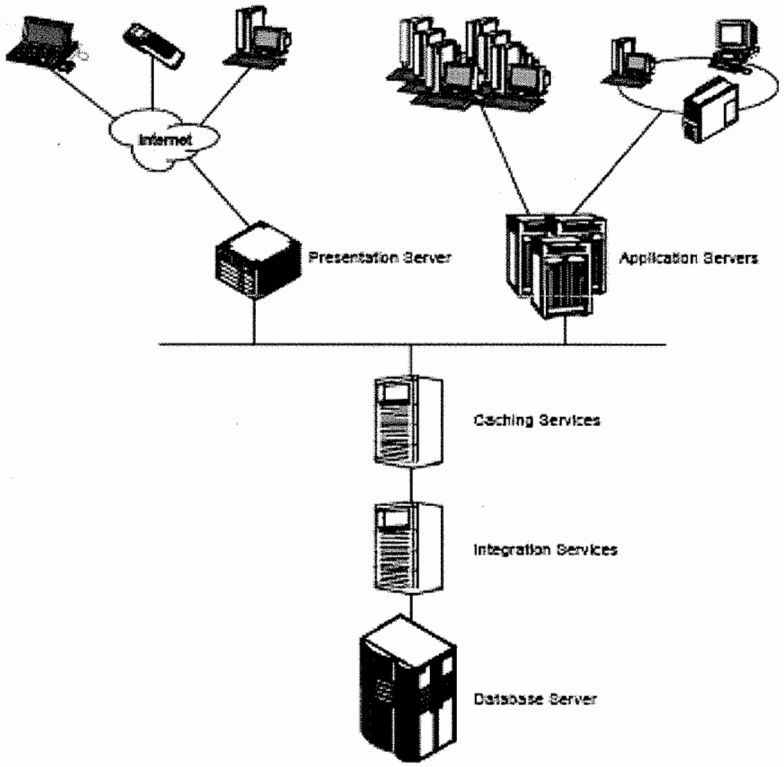
1. Local software complementing a cloud service.
2. Local software being augmented by a cloud service (for example, a cloud-based anti-spam, anti-phishing service augmenting a locally run mail server). This model allows a multitude of value-added services to be added in the

cloud, freeing existing systems that control data deemed preferable to keep within the corporate boundaries.

3. Location-independent, many-to-one service consumption in corporate IT (for example, "extended SOA" scenario). This scenario is a typical IT optimization scenario. In this scenario, operates the *EIR service.*

Because the *EIR service* is a system that will be publicly accessible anywhere on the Internet to the users (OLTP organizational systems) and the main technical build aspects of the service are SOA, REST, S+S and Enterprise Mashup, the application N-tier architecture would be best suited.

Figure 9. N-tier architectures.



N-tier architectures are characterized by multitiered, server-centric applications.

One concern of this kind of architecture is that it is more expensive and requires a complex infrastructure component integration design, which will be explained in the following sections.

3.3 General design approach

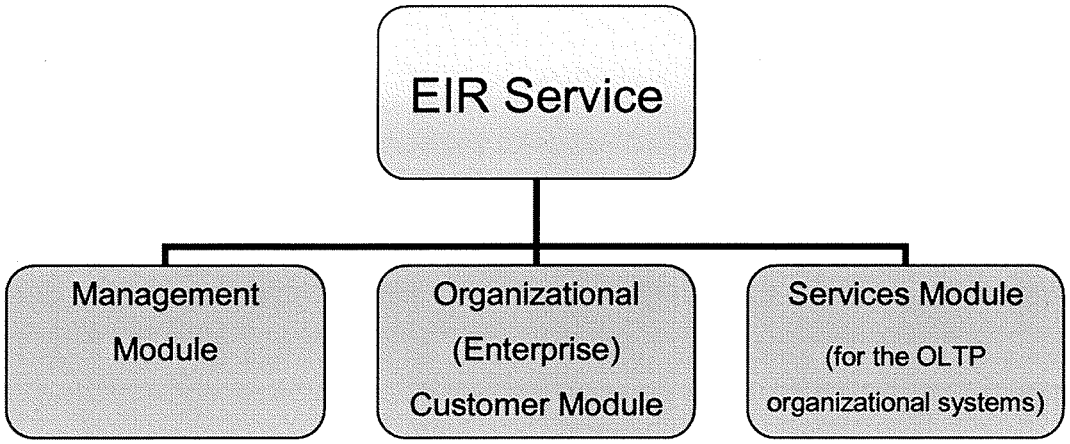
After defining the architecture, we will be working on the general model design of the *EIR service*, which considers the three perspectives for the solution:

1. Conceptual Design: identifies the requirements of the *EIR service* business rules as well as the expected behavior of the users (the OLTP organizational systems). Its purpose is to capture and understand such needs and requirements and generate scenarios.

2. Logical Design: takes the business problem identified in the conceptual design and develops an abstract model of the solution. For the *EIR service*, we will be working in building a modular design of the main functions for the system and the logical database design.

The following figure presents the Top Level Modular Design for the *EIR service*:

Figure 10. Top Level Modular Design for the EIR Service.



In the logical design we will work the following tasks:

- Identify objects, services, attributes, and interfaces. Some of the main business objects are: organization, system, subscription plan, schedule, access, operations, etc.
- Define the business rules: for the *EIR service* these rules are dependant on the nature of the information and its principal source.
- Create the User Interface prototypes: because the users are the OLTP organizational systems, the prototypes will be built in a programmatically way.
- Create the logical data model: database structure. This task depends on the identified objects, services, attributes and interfaces.
- Create the logical design: This involves using UML to create a static class diagram, sequence diagrams and collaboration diagrams.
- Validate, test and redesign: this will be focused mainly on the Data Definition Schemes for the Data and Operations Services, i.e., the Software Level Agreement of the contracts.

3. Physical Design: It takes the output of the logical design and applies real world technology constraints by specifying the details of the solution and thereby produces components, user interface and physical database design.

For the *EIR service*, we will be focused on describing a proposed component design for the necessary infrastructure. This refers to the implementation of the MSF Application Model, which aims primarily to the creation of the physical data model. Also the UML Deployment diagram for the *EIR service* will be made at this stage, which describes the final selection of the application and hardware components needed.

In the next section, we will describe the main hardware and software components that we will choose for the physical design.

3.4 General components

In the general design of the application is important to consider that due to keeping the costs as low as it is possible, at the beginning de system will be running in a third-party hosting. The advantage of using a hosting service is that these companies provide high availability and redundancy. This modality will be used for the beginning of the service and while the product is been introduced. After that, the administration of the system and information will force the company to move the service to the own servers. The following design described will be the architecture implemented when the product is been installed in the company's server.

3.4.1 Hardware

3.4.1.1 Servers

The physical design needs two servers with the following specifications. One server will be used for the data access layer and the other one for the presentation and business logic layer.

Table 1. A server specs example for the physical design.

Feature	Description
Processor	Intel® Pentium® core duo E2160, 1.8GHz, 1MB Caché, 800MHz FSB
Operating System	Windows Server 2003 Standard
Memory	DIMM 4GB, DDR2, 667MHz (4 x 1 GB), Dual Ranked
Hard Disk configuration	Expantion controller SAS5iR (SATA/SAS). Supports 2 hard disk units – RAID 1
Hard Disk configuration	Internal RAID adapter SAS 5IR, PCI-Express
Hard Disk	250 GB hard disk, SATAII, 7,200 RPM speed
Secondary hard disk	80 GB hard disk, SATA, 7,200 RPM speed
Optical device	CD-RW/DVD-ROM IDE 48X unit
Network	Integrated network adapter. 1 port, Gigabit
Backup unit	PowerVault 100T internal unit DAT72, 36/72 GB. (only in one Server)

3.4.1.2 Clustering

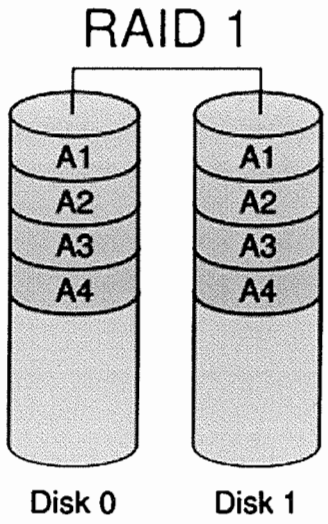
As described in the previous section, at the beginning only two servers will be acquired. Depending on the growing of the services and clients another two server can be acquired, one for each layer. This change in the configuration will force the acquisition of a load balancing device or a switch with this feature for example a L2/L7 switch.

3.4.1.3 Mirroring and redundancy

3.4.1.3.1 RAID 1

RAID 1 is usually implemented as mirroring; a drive has its data duplicated on two different drives using either a hardware RAID controller or software (generally via the operating system). If either drive fails, the other continues to function as a single drive until the failed drive is replaced. Conceptually simple, RAID 1 is popular for those who require fault tolerance and don't need top-notch read performance. A variant of RAID 1 is duplexing, which duplicates the controller card as well as the drive, providing tolerance against failures of either a drive or a controller. It is much less commonly seen than straight mirroring.

Figure 11. RAID 1 scheme.



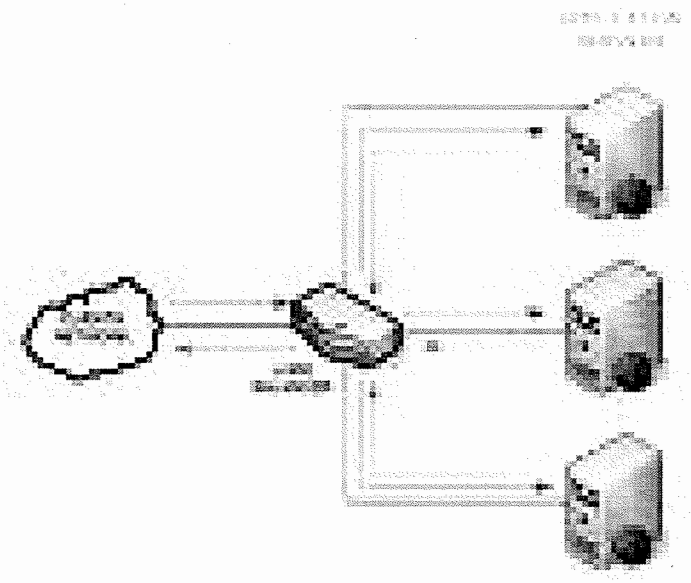
The servers and the SAN device considered for this design supports RAID 1. This schema will allow the system to do a "hot copy" of the data.

3.4.1.4 High availability

3.4.1.4.1 Load balancing

Load balancing is dividing the amount of work that a computer has to do between two or more computers so that more work gets done in the same amount of time and, in general, all users get served faster. Load balancing can be implemented with hardware, software, or a combination of both.

Figure 12. Load balancing.



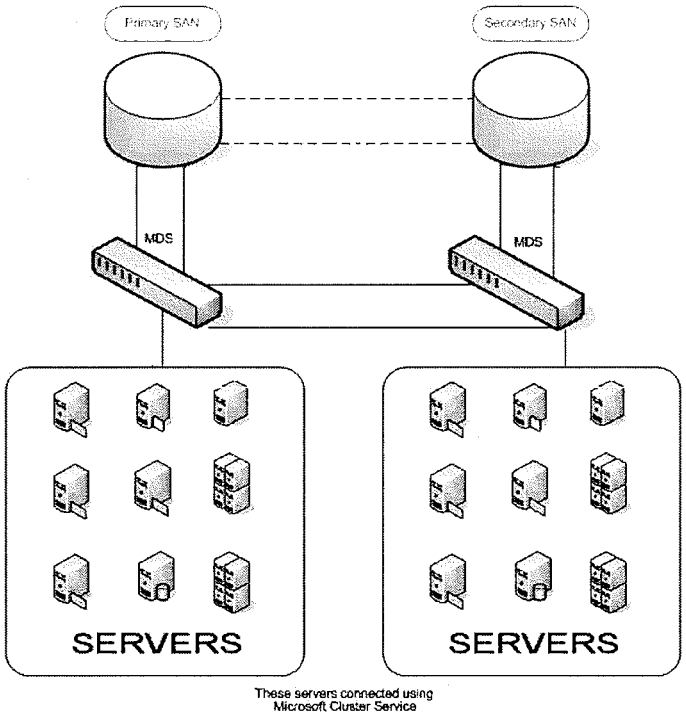
The high availability is very important for this service. As is expose in the previous section, with the services and clients growing two (2) more servers will be acquired and a switch with load balancing features. This action will convert the system in a fault tolerant one.

3.4.1.5 Data storage Architecture

3.4.1.5.1 SAN

Storage Area Network (SAN) is architecture to attach remote computer storage devices (such as disk arrays, tape libraries and optical jukeboxes) to servers in such a way that, to the operating system, the devices appear as locally attached.

Figure 13. Storage Area Network (SAN).



Due to the characteristics of the system, much of the information will be got on-line and some other will be stored in the site. This allows defining much simple data storage architecture. For scalability reasons the first design will implement a very simple Storage Area Network. For the current needs and the future growing the Dell EMC AX150 is a proper option and the specifications of this device are detailed in the following table:

Table 2. Technical specs for the proposed SAN device.

Feature	Description
Drive scalability	12
Host scalability	10
Host connections	4 SFF optical or 4GbE
Rack size	2U
RAID	5, 1 / 0

3.4.1.6 Backup architecture

For costs reasons, the backup system will not be considered. The physical design will consider only the backup device included in the servers.

3.4.1.7 Client

The system will publish Web services for client consuming. The clients don't need any special feature for using the system besides a Web-enabled client.

3.4.2 Software

3.4.2.1 Server operating system

Microsoft Windows Server 2003 or 2008 (Standard Edition). This operating system is pre installed in the servers.

3.4.2.2 Databases

In order to keep the costs as low as it is possible, the system will be built using an open source database like MySQL.

3.4.2.3 Web services

This is the base of the system. All the services will be published as a REST-full access and XML-based Web Services implementation, using an internal authentication algorithm. The main advantage of this is the standardization that XML provides.

3.4.2.4 Client operating system

The operating system doesn't represent a problem for using the services, because the Web services are XML-based.

3.4.2.5 Development tool

The chosen tool is Microsoft Visual Studio .NET due to the knowledge of *IL Technologies* partners. For keeping low costs, the version of Visual Studio to be used will be the *Express Version*.

3.4.2.6 Communications

All the services will be accessible through Internet.

3.5 Information Systems Theories applied to the design

In this section we will enumerate some of the Information Systems Theories that were used in the conceptual and modeling structure of the *EIR Service*. The functional scope of each theory is related to its structural impact in the overall design of the service components:

- Functional scope: **resource** (operations and data services).
    - Actor network theory.
    - Agency theory.
    - Resource-based view of the firm.
    - Resource dependency theory.
- Functional scope: **interaction** (communication).
    - Communication theory.
    - Complexity theory.
    - Theory of planned behavior.

    - Theory of reasoned action.
- Functional scope: **structural** (overall integration).
    - Contingency theory.
    - Design Theory.
    - Ecology theory.
    - General systems theory.
    - Information integration theory.
    - Information processing theory.
    - Organizational information processing theory.
    - Structuration theory.
- Functional scope: **economics** (evaluation of the use of resources).
    - Technological frames of reference.
    - Transaction cost economics.
    - Work systems theory.

4. ECONOMICAL AND FINANCIAL STUDY OF THE SERVICE.

As part of the specific objectives presented in this work is a main issue the description of a direct application on an economical proposal about the service.

The economical and financial study is organized and structured in specific subsections which present a theorical summary of the main concepts used in the proposed model and its direct application.

This *IT* (*Information Technology*)[9] service proposal offers an innovating solution that is not currently presented in the Guatemalan information industry. The service constitutes an investment project to be analyzed to assess its financial performance, considering basic microeconomic and macroeconomic concepts under the Guatemalan market context.

The following sections present a complete structure of the economical description about the enterprise proposal of the *EIR service*. Specifically, it describes:

- A market analysis framework.
- A behavioral analysis of the consumers and investor.
- Proposed of a proper structure of the investment for the business service (development and maintenance): investment structure.

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[9] To differentiate the concepts of *Information Technologies* (set of computer and information tools that are used to build information systems) and *Technology* (the production enterprise factor which defines the set of knowledge and techniques that link the capital with the labor factor), it will be use the following convention: (1) when the context refers to "*Information Technologies*" it will be expressed by the abbreviation "**IT**"; (2) when the context refers to the enterprise factor of production, it will be explicitly use the word "**Technology**".

- Analysis of major local labor market factors that influence the development and maintenance of the business service.
- Analysis of Guatemalan GDP growth, local market expansion and its influence on the business proposition.
- Simple model of financial analysis, based on the investment structure of production factors described, to assess, in a preliminary way, the profitability of the *EIR* business service.
- Expanded model of financial analysis, based on the investment structure of production factors described. This model considers in the expected cash flows estimation the corresponding to the direct and indirect taxation, to assess the profitability of the *EIR* business service.
- Key factors to consider of the Guatemalan foreign trade sector and its impact on the market research of the *EIR service* and the business context of *IL Technologies*.
- Sensitivity analysis on the financial model of evaluation to see how the main macroeconomic variables (inflation, interest and exchange rates) affect the profitability of the investment project. It will be use a set of statistical and simulation tools.

4.1 Demand and market structure

In a market free economy, the forces of supply and demand determine the prices of products and services. Depending on the product or service, we can found different competency frameworks and, generally, the feature set that gives an added value to the product or service offered highlights the distinction between them compared to the other competitors in the same industry.

The analysis of demand and market structure for a specific product or service must be made through a detailed study or market research.

4.1.1 Demand: Consumers of the EIR service - Needs to be solved

This subsection presents a brief description of the identified market needs as the justification of its business definition and purpose.

- Identified need: in general, the organizations that base its operational infrastructure in diverse transactional information systems need to have access to quality information. This information has to be "fresh" and standard based and it is produced from multiple reliable and integrated data sources. Additionally, the organizations need to process specific data validations based in discrete operations of business logic. In many cases, the organizations do not have a robust mechanism (reliable, secure and upgraded) for gathering, processing and validation data tasks. The *EIR service* will offer a set of data and discrete business logic services to solve this enterprise needs apply to any industry.

- Potential market: the potential market is formed of those organizations (either from the for-profit enterprise of any industry or government) that have transactional information systems and need to perform gathering, processing and validation tasks of "fresh" and standard data from external sources.

- Effective market: to have a better knowledge of the effective market is necessary to perform a detail research in order to measure an estimated budget that the organizations would invest on this service. In a preliminary approach, the major corporations of different industries like finance, communications, distribution and logistics, conform the effective market for the *EIR service*. This is because the identified organizations, generally, have a robust IT infrastructure and required a reliable and

unique source for upgraded and general data validation operations for its information systems.

The SOA design of the product allows the company to cover a local (Guatemala) and regional market (Central America). The difference between these two markets is given for the kind of information to be provided. However some global information is useful for any country. This represents an interesting advantage for the company.

- Model of Payment: for the *EIR service* is planned to study different subscription schemas that will serve as the main revenue structure. The subscription plans are based in the following criteria:
    - Periodicity or access frequency for each offered data and logic operations.
    - Time period of the access (defined date ranges).
    - Set and nature of the services to be consumed (data and/or logic operations).

- Differentiation analysis: for a differentiation analysis, it will consider the following criteria evaluation framework, which aims to:
    - Stimulate the careful thinking on what makes the service stand out in relation to the competition.
    - Help with a competitive classification of the service lines.

  For the analysis will be use three sub-sets of criteria:

    1. In relation with the offered service: *EIR*.
    2. In relation with the enterprise organization: *IL Technologies*.
    3. In relation with the market in which it operates.

A structured form will be a useful tool for qualifying the competition of the service according to the criteria, assigning a numeric value between 0 (no advantages) and 10 (full advantage). If any of the criteria is of a particular strategic importance, its associate weight will be increased.

The service will be compared with similar by a criteria series or in its totality (by aggregation). Thus, higher scores would indicate a comparative advantage through market differentiation.

It is noteworthy that this analysis will be made subsequently until we have a better panoramic description of the service features depending on the market conditions. Some technical and marketing major definitions about the service depends on strategic decisions in the initial planning of the company (*IL Technologies*), which have not yet been materialized.

Table 3. Differentiation analysis template.

Differentiation analysis

Service name: *EIR – Enterprise Information Resource*

Criteria	**Competitive classification**	**Weight**	**Total Value**
1) Criteria related with the offer service:			

Service benefits (savings, service improvement, etc.)		x	
Unique characteristic of the offer		x	
Perceived quality of the offer		x	
Provided service(s) with the offer – pre- and post-sales activities		x	
Offer presentation to possible customers		x	
Offer price		x	
Delivery method of the offer		x	
Delivery time		x	
Relationship between the offer and other complementary offers		x	-
Sub-total			
2) Criteria related with the organization: Geographic location of the office		x	
Desirability of the organization to buy		x	
Knowledge about the offer		x	
Relationship with the customers (shared knowledge, values, trust, etc.)		x	
Corporate image		x	
Long term enterprise vision		x	

Strategic alliances, associations or membership		x	
Finance enterprise stability		x	-
Sub-total			
3) Criteria related with the market: **Supply position in the market (early, middle, late)**		x	
Ease of market entry (time, costs, restrictions on entry, etc.)		x	
Requirements for continuous innovation in supply		x	
Deadlines for the obsolescence of service		x	
Opportunities for vertical or niche markets		x	
Sub-total			-
TOTAL			- -

4.1.2 Market structure: competitors

- Level of competition: According to the preliminary research, the *EIR service* provides an innovative solution in the industry. Currently, there are specific information bureaus that offer different kinds of data (on persons, entities, market research, statistical information: population, income distribution, preferences, etc.), but this data is not accessible electronically, through an independent architecture published services on the *Internet.* Additionally, it requires human intervention for such access.

  Thus, since there isn't a direct competition due to the innovative nature of the service, the competition structure/level would resemble a monopoly, being *IL Technologies* the only participant. However, in a context of competition with the other information bureaus, the structure would be: monopolistic competition.

- Major competitors: not yet been identified. The basic characteristics of the competitors for this market would be the following:
  - *IT* companies that publish electronic services to be consumed on the *Internet.*
  - Producers of diverse information.
  - Business model based on subscriptions and online access.

  Based on these characteristics, market competitors have not yet been detected in Central America, thus the market would be "virgin".

- Qualitative analysis of competitors: the aim to develop a detailed analysis of competition is to describe the major strengths, weaknesses and strategies of each competitor. For each competitor, if possible, there

should be established its current situation, including total sales, sales by product/service, market share, product policies, price range, cost structures, profitability, financial strength and reasons for success or failure.

The qualitative analysis for each competitor offers a clear outline of the competition. For each competitor, will be examined thoroughly the sales in the market, including customers, service delivery, technological capital and processes and financial resources. Also it will be examined the disadvantages, and as far as possible, it will be defined its strategies. This tool is used to understand the competition, following two basic questions:

1. What can the competitor do? An analysis of the competitor capabilities requires an assessment of its financial and operational strengths and weaknesses.
2. What will the competitor do? Companies and individuals, have personalities which affect the actions undertaken. This personality or corporate culture can impact on all aspects of the activities of the company, from financial policy to pricing tactics.

The *Form of Competitors Analysis - Synthesis* provides a way to consolidate all that is known about the competitors, by product/service. The information collected on this form is used, not only from the point of view for develop strategies to address the position of competitors in the market, but also to see what lessons can be drawn and apply on their own lines of products/services of *IL Technologies*.

Table 4. Qualitative analysis of the competition (template).

Qualitative analysis for each competitor

MAIN CRITERIA	COMPETITOR:_____ _____
Competitor's advantages in relation with: Customers groups and sale channels.	
Competitor's advantages in relation with: Better and more complete respond to the customer's necessities (offering benefits).	
Competitor's advantages in relation with: Technologies and implemented procedures, financial resources, etc.	
Competitor's disadvantages.	
Recognizable enterprise strategy	

Table 5. Form of Competitors Analysis – Synthesis (template).

Form of Competitors Analysis - Synthesis

(Synthesis of the answers gathered by the previous form)

Competitors	Products/Services	Major competitor's disadvantages	Major competitor's advantages	How do competitors get these benefits?

This analysis will be conducted after we get a better overall description of the possible market competitors, if they do exist.

4.2 Behavioral analysis (consumers and investors)

The previous section presented an analysis of demand (identifying the need, potential market, target market, model of payment and analysis of differentiation) and market structure, referring to competitors (level of competition, major competitors and qualitative analysis of the competitors).

The following section describes a brief analysis of the behavior of consumers and investors on the proposed *EIR* Business Service.

4.2.1 Description of the representative model of the circular flow of income: demand and supply of production factors.

- Offer (producer company): In the case of the *EIR service*, the offeror company *IL Technologies* will provide an information service (intangible asset) to any organization (producer or consumer of other assets/services) regardless of their industrial approach or money business.

- Demand (institutional consumers): Thus, the consumers of the *EIR service* are mainly organizations (public or private) of any governmental or industrial sector, which have an information infrastructure based on transactional systems and engaged in the collection and validation of data that require integrated information, "fresh" and standards-based.

  For this case, it is clear that the *EIR service* is oriented to organizations and companies as a provider of quality information in their information supply chains. Therefore, the families or individuals are excluded from the demand.

4.2.2 Demand: characteristics on consumer behavior.

- Identification of consumption and definition of what will be produced: According to the identified need upon which is based the *EIR service* idea, it will proceed to consider carefully the main data services and logic operations to be offered initially, with the intention to provide a suitable portfolio of data interfaces and operations that meet the most common and important needs of the organizations that make up the target market. Thus, the consumer organizations would make the definition of the set of interfaces and services to produce.

- Consumer decision: the *EIR service* will integrate different data interfaces and operations, so that consumers can choose different subscription schemes according to their needs and information requirements. In turn, this flexible consumption method will provide an alternative to organizations to determine their consumption based on various factors, such as their income.

- Dependence on the sector's productivity: the effective market of the *EIR service* includes organizations from different sectors, so it is expected a very mixed and dispersed use among the organizations depending on the productivity of each sector. Special emphasis will be given to those sectors with high income and relatively productive as mobile telephony, banking and distributors.

- Type of product according to its consumption: *EIR* falls under the category of consumer services with high durability, since it's never exhausted due to the fact that manages intangible assets (information).

- Estimated income of consumers: based on their productivity, incomes are expected to be comparatively high relative to the industry in which they operate. Special emphasis is given to those organizations and businesses to submit high income in their respective sectors and/or present a constant behavior of investment in its IT infrastructure.

- Purchase estimation: (How much will they buy?) basically, it depends on the need for information held by each organization. Part of the challenges of the *EIR service* is to present a flexible scheme of multiple options of

subscription to the data interfaces and logic operations, to offer a range of configurable packages that encourage their purchase by the organizations.

- Effective market analysis based on the behavior of investment in IT: is necessary to conduct an analysis of the estimated disposable income of the organizations and companies of the effective market, to observe their purchase inclination (subscription to the *EIR service*). This will depend in great measure, on the performance of IT investment in each organization, because the operation model of the *EIR service* implies that the consumer organization/enterprise is working in a sophisticated way and has defined policies and strategies for SOA-based integration (*SOA, Service-Oriented Architecture*).

- Mode of payment and consumer preference based on the type of use: the subscription scheme for the *EIR service* will be submitted in the form of **post-paid payment**, i.e., when the period of use has ended (which can vary: weekly, monthly, etc.) will be presented to the client organization a "*statement of use*" with the details of the accesses to the data interfaces and/or operations subscribed and consumed. Depending on the demand for access/use and cost of "production" of each interface (data and operations), it would periodically be calculated the base price per access to each interface. Or, alternatively, the calculated weight that would be added to a subscription-based per period of time and not by the access based on a subscription of a portfolio of interfaces. Similarly, the addressing of the segment by the method of subscription depends on the transactional access volume to the *EIR service*.

4.2.3 Investor: Characteristics of the behavior.

- Level of productivity in the IT sector: in general, we can say that the IT sector productivity is high, mainly due to factors of intellectual capital (knowledge) and innovation that provide the basic inputs to develop robust *software* with a high degree of usability. Moreover, the *software distribution* is a process that requires no additional costs (intangible asset). Additionally, the "package" sale includes high level consulting services, which have high interest in the market. From this account, for the labor factor (L) it would be estimated a cost (wage) above the GTQ. 10,000.00 per month per resource.

- Factors affecting production: for the *EIR service* case, the main factor to consider is only the labor (L) x 2 resources. According to the enterprising spirit of *IL Technologies* the same founders of the company will work to develop these services, which would imply an initial operation at minimum cost. At the intellectual level, it is necessary to carry out research and technical development in certain areas on the architecture of the service (software engineering) as well as strategic planning and business design scheme, which involves fostering innovation.

- Types of investment to consider:
    - Machinery and equipment → investment is minimal, since it would be used the own infrastructure of the founders of *IL Technologies* for software development and would be used a "*hosting*" service for its publication over *Internet*.
    - Inventories → don't apply because the service is an intangible asset.

- Residential structures → don't apply.
- Human capital: training → doesn't apply.
- Working capital: goods and currency in cash (liquidity) → initially it would be used very little working capital because, currently, the necessary infrastructure to build the service (development activity) it's available.

- Opportunity cost: the opportunity cost evaluation was made subjectively in its time. *IL Technologies* has planned different product lines and services, so the opportunity cost could be measured comparatively between these product lines and services.

- Minimum expected rate of return acceptable: for this case, corresponded to the industry rate in the IT sector (software producers). It would be estimated based on information obtained from the Software Export Commission (SOFEX) of AGEXPORT and the Chamber of Commerce and Industry.

4.3 Investment, Labor market, GDP

This section continues the description of the investment structure, laboral market input analysis and GDP[10] growth analysis related to the *EIR service* proposal.

[10] Gross Domestic Product.

4.3.1 Investment Structure

In practical terms, *IL Technologies* will be based on initial management of a structure to minimize costs. This implies that for the development, implementation and maintenance of their products and services, including the *EIR service*, there will be a very small investment in its different types.

According to the orientation and use, the investment is classified in the following categories:

1. Machinery and equipment: investment is minimal, since we use personal installations of specialize tools (*hardware* and *software*) for *software* development; i.e., it will use its own infrastructure of the founders of *IL Technologies*, which does not mean procurement of new working tools. To implement the service in a production environment will be used the hiring of a service of "*hosting*" for *Internet* publishing. That service includes housing costs, high availability and continuous *Internet* connection (*hardware*). With it is estimated to obtain much higher marginal revenue to marginal cost which will involve the use of *software*.

2. Inventories: inventories include raw materials, goods in process and finished products. According to the *Baumol-Tobin* model, is necessary to locate the optimal inventory level in line with demand to have an appropriate value: increased volatility of demand makes the inventory greater, while with stable demand (forecast) the inventories are minimized.

   In the case of the *EIR service*, in practical terms, there will be no inventories (not applicable). This is mainly because it will not sell the *software*, but the **information** managed by the *software*: the information is

the product sold under the *EIR service* scheme, which is an intangible asset. However, the information to be sold may exhibit characteristics and behaviors similar to an inventory; in the sense that it will take a process of transformation: (1) raw material (to find appropriate data sources), (2) process information (required development of logic functions), and (3) complete information (exhibit and publish the new operations and interfaces in the service). In this sense, the more expensive input will be the raw materials finding of information to sell (the data sources), which are dispersed and varied and involve *a priori* estimate difficult to quantify. It will be necessary to develop a detailed cost control access to these data sources: raw materials of the information to sell.

3. Residential structures: for this type of investment, supply is constant; also it requires a heavy capital investment. This type of investment is not considered for the *EIR service*.

4. Human Capital: this type of investment involves general training to increase human resource productivity. Training costs should be less than the income that represents the work of human resources. In practical terms, this type of investment is not considered for the *EIR service* development. This is due mainly because the human resources are the founders themselves of *IL Technologies*, who will conduct individual and internal tasks of research and development. In any case, the most important would be the quantification of the opportunity cost for the "time reversal" by the founders of *IL Technologies*, dedicated to the development of the *EIR service*.

5. Working Capital: it refers to the amount of money to make liquid operations (goods and money in box: liquidity). For this case, initially it would be used

very little the working capital because, currently, we have the necessary infrastructure to make the development of the *EIR service*.

4.3.2 Labor market

The labor factor analysis (**L**) in the production function is complex, and is accomplished by holding the capital factor (**K**) constant.

Law of diminishing returns:

- The increase in the labor factor (number of workers) makes it progressively reduced the marginal productivity of labor resource (MPL).
- The hiring of a new element to the labor factor (increase of L) implies a cost to the employer: as for "w" (wages + costs involved with hiring the worker).
- To be profitable the labor input growth (L), the marginal productivity of labor (MPL) must be greater than wages.
- Wages are determined by the less productive L factor.
- There is a "producer surplus" given by contracting with the lowest wages possible, based on the behavior of the marginal productivity of labor.

Under this context, in order to develop and implement the *EIR service*, two resources of labor input (L) are estimated, with it which is desired to get an appropriate marginal productivity of labor (MPL).

The productivity-based model on the labor supply (workers) and labor demand (firms) depends on the level of productivity in the IT sector: described in the section 4.2.3 about the investor.

Additionally, it is necessary to consider the distribution of production factors, i.e., when should increase capital (K) or the labor input (L)? The proper response to this approach depends on the factor cost:

K → i+d (capital cost).

L → w (labor cost).

In the case of the *EIR service*, the analysis of "factors affecting production" is considered: this has been described in the section 4.2.3 about the investor.

4.3.3 GDP: Gross Domestic Product

The Gross Domestic Product (GDP) is the country aggregated production of final assets during a specific year. The GDP, as an indicator, describes in general terms with how many assets and services the country has to meet the needs of the population. An inescapable fact is: the greater population, more needs to be met.

Approximately, the population growth in Guatemala is about 2.5% by year; comparatively, the Guatemalan GDP growth of 2007 was about 5.6% annual, which means an increase in the production, in a country perspective, of products and services to meet the needs of the population.

In general, we mention that by increasing the production of enterprises, and thus the competitiveness between them, they require to carry out a continuous process of optimization of their IT systems to support productivity. By this way, the *EIR service* would be an important complement as an information provider for the business transaction systems. In addition, we would expect to have a progressive incremental demand through the years.

4.4 Financial Study - Preliminary analysis of profitability

A macroeconomic study carefully examines the Government role in the market system. Some aspects that one has to consider are:

- Research market: identify needs and market segment and identify the production factors. This study will establish a proper and attractive price, marginally profitable.
- Analysis of growth needs and focus on the overall performance of the economy: population growth, imitation effect, actual requirements gap.
- Gross Domestic Product (GDP): measure the production level (value added) in a country in a given year. Indication of the distribution of value added in the production factors.
- Value added concept.
- Analysis of the importance of savings and direct involvement in the business investment.
- Analysis of the labor factor in Guatemala.
- Difference between economic growth and economic development.
- Understanding the Human Development Index.
- Country Risk Index.
- Government: as the 3er. economic agent:
    - Market system: characteristics → free trade, competition, stability, and efficiency.
    - Benefits and market failures.
    - Government function: correcting market failures for the market to work better.

This section describes a finance model analysis about the proposed service. The financial analysis is based on the investment framework of the

production factors that were presented before. This model will be use to evaluate, in a preliminary way, the profitability of the proposed service.

4.4.1 Investment financial analysis

The investment refers to money placed under the production factor capital (K) in an enterprise, to produce a good or service and profit. In practical terms, the price paid for capital investment (K) is the interest ceased to perceive as a real rate of interest (r). The capital may be structured in different types: machinery and equipment, inventories, residential structures, human capital and working capital.

The capital investment can be analyzed as an expense advance, which entails a cost in time. In general, one can say that an investor makes a comparative analysis of different investment projects to identify the most profitable option, i.e., the one that makes more profit. Thus, comparatively, an investor makes an analysis of opportunity costs and performance.

The cost of the investment (interest) is subject to the minimum expected rate of return acceptable (Minimum Accepted Rate of Return, MARR), which indicates the minimum interest rate that the investor is willing to accept for the investment. Thus, the financial analysis model is based on projected net cash flows (revenues minus expenses/costs) discounted at present using the MARR. Therefore, the study makes an analysis of Net Present Value (NPV) or Internal Rate of Return (IRR) to assess the return on investment.

4.4.2 Financial analysis: Preliminary analysis of profitability.

Based on the investment structure presented in the previous section, the production factors to consider, with their respective cost estimates [11] are:

1) **Capital (K)**: Capital structure.
   a. Machinery and equipment (*Hardware + Networking*) → procurement of a corporate service of "*hosting*" with the required technological infrastructure. For this it will opt for a service that includes the necessary tools[12]. Based on a market research, it is estimated that the annual cost of procurement of "*hosting*" is **USD 40.00**.
   b. Inventories → treatment process information (source data + processing + publication). As indicated, *a priori* quantification of the data sources is particularly difficult. For now, it will be considered a single cost approximately USD 250.00 for each data source to develop. It is worth mentioning that this cost was estimated under the assumption of work in a period of 3 months, therefore it will be worked annually 4 data sources to a single annual cost of **USD 1,000.00**
   c. Residential structures → don't apply.
   d. Human Capital (technological training) → doesn't apply.
   e. Work Capital → requires little; annually it estimates a heading of **USD 500.00**.

2) **Labor (L)**:

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[11] For ease of calculation, all cost estimates are presented in U.S. dollars (USD).

[12] In the case of *hardware* tools, options will be sought, based on competitive products and substitutes; with it we want to find that prices do not vary much over time.

a. Two (2) resources are required to work on developing the *EIR service* platform for about 4 months.
b. Resource price[13]: USD 1,300.00 monthly (equivalent to GTQ 10,000.00).
c. Total cost: **USD 10,400.00**. It is worth mentioning that this cost only applies as part of the initial investment. For subsequent periods in the financial feasibility analysis, be regarded as support and maintenance cost of 5% of the total cost (**USD 520.00**) for each year, from the 2nd year.

3) **Technology (τ)**: this factor of production refers to the set of knowledge, skills and techniques that link directly the capital (**K**) with the workers (**L**) to produce. According to the description given above, this factor is intrinsic to the labor input of production (company founders).

4) **Natural Resources**: it doesn't apply. It will be not considered as part of the analysis since the offered service is intangible: is provided in electronic form published on the *Internet*.

5) **Entrepreneurship**: entrepreneurial ability to identify what and how to produce. Define the framework for the expected profits and establishing proper price to offer the service, is a complicated issue that requires thorough analysis. For the moment, it will present an adequate estimate price to offer based on the following points:

[13] The resource price corresponds to the opportunity cost of the founders of *IL Technologies*, according to the description presented.

- Effective market: preliminarily, we identify large companies (banks, telephone operators, distributors, etc.) as those organizations that form the effective market of the service, due to the requirement to have update information for its transactional systems and specific tasks of data, such as collection and validation ("freshness" of the information and/or standards-based information).

- Model of Payment: the subscription plans of the *EIR service* will be based on the following criteria:
    - Periodicity or frequency of the access/use of the services. This will have its specific price.
    - Period of time or access duration: will be considered an annual period. This will have its specific price.
    - Joint and nature of services (data and/or logical) to consume.

- It is expected that revenues will be obtained from the 2nd year of operations.

The accompanying table presents the financial analysis of investment, which is used to evaluate the profitability of the *EIR service*. This analysis describes a cost structure based on production factors presented above and includes unbudgeted costs (additional activities and failure probability), that may affect the expected revenue. Furthermore, the analysis estimated revenue does not include price differentiation according to the set and kind of services, but only focuses on the presentation of the subscription plans (per period or frequency of consultation and effective access).

Table 6. Financial analysis: Preliminary analysis of profitability.

Investment project: EIR Service (IL Technologies)

• Name: <EIR, Enterprise Information Resource>.

Proyect description A set of independent services based on generated interfaces publicly exposed, that offers useful data and operations encapsulated in discrete units of business logic that can be consumed or accessed through out a planning model of temporal o transactional subscription for the organizational client (government or enterprise).

Assumptions
(1) All amounts are expressed in U.S. dollars (USD).
(2) The technology infrastructure will be rented through a hosting service.
(3) The costs and benefits are expressed in annual temporary periods.

Estimated time for financial analysis
n = 5.00 years

Budgeted costs identified (cost focus to the technological infrastructure of initial investment and operating costs)
Hardware and Software Costs: [refers to the part of primary infrastructure offered by the corporate hosting service]
Enterprise Hosting Service "hosting" = (40.00) (USD) - Annual cost.
Information Costs : [under this item includes the cost of inventories for the treatment of information]
Cost to include data sources = (1,000.00) (USD) - Annual one-time cost; includes 4 new data sources.
Working capital : [working capital]
Working capital = (500.00) (USD) - Annual cost.
Development costs : [includes labor costs associated with application development and content, testing and documentation phases]
HH.RR. I.T.: development team = (10,400.00) (USD) - 2 people x 4 months x USD 1300.00 | Only for the initial investment
Support and maintenance costs : [costs associated with help desk, training, maintenance and support contracts]
Support and maintenance = (520.00) (USD) - Annual cost from 2nd. year.

Identified unbudgeted costs (hidden costs)
End User Costs : [costs to be spent on the end user of the system: on-site support, marketing efforts, casual learning, etc.]
End users support = (200.00) (USD) - Annual cost from the first year.
General failure costs : [costs related to productivity gains and losses caused by general failures of the system]
Unplanned general failures = (800.00) (USD) - Annual cost.

Identified Quantifiable Benefits
Subscription plan for access : [estimated revenue for the subscription plan based on the frequency service access]
Access price per transaction = 0.45 (USD) - Price per access for each service query
Estimated visitors per annum = 5,280 Estimated annual number of hits (baseline: 20 daily hits).
Annual growth rate = 25.00% (expected)
Effective subscription plan : [estimated revenue for the subscription plan based on access life-time]
Price duration = 250.00 (USD) - Monthly price. The granularity of eligibility period is MONTHLY.
Estimate subscriptions X eligibility period = 16 Number of contracts per year.
Estimated annual income = 4,000 (USD) - Annual estimation per subscription plan per eligibility period.
Annual growth rate = 18.00% (expected)

Rate of Return MARR
Bank lending rate (%) = **9.0000%**
[PLUS] Additional points (%) = **5.0000%** (Information Technology Sector)
MARR (%) = **14.0000%** (Bank lending rate + PLUS sector)

Table 6. Financial analysis: Preliminary analysis of profitability.

Estimated cash flows for 5 years		**(All values are expressed in USD)**				
Period: Annual	**0**	**1**	**2**	**3**	**4**	**5**
Description of item						
Identified Quantifiable Benefits						
(+) Access subscription plan			2,376.00	2,970.00	3,712.50	4,640.63
(+) Effective subscription plan			4,000.00	4,720.00	5,569.60	6,572.13
Budgeted costs identified						
(-) Hardware and Software Costs	(40.00)	(40.00)	(40.00)	(40.00)	(40.00)	(40.00)
(-) Information Costs	(1,000.00)		(1,000.00)		(1,000.00)	
(-) Working Capital	(500.00)	(500.00)	(500.00)	(500.00)	(500.00)	(500.00)
(-) Development Costs	(10,400.00)					
(-) Maintenance/Support Costs			(520.00)	(520.00)	(520.00)	(520.00)
Identified unbudgeted costs						
(-) End User Costs		(200.00)	(200.00)	(200.00)	(200.00)	(200.00)
(-) General Failure Costs		(800.00)	(800.00)	(800.00)	(800.00)	(800.00)
Net Cash Flow	**(11,940.00)**	**(1,540.00)**	**3,316.00**	**5,630.00**	**6,222.10**	**9,152.75**

Net Present Value (NPV) **1,498.40** (on current flows)
Internal Rate of Return (IRR) **17.4321%** (on current flows)

***Conclusion**: The financial feasibility analysis for the project has a positive estimate about managing costs and expected net benefits. Thus, there is a Net Present Value (NPV) positive over **USD 1,498.40** and an Internal Rate of Return (IRR) higher compared with the expected rate of return Minimum Accepted (MARR) based on estimates of the bank lending rate plus 5 bonus points. Thus, we conclude that the project is profitable, the first revenues would be expected after the first year of operation (period # 1).*

4.5 Financial study – Preliminary profitability analysis (evaluation with taxes)

Under the macroeconomic context, the study of the public sector (Government) incoming and expenses structure is very important due to its general impact in the enterprise profitability. This section will describe the financial analysis model on the proposed *EIR service* presented above, with appropriate modifications to include the impact of taxation (direct and indirect) in the estimation of the expected cash flows. The financial analysis presented is based on the investment structure of production factors described before.

The investment structure presented earlier (sections 4.3.1 and 4.4.2), and production factors to consider with their respective cost estimates, are retained in this financial analysis. However, it includes the impact of direct and indirect taxation in the expected cash flows.

Thus, the capital structure **K** (machinery and equipment: *hardware & networking*, inventories, residential structures, human capital: technological training and working capital), the labor factor **L**, the technological factor (**τ**), natural resources and entrepreneurship, are the same as were presented in the previous financial evaluation model.

The following tables attached, presents the modified financial analysis of investment, which is used to evaluate the profitability of the *EIR service*. This analysis is based on the financial model presented in section 4.4.2, but includes the impact of direct and indirect taxation in the estimation of the expected cash flows at different periods in analysis, which implies a more precise estimate and actual profitability on the service.

Table 7. Financial analysis: Preliminary analysis of profitability (evaluation with taxes).

Investment project: EIR Service (IL Technologies)

• Name: <EIR, Enterprise Information Resource>.

Proyect description A set of independent services based on generated interfaces publicly exposed, that offers useful data and operations encapsulated in discrete units of business logic that can be consumed or accessed through out a planning model of temporal o transactional subscription for the organizational client (government or enterprise).

Assumptions
(1) All amounts are expressed in U.S. dollars (USD).
(2) The technology infrastructure will be rented through a hosting service.
(3) The costs and benefits are expressed in annual temporary periods.

Estimated time for financial analysis
n = 5.00 years

Budgeted costs identified (cost focus to the technological infrastructure of initial investment and operating costs)
Hardware and Software Costs: [refers to the part of primary infrastructure offered by the corporate hosting service]
Enterprise Hosting Service "hosting" = (40.00) (USD) - Annual cost.
Information Costs : [under this item includes the cost of inventories for the treatment of information]
Cost to include data sources = (1,000.00) (USD) - Annual one-time cost; includes 4 new data sources.
Working capital : [working capital]
Working capital = (500.00) (USD) - Annual cost.
Development costs : [includes labor costs associated with application development and content, testing and documentation phases]
HH.RR. I.T.: development team = (10,400.00) (USD) - 2 people x 4 months x USD 1300.00 | Only for the initial investment
Support and maintenance costs : [costs associated with help desk, training, maintenance and support contracts]
Support and maintenance = (520.00) (USD) - Annual cost from 2nd. year.

Identified unbudgeted costs (hidden costs)
End User Costs : [costs to be spent on the end user of the system: on-site support, marketing efforts, casual learning, etc.]
End users support = (200.00) (USD) - Annual cost from the first year.
General failure costs : [costs related to productivity gains and losses caused by general failures of the system]
Unplanned general failures = (800.00) (USD) - Annual cost.

Identified Quantifiable Benefits
Subscription plan for access : [estimated revenue for the subscription plan based on the frequency service access]
Access price per transaction = 0.45 (USD) - Price per access for each service query
Estimated visitors per annum = 5,280 Estimated annual number of hits (baseline: 20 daily hits).
Annual growth rate = 25.00% (expected)
Effective subscription plan : [estimated revenue for the subscription plan based on access life-time]
Price duration = 250.00 (USD) - Monthly price. The granularity of eligibility period is MONTHLY.
Estimate subscriptions X eligibility period = 16 Number of contracts per year.
Estimated annual income = 4,000 (USD) - Annual estimation per subscription plan per eligibility period.
Annual growth rate = 18.00% (expected)

Rate of Return MARR
Bank lending rate (%) = **9.0000%**
[PLUS] Additional points (%) = **5.0000%** (Information Technology Sector)
MARR (%) = **14.0000%** (Bank lending rate + PLUS sector)

Tax rates (taxes)
Direct: Income Tax (%) = **5.0000%**
Indirect: Value Added Tax (%) = **12.0000%**

Table 7. Financial analysis: Preliminary analysis of profitability (evaluation with taxes).

Estimated cash flows for 5 years		**(All values are expressed in USD)**				
Period: Annual	**0**	**1**	**2**	**3**	**4**	**5**
Description of item						
Identified Quantifiable Benefits						
(+) Access subscription plan			2,376.00	2,970.00	3,712.50	4,640.63
(+) Effective subscription plan			4,000.00	4,720.00	5,569.60	6,572.13
Outflows of taxation :						
(-) Direct: Income Tax.			(280.54)	(338.36)	(408.41)	(493.36)
(-) Indirect: Value Added Tax.			(765.12)	(922.80)	(1,113.85)	(1,345.53)
Budgeted costs identified						
(-) Hardware and Software Costs	(40.00)	(40.00)	(40.00)	(40.00)	(40.00)	(40.00)
(-) Information Costs	(1,000.00)		(1,000.00)		(1,000.00)	
(-) Working Capital	(500.00)	(500.00)	(500.00)	(500.00)	(500.00)	(500.00)
(-) Development Costs	(10,400.00)					
(-) Maintenance/Support Costs			(520.00)	(520.00)	(520.00)	(520.00)
Identified unbudgeted costs						
(-) End User Costs		(200.00)	(200.00)	(200.00)	(200.00)	(200.00)
(-) General Failure Costs		(800.00)	(800.00)	(800.00)	(800.00)	(800.00)
Net Cash Flow	**(11,940.00)**	**(1,540.00)**	**2,270.34**	**4,368.84**	**4,699.84**	**7,313.86**

Net Present Value (NPV) **(2,013.81)** (on current flows)
Internal Rate of Return (IRR) **9.0321%** (on current flows)

Conclusion:

*The financial feasibility analysis for the project has a **negative** estimate about managing costs and expected net benefits. Thus, there is a Net Present Value (NPV) of less than negative **USD 2,000.00** and an Internal Rate of Return (IRR) **lower** compared with the expected Minimum Accepted Rate of Return (MARR) based on estimates of the bank lending rate plus 5 bonus points.*

Thus, we conclude that the project is NOT PROFITABLE, because the financial impact of taxes.

This will proceed to conduct a review of prices offered and the level of sales expected for each time period in order to make an estimate of the increase needed to achieve profitability.

Table 8. Financial analysis: Preliminary analysis of profitability (evaluation with taxes, 2nd scenario): Incremental.

Investment project: EIR Service (IL Technologies)

• Name: <EIR, Enterprise Information Resource>.

Proyect description A set of independent services based on generated interfaces publicly exposed, that offers useful data and operations encapsulated in discrete units of business logic that can be consumed or accessed through out a planning model of temporal o transactional subscription for the organizational client (government or enterprise).

Assumptions
(1) All amounts are expressed in U.S. dollars (USD).
(2) The technology infrastructure will be rented through a hosting service.
(3) The costs and benefits are expressed in annual temporary periods.

Estimated time for financial analysis
n = 5.00 years

Budgeted costs identified (cost focus to the technological infrastructure of initial investment and operating costs)
Hardware and Software Costs: [refers to the part of primary infrastructure offered by the corporate hosting service]
Enterprise Hosting Service "hosting" = (40.00) (USD) - Annual cost.
Information Costs : [under this item includes the cost of inventories for the treatment of information]
Cost to include data sources = (1,000.00) (USD) - Annual one-time cost; includes 4 new data sources.
Working capital : [working capital]
Working capital = (500.00) (USD) - Annual cost.
Development costs : [includes labor costs associated with application development and content, testing and documentation phases]
HH.RR. I.T.: development team = (10,400.00) (USD) - 2 people x 4 months x USD 1300.00 | Only for the initial investment
Support and maintenance costs : [costs associated with help desk, training, maintenance and support contracts]
Support and maintenance = (520.00) (USD) - Annual cost from 2nd. year.

Identified unbudgeted costs (hidden costs)
End User Costs : [costs to be spent on the end user of the system: on-site support, marketing efforts, casual learning, etc.]
End users support = (200.00) (USD) - Annual cost from the first year.
General failure costs : [costs related to productivity gains and losses caused by general failures of the system]
Unplanned general failures = (800.00) (USD) - Annual cost.

Identified Quantifiable Benefits
Subscription plan for access : [estimated revenue for the subscription plan based on the frequency service access]
Access price per transaction = **0.55** (USD) - Price per access for each service query
Estimated visitors per annum = **6,072** **Estimated annual number of hits (baseline: 23 daily hits).**
Annual growth rate = 25.00% (expected)
Effective subscription plan : [estimated revenue for the subscription plan based on access life-time]
Price duration = **260.00** (USD) - Monthly price. The granularity of eligibility period is MONTHLY.
Estimate subscriptions X eligibility period = 16 Number of contracts per year.
Estimated annual income = 4,160 (USD) - Annual estimation per subscription plan per eligibility period.
Annual growth rate = 18.00% (expected)

Rate of Return MARR
Bank lending rate (%) = **9.0000%**
[PLUS] Additional points (%) = **5.0000%** (Information Technology Sector)
MARR (%) = **14.0000%** (Bank lending rate + PLUS sector)

Tax rates (taxes)
Direct: Income Tax (%) = **5.0000%**
Indirect: Value Added Tax (%) = **12.0000%**

Table 8. Financial analysis: Preliminary analysis of profitability (evaluation with taxes, 2nd scenario): Incremental.

Estimated cash flows for 5 years		**(All values are expressed in USD)**				
Period: Annual	**0**	**1**	**2**	**3**	**4**	**5**
Description of item						
Identified Quantifiable Benefits						
(+) Access subscription plan			3,339.60	4,174.50	5,218.13	6,522.66
(+) Effective subscription plan			4,160.00	4,908.80	5,792.38	6,835.01
Outflows of taxation :						
(-) Direct: Income Tax.			(329.98)	(399.67)	(484.46)	(587.74)
(-) Indirect: Value Added Tax.			(899.95)	(1,090.00)	(1,321.26)	(1,602.92)
Budgeted costs identified						
(-) Hardware and Software Costs	(40.00)	(40.00)	(40.00)	(40.00)	(40.00)	(40.00)
(-) Information Costs	(1,000.00)		(1,000.00)		(1,000.00)	
(-) Working Capital	(500.00)	(500.00)	(500.00)	(500.00)	(500.00)	(500.00)
(-) Development Costs	(10,400.00)					
(-) Maintenance/Support Costs			(520.00)	(520.00)	(520.00)	(520.00)
Identified unbudgeted costs						
(-) End User Costs		(200.00)	(200.00)	(200.00)	(200.00)	(200.00)
(-) General Failure Costs		(800.00)	(800.00)	(800.00)	(800.00)	(800.00)
Net Cash Flow	**(11,940.00)**	**(1,540.00)**	**3,209.67**	**5,533.64**	**6,144.79**	**9,107.01**

Net Present Value (NPV) **1,282.01** (on current flows)
Internal Rate of Return (IRR) **16.9423%** (on current flows)

Conclusion:
The financial feasibility analysis for the project has a ***positive*** *estimate about managing costs and expected net benefits. Thus, there is a Net Present Value (NPV) positive over* ***USD 1,280.00*** *and an Internal Rate of Return (IRR)* ***higher*** *compared with the expected Minimum Accepted Rate of Return (MARR) based on estimates of the bank lending rate plus 5 additional points.*

Thus, we conclude that the project IS PROFITABLE, under the following premises of increases in prices and sales:

INCREASES REQUIRED TO MAKE PROFITABLE THE PROJECT:
Access Subscription Plan:
+ ***USD 0.10*** *(price per access)*
+ ***3*** *(aditionals daily access)*
Effective Subscription Plan:
+ ***USD 10.00*** *(monthly price)*

One can see that in the first scenario (table 7), the inclusion of direct and indirect tax negatively affects the project to the point that it does not make it profitable. Thus, we proceeded to a second estimate (table 8), keeping new expenditures estimated tax but including a conservative increase in the prices of the two subscription plans and increased sales of subscription by access, to estimate the level of increase needed to make the project profitable. These data are shown in the second scenario.

4.6 Enterprise analysis of the foreign trade sector

The Guatemalan foreign trade sector analysis is important for knowing its overall impact to the *IL Technologies* organization and to the *EIR service* proposal. This section describes which factors must be considered to analyze its impact in the market agents (supply and demand).

The direct impact of the foreign economic sector is in the providers of *IL Technologies*, because these are mainly technological vendors and distributors of *hardware* and *software* products. This affects the estimated costs and operating expenses. In this context, we can mention that *IL Technologies* is an importer of capital goods machinery and equipment due to its focus of work in the Information and Communications Technologies (ICT) areas.

At the level of competitors in the market, is estimated to be very difficult to have direct competition in immediate or medium term, because the information to be provided by the *EIR service* is related to the Guatemalan area. However, for general background information as a catalog of standard codes of countries, currencies, languages, etc., there are already other international companies that provide this information, which would be a direct competition.

The approach that will provide IL Technologies is to add value by integrating this information to a set of specialized data services under the Guatemalan context, as part of an innovative platform for easy access at a competitive price.

The elimination of the foreign trade barriers by the Guatemalan Government, for example through the free trade agreements, doesn't have a direct impact in the industry competition for the *EIR service*. The globalization process is a world wide transformation factor that any organization should seize to offer similar services in other regions. This issue is considered in the strategic planning of the company.

At last, the macroeconomic variables of inflation, interest rate and exchange rate are very important to consider in a sensitivity analysis in the financial model that evaluates the profitability of the *EIR service*.

4.7 Key macroeconomic variables and sensitivity analysis

This section presents a sensitivity analysis about the financial model profitability evaluation to examine how the macroeconomic variables (inflation, interest rate and exchange rate) affect the profits of the investment project.

In conducting an analysis to evaluate the financial profitability of an investment project, based on an estimated budget of income and expenditures over several consecutive periods (annuities), is necessary to adjust the amounts according to an appropriate variation of the main macroeconomic variables that could influence prices.

Also, to conduct a thorough analysis of prices is necessary to study the current market and its context, including future expectations. Overall, the sensitivity analysis of the investment project profitability should be undertaken on the following variables or economic factors that directly affect the estimate of income and expenses:

- Inflation (π).
- Exchange rate (e).
- Interest rate (i).

For the profitability analysis, is feasible to use the measure of the following perceptual indicators:

- Profit Margin on Revenue (%) = (Profit)/(Income).
- Investment Profit Margin (%) = (Profit)/(Investment). This indicator is of particular interest, since if it is over MARR (has a greater value), then it follows that the investment is profitable.

The following tables and graphics present the sensitivity analysis for the financiai model of profitability evaluation of the investment project: the *EIR service*. Importantly, for the sensitivity analysis we used a set of statistical and simulation tools to generate various scenarios of variability. Thus, we have more accurate information about profitability and of how these macroeconomic variables affect the analysis.

As part of the analysis, we present the material generated from the simulation scenarios and statistical study of the behavior exhibited by the referred variables.

Table 9. Key macroeconomic variables and sensitivity analysis.

Investment project: EIR Service (IL Technologies)

	• Name: <EIR, Enterprise Information Resource>.
Proyect description	A set of independent services based on generated interfaces publicly exposed, that offers useful data and operations encapsulated in discrete units of business logic that can be consumed or accessed through out a planning model of temporal o transactional subscription for the organizational client (government or enterprise).
Assumptions	(1) All amounts are expressed in U.S. dollars (USD). (2) The technology infrastructure will be rented through a hosting service. (3) The costs and benefits are expressed in annual temporary periods.
Estimated time for financial analysis	
n =	5.00 years
Budgeted costs identified	(cost focus to the technological infrastructure of initial investment and operating costs)
Hardware and Software Costs:	[refers to the part of primary infrastructure offered by the corporate hosting service]
Enterprise Hosting Service "hosting" =	(40.00) (USD) - Annual cost.
Information Costs :	[under this item includes the cost of inventories for the treatment of information]
Cost to include data sources =	(1,000.00) (USD) - Annual one-time cost; includes 4 new data sources.
Working capital :	[working capital]
Working capital =	(500.00) (USD) - Annual cost.
Development costs :	[includes labor costs associated with application development and content, testing and documentation phases]
HH.RR. I.T.: development team =	(10,400.00) (USD) - 2 people x 4 months x USD 1300.00 | Only for the initial investment
Support and maintenance costs :	[costs associated with help desk, training, maintenance and support contracts]
Support and maintenance =	(520.00) (USD) - Annual cost from 2nd. year.
Identified unbudgeted costs	(hidden costs)
End User Costs :	[costs to be spent on the end user of the system: on-site support, marketing efforts, casual learning, etc.]
End users support =	(200.00) (USD) - Annual cost from the first year.
General failure costs :	[costs related to productivity gains and losses caused by general failures of the system]
Unplanned general failures =	(800.00) (USD) - Annual cost.
Identified Quantifiable Benefits	
Subscription plan for access :	[estimated revenue for the subscription plan based on the frequency service access]
Access price per transaction =	**0.55** (USD) - Price per access for each service query
Estimated visitors per annum =	**6,072** **Estimated annual number of hits (baseline: 23 daily hits).**
Annual growth rate =	25.00% (expected)
Effective subscription plan :	[estimated revenue for the subscription plan based on access life-time]
Price duration =	**260.00** (USD) - Monthly price. The granularity of eligibility period is MONTHLY.
Estimate subscriptions X eligibility period =	16 Number of contracts per year.
Estimated annual income =	4,160 (USD) - Annual estimation per subscription plan per eligibility period.
Annual growth rate =	18.00% (expected)
Rate of Return MARR	
Bank lending rate (%) =	**13.5000%**
[PLUS] Additional points (%) =	**5.0000%** (Information Technology Sector)
MARR (%) =	**18.5000%** (Bank lending rate + PLUS sector)
Tax rates (taxes)	
Direct: Income Tax (%) =	**5.0000%**
Indirect: Value Added Tax (%) =	**12.0000%**

Table 9. Key macroeconomic variables and sensitivity analysis.

Macroeconomic Variables (For the sensitivity analysis, we assume a triangular distribution)

Inflation (%) = **9.0000%** (annual)

Real Interest Rate (%) = **4.5000%** (annual)

NOTE: For the moment this is not considered macroeconomic variable, since it is assumed that any amounts will be handled in USD (revenues and expenses). The only point where it could affect profitability is in taxes (direct and indirect), as these are paid to the Treasury in GTQ.

Exchange Rate (GTQ) = **7.7000**

Sensitivity Analysis	Minimum	Expected	Maximum	% variation
Inflation (%) =	8.1000%	9.0000%	9.9000%	10.00%
Real Interest Rate (%) =	3.3750%	4.5000%	5.6250%	25.00%
Exchange Rate (GTQ) =	7.2380	7.7000	8.1620	6.00%

Estimated cash flows for 5 years **(All values are expressed in USD)**

Period: Annual Description of item	0	1	2	3	4	5
Identified Quantifiable Benefits						
(+) Access subscription plan			3,339.60	4,550.21	6,199.65	8,447.03
(+) Effective subscription plan			4,160.00	5,350.59	6,881.93	8,851.54
Outflows of taxation :						
(-) Direct: Income Tax.			(329.98)	(435.64)	(575.59)	(761.14)
(-) Indirect: Value Added Tax.			(899.95)	(1,188.10)	(1,569.79)	(2,075.83)
Budgeted costs identified						
(-) Hardware and Software Costs	(40.00)	(43.60)	(47.52)	(51.80)	(56.46)	(61.54)
(-) Information Costs	(1,000.00)		(1,188.10)		(1,411.58)	
(-) Working Capital	(500.00)	(545.00)	(594.05)	(647.51)	(705.79)	(769.31)
(-) Development Costs	(10,400.00)					
(-) Maintenance/Support Costs			(520.00)	(566.80)	(617.81)	(673.42)
Identified unbudgeted costs						
(-) End User Costs		(200.00)	(218.00)	(237.62)	(259.01)	(282.32)
(-) General Failure Costs		(800.00)	(872.00)	(950.48)	(1,036.02)	(1,129.27)
Net Cash Flow	**(11,940.00)**	**(1,588.60)**	**2,829.99**	**5,822.85**	**6,849.53**	**11,545.75**

Net Present Value (NPV) **648.88** (on current flows - includes the inflation)

Internal Rate of Return (IRR) **20.0350%** (on current flows - includes the inflation)

Conclusion:

*The financial feasibility analysis for the project has a **positive** estimate about managing costs and expected net benefits. Thus, there is a Net Present Value (NPV) positive over **USD 600.00** and an Internal Rate of Return (IRR) **higher** compared with the expected Minimum Accepted Rate of Return (MARR) based on estimates of the bank lending rate plus 5 additional points.*

Thus, we conclude that the project IS PROFITABLE, under the following premises of increases in prices and sales:

INCREASES REQUIRED TO MAKE PROFITABLE THE PROJECT:

Access Subscription Plan:

*+ **USD 0.10** (price per access)*

*+ **3** (aditionals daily access)*

Effective Subscription Plan:

*+ **USD 10.00** (monthly price)*

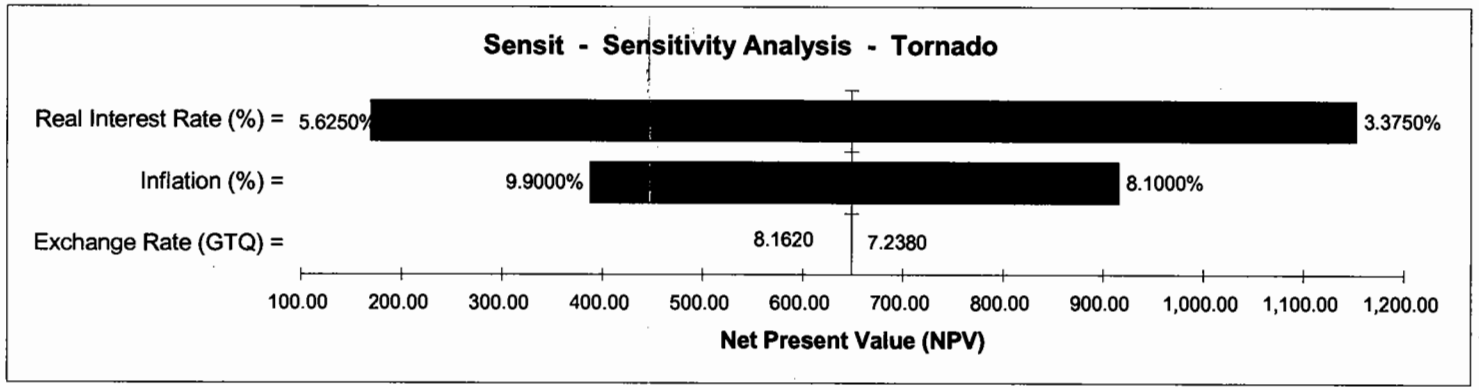
Figure 14. Sensit - Sensitivity Analysis: Tornado.

Tornado Analysis

Macroeconomic Variables					Analysis for the Net Present Value (NPV)		
Sensitivity Analysis	Minimum	Expected	Maximum		Minimum	Expected	Maximum
Real Interest Rate (%) =	3.3750%	4.5000%	5.6250%	4.5000%	1,152.92	648.88	169.11
Inflation (%) =	8.1000%	9.0000%	9.9000%	9.0000%	915.79	648.88	387.68
Exchange Rate (GTQ) =	7.2380	7.7000	8.1620	7.7000	648.88	648.88	648.88

Range	% Variance
983.81	77.6304%
528.11	22.3696%
0.00	0.0000%

Total Variance
1,246,789.0109



CONCLUSION: You can see that even with changes in inflation and interest rate, the investment project remains profitable.

There is an important observation: the estimated inflation applies only to products and services purchased from suppliers based in Guatemala.
This is mentioned because the cost of the *hosting* service provider will be purchased from abroad (USA), as far as the prices offered by the supplier, are exempted from the Guatemalan inflation but the U.S. (approximately 3%).

Figure 15. Sensit - Sensitivity Analysis: Spider.

Values for input variables: macroeconomic variables

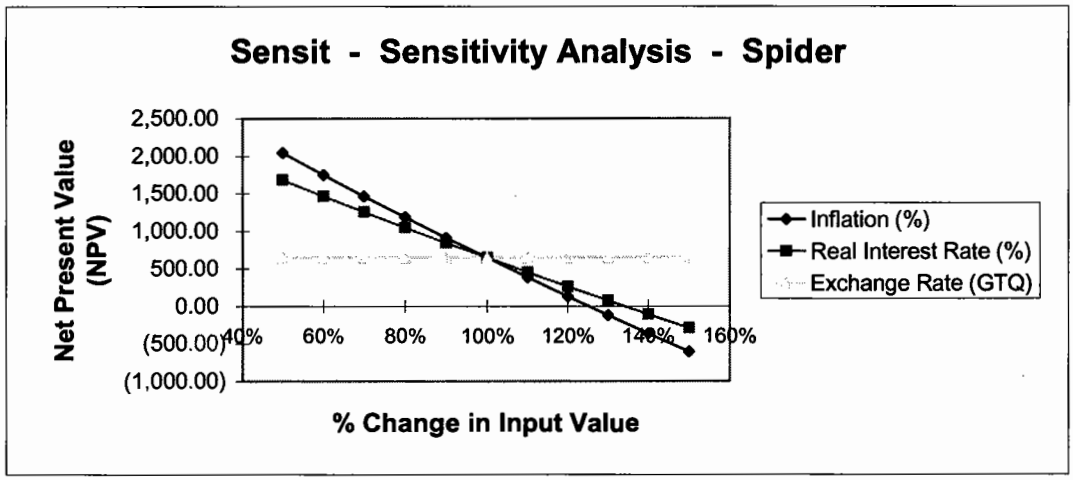
	50%	60%	70%	80%	90%	100%	110%	120%	130%	140%	150%
Inflation (%)	4.5000%	5.4000%	6.3000%	7.2000%	8.1000%	9.0000%	9.9000%	10.8000%	11.7000%	12.6000%	13.5000%
Real Interest Rate (%)	2.2500%	2.7000%	3.1500%	3.6000%	4.0500%	4.5000%	4.9500%	5.4000%	5.8500%	6.3000%	6.7500%
Exchange Rate (GTQ)	3.8500	4.6200	5.3900	6.1600	6.9300	7.7000	8.4700	9.2400	10.0100	10.7800	11.5500

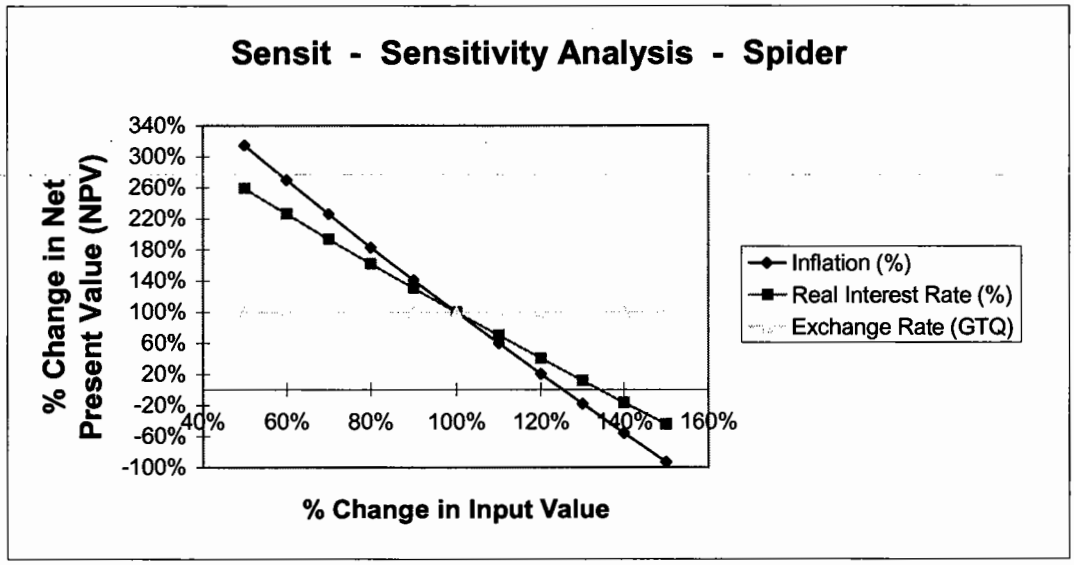
Values for the output variable: Net Present Value (NPV)

	50%	60%	70%	80%	90%	100%	110%	120%	130%	140%	150%
Inflation (%)	2,043.96	1,752.49	1,467.42	1,188.58	915.79	648.88	387.68	132.04	(118.21)	(363.21)	(603.10)
Real Interest Rate (%)	1,682.73	1,467.61	1,256.77	1,050.10	847.50	648.88	454.14	263.19	75.94	(107.70)	(287.81)
Exchange Rate (GTQ)	648.88	648.88	648.88	648.88	648.88	648.88	648.88	648.88	648.88	648.88	648.88

% For the output variable: Net Present Value (NPV)

	50%	60%	70%	80%	90%	100%	110%	120%	130%	140%	150%
Inflation (%)	315.00%	270.08%	226.15%	183.17%	141.13%	100.00%	59.75%	20.35%	-18.22%	-55.97%	-92.94%
Real Interest Rate (%)	259.33%	226.18%	193.68%	161.83%	130.61%	100.00%	69.99%	40.56%	11.70%	-16.60%	-44.36%
Exchange Rate (GTQ)	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%





4.8 Key marketing strategies

The following presents a brief description of some marketing strategies that have been defined for corporate image and sales activities of the service.

4.8.1 Identity strategy

- Build an independent company but related to *IL Technologies*, with the purpose of managing all the aspects concern to the *EIR service* (from software engineering to marketing and sales activities).
- The name of the "*EIR service*" will be changed since it doesn't indicate much. Basically, we want the name to be more meaningful to the customers. A proposed name is: **Data Channel Connection (DCC)**.

Some benefits of this strategy would be:

- Related to the identity: the specialized manage for a specific market niche (different marketing).
- Related to the name: link a "catchy" name with a unique business model.
- Modularization and organization of business activities.

4.8.2 Sales strategy

- Develop specific demo scenarios to present the benefits of the service related to different industry perspectives.
- Create different business case studies to present the strengths of the *EIR service*. The business cases must show the impact of the service in the daily operation of the customers systems.
- Expand the range of service plans and subscription models.

Always keep in mind:

- "*The technicians do not buy software, but business people*".
- "*As a customer (business man), what is exactly that I will win with this service?*"
- "*The companies buy because they need it, not because they want (as individuals)*".

With this, we can develop the best reasons of why the *EIR service* is required in any company.

4.8.3 Implementation strategy

- Develop the initial business case from a pilot implementation of the *EIR service* over a simple enterprise context.
- Develop and publish a prototype of the service.
- Keep in mind that the *EIR service* is difficult to sale due to its intangible nature and pioneer market idea, although is expected to have an excellent response in the local information industry (meaning a sustainable income in a long term basis).
- As part of the marketing plan, we must develop a method to reach the potential customers, based on different criteria: industry type, complexity of business scenarios, identified needs, etc.

4.9 Future work

- Conduct a detailed market study as input for the development of service differentiation analysis and qualitative analysis of competitors.
- Tune of the advanced model of financial analysis for the investment project, through constantly updating it with better estimations of the variables.

- The analysis of the external trade sector factors in Guatemala, the Guatemalan GDP growth and the expansion of local market and their influences on the *EIR service* market and the industry context for *IL Technologies*, was made subjectively and needs to be reviewed in more detail.
- Perform a more detailed analysis on how the external trade sector of Guatemala and local market expansion affects the development of the *EIR service* and the industry context of the company.

CONCLUSIONS

At the end of this document, we can conclude the following:

- The basis for the technical design of the proposed service implies a new method to access enterprise data in a Web-based platform. This builds a market differentiation in the Guatemalan information industry.
- The key components of the technical architecture (REST, SOA, Enterprise Mashup and Software+Service Model) provide a robust modularization and data abstraction for the logical operations of the service.
- The *EIR service* is a direct example of the model **Data as a Service** (DAAS). Based in cloud computing, this provides data on-demand operations, opening the world of high-powered analytics and other data-focused offerings to a host of diverse organizations.
- To perform a depth market analysis/study is required to invest a lot of time, effort and economic resources. Unfortunately, in Guatemala we lack of public and updated information on the context of the ICT industry.
- A critical success factor for the development of a new product or service is making a thorough analysis on the consumer behavior of the target market.
- The economic proposal that was presented in this paper concerning the structure of investment (for the development and maintenance of the business service) and the local labor market factors constitute a solid complement to strategic service planning.
- Overall, the proposed project is technically feasible and financially profitable. This constitutes a great basis for an experimental building of this concept in the Guatemalan information industry.

RECOMMENDATIONS

- To accelerate the software development of the service, we must consider the use of a platform that enables REST-full access to Web resources. The REST-full platform must deliver a set of patterns as well as a concrete infrastructure for creating and consuming data services using Web technologies. In a technical perspective, this platform turns entities/records into resources, and those resources are addressable through the URI space that the server presents. Every resource can be obtained and manipulated through the HTTP uniform interface, and the system allows for simple layering and caching through the traditional methods that are used by the WWW. One possible tool would be Microsoft Project Astoria [6].

- The continued development of financial analysis models to evaluate the profitability of the *EIR* business service presented in this paper: (1) simple (based on the investment structure of production factors described), (2) expanded (included in the estimate of the expected cash flows for the direct and indirect taxation), and (3) advanced (sensitivity analysis of the macroeconomic variables of inflation, interest and exchange rate); constituted an initial practical financial model that evaluates the profitability of the service. However, it requires further work to tune the model with more realistic estimates.

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