An architecture for a viable information system

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An Architecture for a Viable Information System

Anton Selin and Vitor Santos

Abstract. The present work is born in the context of problems that organizations facing with their information systems. Modern information systems are monolithic, complex and not ready for the future challenges. And they are playing a key role in a chain of value delivery. Most of the time people do not approach ISs problems in a systemic thinking way, but instead in a reductionist way. In this work, Viable System Model will be used to solve problems described above. The goal of this work is to apply Viable System Model to the Information artifacts. The main outcome from this work is an architecture for Viable Information System, which achieves following goals: understanding of complexity, resilience to change, survival to an external environment and ability to exist independently of its external environment. Systems thinking will be taken as a basis for the development of the ideas presented in this research.

Keywords: Information Systems Architecture, Viable System Model, Systems Thinking, Fuzzy Logic, Complex Problems.

1 Introduction

We can observe that nowadays many information systems are big, monolithic, and embedded in every big organization. These organizations influence, directly or indirectly, our day to day life. For these organizations is extremely important to know each aspect of their information systems. One of the most important pieces is a need to know the behavior and all possible implications of changes could be performed toward information system. The ISs nowadays is playing a key role in chain of value delivery. [1]

Also because of the complexities of the systems, nowadays it’s almost impossible to understand a system end to end. By the rule, we have different people responsible for different parts of the system. Because of that any changes that are made to an information system are preceded by meetings between different stakeholders. We can argue that normally these meetings are not perfect, not even well driven for several reasons like human factor, different points of view, a different understanding of the purpose of parts of the system, lack of knowledge, and so on... Which leads us to the logical conclusion, that well-done changes in modern ISs are timely and costly projects, which may not correspond to the needs of modern market requirements. [2]

Complex systems are characterized by large numbers of heterogeneous components with a high degree of interconnections, relationships, and dependencies. They exist in a dynamically changing environment that demands dynamically responding behaviour. In other words, these systems must adapt to their environment. [3]

Companies have wondered about how to better understand their systems. Since the information systems appeared, several trials were made. Nowadays businesses have a missing "one single solution" which will allow them to work with information systems in an efficient way, without old reductionist fashion. A great solution comes when a problem is analyzed from the Information Systems perspective. [4]

Previously subject was approached by Joao Alvaro Carvalho. [5] The work was of great importance at the time, but given that in past 20 years technology changed into an almost new paradigm, the work needs to be updated referring the modern state of the art of knowledge in information systems. Also, additional insights could be generated by using the systems thinking techniques when analyzing the modern systems, which will also do a big difference in terms of understandability of the work.

The outcome of this research can have great importance for those who want to build understandable and predictable information systems, as well as will give a new perspective of how to think about ISs field in systems thinking way.

This work is intended to help Managers of the companies, Information Systems Architects, Project Managers, and all interested in better understanding of their information systems and to create a new knowledge of how Information Systems could be transformed or created to be viable. The result of the investigation will have a practical application. The main outcome is the blueprint for the information system architecture and a new perspective on how information systems should be constructed to face challenges of the present world, and of the future, will be provided. That will create a new state of the art for the field of information system architecture.

2 Systems Theory

The systems theory is the concept which first was proposed by the biologist Ludwig von Bertalanffy, in his work of General Systems Theory and further was developed by Ross Ashby in his work Introduction to Cybernetics. Systems theory can be defined as the transdisciplinary study of the abstract organization of phenomena, independent of their substance, type, or spatial or temporal scale of existence. It investigates both the principles common to all complex entities and the (usually mathematical) models which can be used to describe them. [6]. In other words, general systems theory covers several methodologies which employ a systems approach to understand complex phenomenon and problems.

It plays very important role in the understanding of complex phenomena's. The main approach used by system theorist is to break the big and complex system into smaller pieces and then study the interactions between these small components to understand if something new is happening. The main rule of system theory states that "sum of the parts of the complex system is not the same as the whole system".

Information Systems could be viewed as systems which are intended to process information. They always existed in our world in one way or another, because any phenomena that have as a purpose to transmit and structure information could be considered an information system. That would be logically correct to say that the library is also an information system.

Indeed, in this work by information system will be meant Computer Based Information System. CBIS is an information system in which the computer plays the central role. Such a system consists of the following elements: Hardware, Software, Data, Procedures, and People.

To discover a correct set of information systems, that will be used during the construction of Viable Information System Blueprint we will run through a process of classification. Classification is a method of categorization of things together so that they can be treated as if they were a single unit. In Information Systems, a category could be defined as an abstract concept that describes areas of commonality between different systems. That why it is important for this work to make a taxonomy which can be a support for the development of Viable Architecture.

There is not a simple answer to the question of how to find a good information systems classification. Based on the classification structure, we can find any number of different categories of an information systems. Based on that we can conclude that classification of Information systems into types rely on the division of responsibilities and tasks within organizational structure. As we will see different components of Beer's Viable System Model have distinct responsibilities and distinct purpose. So, we can argue that in addition to find a good taxonomy we also should take into consideration the responsibility of that system. We can define these responsibilities by answering the following questions: "what type of information the system deal with?", "what type of users the system is going to have?", "what is the time space that system deals with?", "what are the speed requirements for the data processing?", etc.

Many companies have the hierarchical structure, meaning that responsibilities and information classes follows a hierarchy (Figure 1). And one of the most used approaches of systems classification in hierarchical structures is "pyramid model". The system in pyramid model mirrors the information, tasks, and responsibilities according to the levels of hierarchy found in the organization.

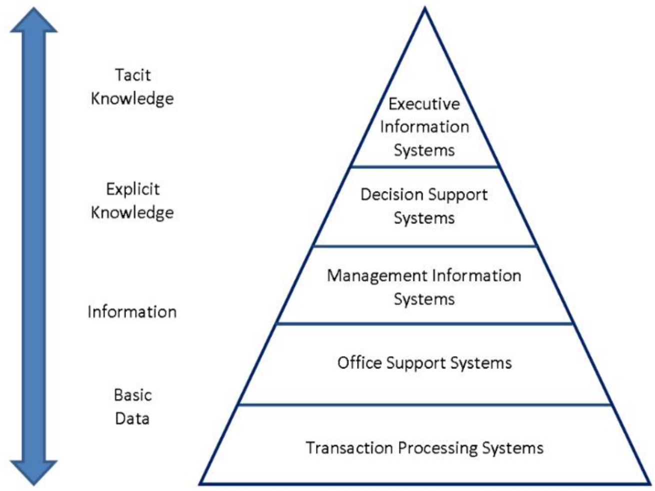

Figure 1 – Five level pyramid model (adapted from: http://www.chris-kimble.com/Courses/World_Med_MBA/Types-of-Information-System.html)

Below we address each of the different levels with some more details:

Transaction Processing Systems. TPS is operational-level system. These systems are the first line of interaction with company's external environment, which collect the key data required to support the management of operations. The process of data collection is usually done through automated or semi-automated tracking of low-level activities and basic transactions.

Management Information Systems. MISs are used by middle managers to help ensure that managers have enough information and action channels to guarantee a stability of a business for short to medium term.

Decision Support Systems. A Decision Support System processes and analyses data to generate knowledge. DSS systems are normally used to allow projections of the potential effects in the future of taking decisions today. Also, DSS helps to identify and manage ill structured problems in an organization.

Executive Information Systems. These are strategic-level systems, where we join company's internal and external information. The information in the EIS is not well structured.

Besides the systems identified above, there are other types of systems which could be considered of high importance to this work. These systems are not related directly to the company hierarchy, but directly manages, measures and perform actions on the existing systems. This could be considered the support systems for existing systems.

Business Process Management System. BPMS is a system that comprised of systematic activities conducted to ensure the successful implementation of strategies and plans in an organization. It provides a tool to clarify how well a company is doing, in terms of processes, actions, and strategies, to achieve its objectives. [7]

Fuzzy Inference System. A Fuzzy Inference System (FIS) is a system that uses fuzzy set theory to map inputs to outputs. [8] This system is composed out of several components, which altogether allow to perform a pre-defined action based on input rule. Some of this input rules, as well as output actions, can be automatically adapted when the FIS is supported by Artificial Intelligence learning capabilities.

BPM Simulation System. A simulation system in a work flow control system confirms whether prepared business process defining information is valid. [9] This type of systems allows simulating the outcome in each business context under specific circumstances. The system takes a business model as a process workflow, then given a set of values for variables in the model the system simulates the behaviour. After the simulation, the results can be compared to understand whether the outcome is beneficial to the business or not.

Artificial Intelligence System. An artificial intelligence system is a system capable of accepting a statement, understanding the statement and making a response to the statement based upon at least a partial understanding of the statement. [10]

3 Beer Model Sub Systems Overview

The viable system model (VSM) is a model of the organisational structure of any autonomous system capable of producing itself. The word "organisational" here is not referring to the company or firm, but as a set of components logically organized between themselves.

One of the primary features of viable systems that they can survive environmental changes through the process of adaptation. The Viable System Model give us an abstract architecture for a system that remains viable along its existence.

As we can see on the model above the VSM is composed out of 5 main components:

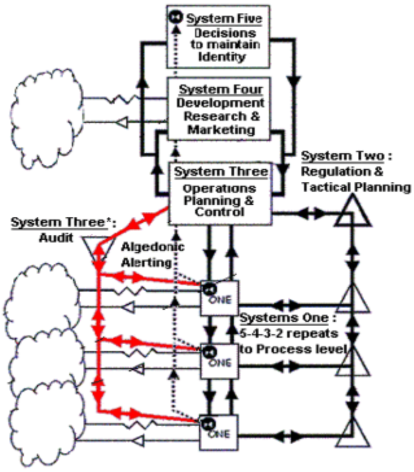

Figure 2 – Viable System Model (adapted from: https://ipfs.io/ipfs/QmXoypizjW3WknFiJnKLwHCnL72vedxjQkDDP1mXWo6uco/wiki/Viable_system_model.html)

Primary Activities/Operations (One). Each Operational Unit should be a viable system by its nature due to the recursive nature of systems as described above. System 1 units are concerned with performing a function that implements at least part of the key transformation of the organization. It comprises a collection of operational systems, each comprising an area of operational activity. [11]

Information Channels/Coordination (Two). System 2 main concern is to allow the primary activities in System 1 to communicate with each other and to allow System 3 to monitor and coordinate the activities within System 1. The overall organization has resources which are normally stored in one single place and are shared among different elements of the system, on demand. For that purpose, System 2 implements scheduling function which monitors availability of the resources that will be used by System 1. System 2 is concerned with coordination. It provides a coordination service to System 1 without which it would be potentially unstable. [12]

Structure and Control/Management (Three). System 3 is a VSM sub system which establishes rules, resources, rights, and responsibilities of system 1 and provides an interface between systems 4 and 5. The structure itself reflects an overall view of processes inside System 1 elements. Its main goal is to guarantee that Systems 1 and 2 are finetuned to steer the organization towards its current objective. The control is performed by "vertical command channels" as we can see on Figure 2. But at the same time this control may not be truly effective if it doesn't have enough requisite variety. To allow the fine tuning of operational units, System 3 needs to have channels to be able to monitor directly all Systems 1. To do this, they may send task forces into the operations to carry out spot checks, audits, etc. [13] This structure was considered by Beer to be the best to deal with requisite variety difference between systems 1 and 3. The module (sub system) responsible to execute these direct monitoring operations is referred to as System 3* (Three-Star).

Vision/Intelligence (Four). The System 4 requires an understanding of the total environment of organization's operation to perform intelligence functions. The model of the whole organization as well as of its environment must be contained in the System 4, otherwise intelligent adaptation would not be possible. The quality of this internal model is crucial to the capability of the organization to adapt to change. [13]

Policy Decisions (Five). System 5 takes policy decisions responsibilities and balances demands from different parts of organizational structure. It drives an organization as a unique element. The presence of the environment in the model is necessary as the domain of action of the system and without it, there is no way in the model to contextualize or ground the internal interactions of the organization. [13] System 5's main roles are to supply logical closure to the viable system to monitor the System 3 - System 4 homeostat. This axiom proposes a function that System 5 should perform to regulate any unstable variety, generated by the interactions between System 3 - System 4.

Algedonic Signals

Algedonic Signaling within Viable System Model monitors the signals passing from System 1 to System 3. If some emergency is identified, the signal is sent directly to System 5. This process goes through system 5 and requests urgent action by Systems 3 and 4. [14]

4 Methodology

To achieve such goals, our strategy for investigation will be based on the design science framework proposed by Hevner. The design science is the field of research where you create something new and then you examine the result of your creation. Design science helps researchers to develop exactly what they want. Sometimes happens that you shoot first, then call whatever you hit "the target". There is a little merit in randomly developing things in the vague hope you might develop something useful. The main goal of design science and what distinguishes it from simply futzing about, hoping to produce something useful, is a prediction. So, the planning of the work and careful prediction of the desired results is done in the first place.

5 Towards a New View Applied to IS

It is clear the advantages that VSM can bring to the IS field if properly implemented. And since Information Systems are a part of Systems theory we can argue that the application of VSM to information systems architecture besides making sense, is also a very good fit.

The rules of viable system model is well defined in the book of Stafford Beer "Heart of Enterprise". These rules are not Information Systems rules, but instead are aphorisms, principles, axioms and other properties which may describe organizational environment. These rules will need to be adapted to the field of Information Systems.

Translating Viable System Model Rule into Information Systems World

Table 1 - Information Systems equivalent of VSM rules

VSM Rule	IS Equivalent
RA1	Good naming convention defined for all components of the Information System.
RA2	Good definition of process capability, in terms of inputs, outputs and volume of transactions.
PO1	Without exaggerated overheads of processing, each operation should be the minimum viable product, so we can reduce the complexity and control system in the proper way.
PO2	This rule has 2 faces in the world of IS. 1 is that the limits of data processed by each transmission channel should be adequate to the maximum amount of data it may carry on. 2 the physical servers should

	be prepared and slightly exceed the performance required by the data is being processed.
PO3	Each subsystem should have its own domain of operations it may perform. Each subsystem should expose an interface that can be used to transform data from other domains into the domain understandable for that subsystem.
PO4	The maintenance process should be defined and automatized. This process should run on the adequate schedule based on the nature of a system.
RST	The Viable System Architecture should be composed out of components which per se are viable.
A1	The system should be available for all the environment that IS deals with.
A2	Artificial intelligence and Business intelligence function must have access to all data that is being managed by system 3.
A3	The Viable Information System should provide functionality by which all inconsistencies between systems 3 and 4 can be managed.
LC	The number of operations supported by the system should be equivalent to the capacity of all software components that compose the system.

Requisite Variety

It is vital that all communication channels have requisite variety to handle transmissions. [13] We can translate this as a need of effective communication of organizational policy to each management units, which, in turn should transform it into smaller and more concrete action steps and communicate them to the operational units. The System 1 then should have effective channels of communication to its local environment. If we fail at any of those steps it will lead an organization to an ineffective action. It is also important to mention that due to requisite variety nature channels must have higher capacity than the variety of all inputs it might receive. That guide us to the Second Principle of Organization of Stafford Beer. This principle brings a time element into the concept. Messages should be exchange fast enough to hold on the rate of variety generated. In the opposite case, the system can turn into unstable state. The stability of the system is dynamic, not static. [13]

Also, it is important to mention that each element of self-organizing system has its own "language". If you consider an IT consulting company, the language used by engineers that designs a solution and solve problems in client's systems is quite different to the language used by the sales and non-technical people at the sales meeting. The languages as well as the local environments in which they operate are likely to be mutually incomprehensive. The same applies to the language used in the VSM organization as compared to the local operational unit language. When a message/request crosses a boundary of a given sub system, it needs to be "translated" to continue to be understood by the whole system. A process is named "transduction". If the transducer does not have requisite variety, the message gets garbled or lost. [13]

The fourth principle of Organization (OP4) states that: "The operation of the first three principles must be cyclically maintained through time without hiatus or lags". [15]

Beer underlines that organizations tend to divide their management activities into pre-defined intervals - month, quarter or year, for example.

We can notice that the real world doesn't follow the same approach. Management must be a continuous process to allow deal with the changes in the environment in real time. If we break our management activities in certain blocks of time, then it certainly will be a situation when the requisite variety will change in the middle of that time block, and so management will not be able to give a required answer promptly. This principle of organization explicitly refers to the need for communication and response to be fast enough to keep up with the rate of changes affecting the organization. [13]

System 1 units can deal with its local environment efficiently, only while it can deal with the variety from it, by attenuating the incoming variety and amplifying its own feedback variety.

In the same way, the System 3 unit can deal with all Operational Units variety effectively if it can handle the variety coming from it, by attenuating the incoming variety and amplifying its own variety back to it. Meaning that the state of equilibrium will be maintained in the system. If these requirements are not met, the system will become unstable, eventually leading to its collapse. [13]

Construction of blue print

Viable System Model is an autonomous system. Autonomous could be defined as having a freedom to govern itself or control its own affairs. As we saw the VSM implements features to govern itself and to perform control over its parts automatically based on the information it receives. And because of being autonomous it's not enough for the system to deal just with raw data. At some points of the processing of that data, it will be important to transform it into the information and create some knowledge based on that information. Also, during the implementation we must allow a system to be resilient enough to deal several changes that might come from outside of context of the system, as well as must provide a system with awareness of its internal state and bodies to take actions accordingly to events happening inside the system in order to maintain the system alive during the time. In other words, to make a system viable.

The following example gives a good insight to the concept described above: All the system has its maximum capacity, it might be several users, processing power, a quantity of data it may handle, or some other aspects. So, if the system just cares about processing information without paying any attention to its maximum capacity several problems may arise which could lead system to go down. To prevent such situation autonomous system must be aware of its maximum capacity at several levels and should be able to take actions necessary to avoid critical situations. It could be done through auto evaluation of its maximum capacity in some defined periods of time, and at the same time by measuring its current usage. Then a set of rules must be defined, in order deal with the situations when the current usage of the system almost reaches the maximum capacity defined during the auto evaluation cycle. These rules must be specified by the users of the system. Also, a system must be flexible enough to allow dynamic amendments to that rules as well as the creation of new rules or deletion of old ones after the system goes live. By saying that, is also important to mention that the system that going to be constructed using the Viable System Architecture should offer means to allow all described above to happen.

The main concern of Viable Information System is the information. The information will be provided to the system through its inputs (from external environment, and so only systems 1 and 4 deals with inputs), going to be processed by the system (important thing during processing are rules, error handling, and correct flow) and finally will be provided as the output of the system (also systems 1 and 4, but also is important to mention that system 4 will give kind of output to the system 5 in the terms of dashboarding).

In the book Beer mention that "Systems 4's job is essentially to realize a potential", it leads us to the conclusion that IS which will be assigned to the System 4 in the VSM should have the capability to deal with a performance management.

That means that the construction of Viable System Architecture should consider channels by which will be possible to achieve such measurements. This could be done through a definition of a set of applicational interfaces and System 1 elements should comply with them to be interconnected with a rest of the system.

Was defined the following rules for the intended architecture of viable information system.

1. All subsystems of type 1 must have recursive nature. They should implement a part of a key transformation of the organization. All systems of type 1 deals with primary operations of the business. All operations should be well-known and should obey the same interface. All of that done to be possible to perform generic operations over all sub-systems of type 1, which are namely: validation against pre-defined rules, logging, etc.
2. There should be a generic logging available among all systems 1;
3. System 2 must enable a channel of communication between systems 1.
4. System 2 must allow system 3 to monitor and coordinate activities of systems 1.
5. System 2 must provide scheduling function and perform a coordination to systems 1.

6. System 3 must provide bodies to establish rules, resources, rights and responsibilities to the systems 1 (whose access will be scheduled and coordinated through the systems 2).
7. System 3 must provide an interface between systems 4 and 5.
8. System 3* must implement ways to send task forces to systems 1 to perform audits. The same system is responsible to send algedonic alerts to system 5 when necessary.
9. System 4 must have defined interfaces to communicate with the external environment.
10. System 4 must contain an updated model of whole organization and its environment.
11. System 5 should specify a domain of action to the whole System based on the model provided by system 4.
12. System 5 must implement Algedonic Alerting System.
13. System 5 must implement bodies to counterbalance systems 3-4 homeostasis when needed.

We may translate a model proposed by Stafford Beer to the information systems in following way:

Primary Activities/Operations. Systems of type 1 should be oriented to the operations execution. They must communicate with the external world. Also, must have interfaces to communicate with each other. Because normally the parts of the external world with which the system 1 is intended to communicate may overlap, and so it's necessary to communicate between systems also.

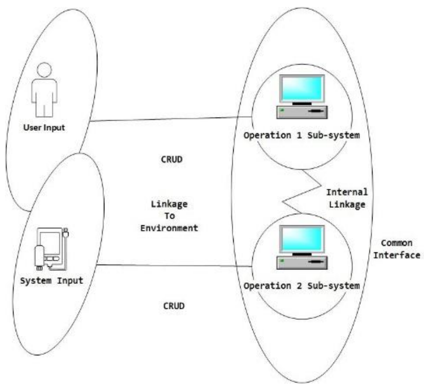

Figure 3 – Viable Information System

Taking into consideration the importance of control over Primary Activities in Viable Systems we argue that system 1 must implement the same interface defined by the system of type 3. This interface will allow to collect the data among all systems of type 1 in a generic way as well as will allow adding new type 1 systems to the whole system on demand in the plug-in-play fashion.

As we can see on the Figure 3 TPS's are being represented by Operation 1 and Operation 2 sub-systems. Each of this system has the Linkage to its environment which should provide a capability to perform CRUD operations. The data interchanged with environment might be generated by the user or by the other system. All the CRUD operations should implement a common interface, which then will be used to create generalized logs. Also, Systems 1 and 2 implement a linkage in between them.

Each of the Operation x Sub system exposes its own translator which translate its internal information types to the information understood by common interface. This is being done to have our TPS's plug-in-play like and decoupled from each other. In such architecture if Operation 1 sub-system wants to interchange data with Operation 2 sub-system it should use the translator to translate data to common format accepted by in interface, that comes from the domain, and then the Operation 2 sub-system will use the translator to translate the data that comes from common interface into its internal format. This functionality should be performed by the orchestrator.

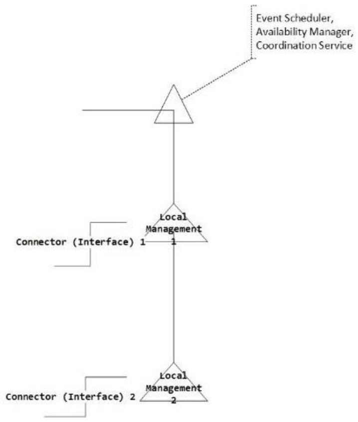

Figure 4 – Coordination

Information Channels/Coordination. Systems of type 2 are intended as adapters between a specific system and orchestrator. It is responsible for taking input information from system 1 and to validate weather the system 1 obey the rules of the business. Also, it communicates with orchestrator which in turn communicates with other systems.

This part will be composed out of several systems/components to achieve desired behavior. For each TPS, there will be a local management system, responsible to extract data from TPS and to summarize it to reduce a variety. Then the data will be provided to system 3 as an input.

Also, this element will have a presence of the Event scheduler which going to have a responsibility to schedule events to be performed by TPS's when necessary.

Another component that should be implemented here is the Availability Manager. This system will be responsible to check the availability of resources.

Finally, the coordination service should be implemented. Coordination service will execute a function of checking the correct execution of work flow and will guarantee that the same resource will not be allocated twice or so on.

As we can see on Figure 4 each System 1 will connect to its local management module. The main purpose of the connector is to serve as the reducer, to summarize the information that will be managed by the Local Management Module. All Local Management systems should be connected to the scheduling system, which will allow to schedule events to be processed inside TPSs.

Structure and Control/Management. Systems of type 3 are where we create rules. Also, serves as the joining peace between all operational subsystems. In this case, the good choice would be the orchestrator, combined with Domain Database.

The orchestrator would combine the data from several TPS's and allow this TPS's to communicate with each other. The Domain Database will establish the limits for each TPS's which could be considered as the organizational rules. The Systems 1 will consume that rules from system 3, and system 3 will receive such rules from system 4.

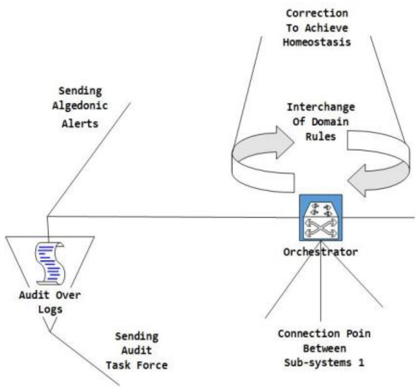

Figure 5 – Management

System of type 3* is the system which performs audit. The audit will be performed over the logs in the predefined time intervals. Such audits will allow guaranteeing that the system is doing what is intended to do, and no suspicious actions have happened. This system will consume the domain rules from the Domain Database, generate the automatic test based on those rules and run this tests over the generic logs of all systems 1 to identify whether something is wrong. If some wrong behavior is detected the algedonic alert will be sent to the system 5 by the channels exposed by system 5.

Another important thing here is that this element will provide a Domain Database. This domain database will contain limits and rules. Also, these rules will be inserted into the Business Model contained in system 4. In the return, the only way to update those business rules would be through the system 4's simulation module, which may at some point decide that rules must be updated. As specified in the VSM rules the system 5 must have the capability to step in when the homeostasis between system 3 and 4 is impaired. This action will consist of sending amendments to the rules that is provided to and retrieved from system 4.

Vision/Intelligence. One of the main purposes of the system is to be able to communicate with the external environment. This will be done using the web services. Through this web services must be possible to integrate external data to the system. It can be done by using the web generalized data formats, such as JSON, or XML.

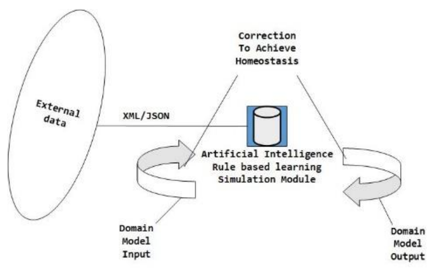

Figure 6 –Intelligence

Another subsystem that is going to be included here is the business modelling and business simulation tool. This will allow business to perform periodic simulations of its business model, as well as have the complete image of business processes (domain) of a system itself as well as of its environment.

This system will also permit the artificial intelligence to be applied here. Based on the data that comes from the systems 1, the system can analyze this data using artificial intelligence systems and then provide meaningful input to the simulation module to see if the results of the artificial intelligence are correct and if they fit well within the business model.

Figure 6 demonstrates the design that the intelligence part of the Viable System Architecture should have. The process here is quite simple, and has as a main goal to foreseen changes and improve TPSs functionality to be prepared for those changes.

Policy Decisions. The Fuzzy Inference System which going to be able to attend the necessity of changing the system workflow and model when needed. The system 5 should understand how the model could be transformed by using the system which speaks some business understandable language, such as BPEL. Also, the fuzzy inference system will be responsible for receiving the communication from other systems (algedonic alerts) and react to that alerts appropriately.

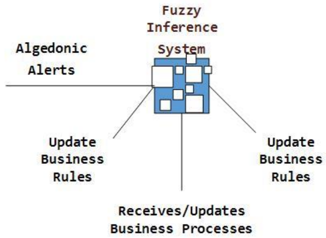

Figure 7 –Policy Decision

The Figure 7 above shows us interfaces that Fuzzy Inference System should expose. One of these interfaces offers the possibility to update business rules now as they were inserted/retrieved to/from the system 4. These actions should be taken as a reaction to the algedonic alert received. Another functionality that is being assured by the system 5 is the possibility to update business processes when needed.

We argue that transforming VSM as described above will bring as the outcome the desired Viable Information System Blueprint, let's see how we can do that.

Table 1 - VSM components to IS artefacts mapping

VSM Component	Main Characteristics	IS Proposed
System 1	Operations	Transaction Processing System
System 2	Coordination	Event scheduler and Availability manager, Coordination service
System 3/3*	Management	Shared databases, Domain database (contains rules such as value limits, dates of executions, etc..), Audit System, Performance Auto-Evaluation System, Logging System.

System 4	Intelligence	Business Intelligence System, Simulation System, Machine Learning / Rules Based Learning, Artificial Intelligence
System 5	Policy	Interfaces Definition System. Algedonic Alerting System.

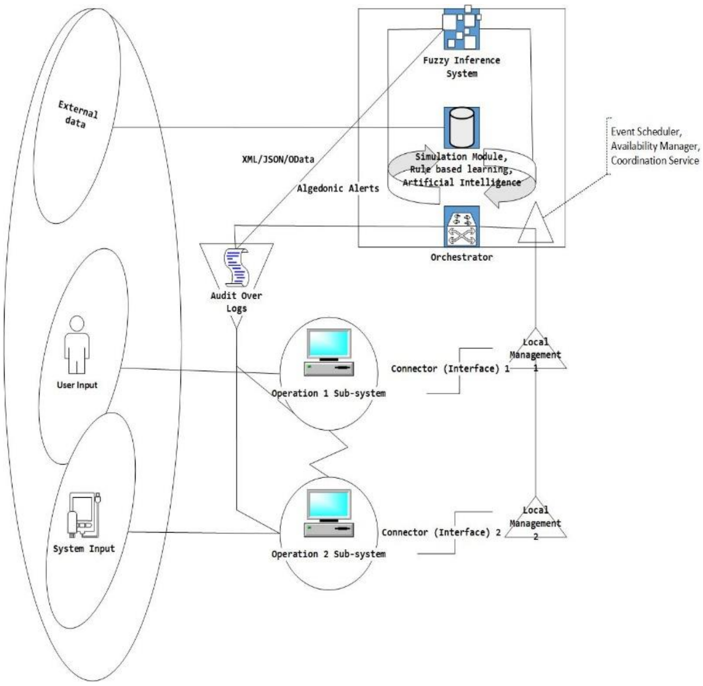

Figure 1 – Viable Information System Architecture

Information systems provide companies with internal and external benefits. Internally, they help to streamline, focus and coordinate the activities of employees and different organizational departments. In turn, companies benefit from having a more efficient workforce, which allow them to focus more time and effort on external affairs such as marketing, sales and establishing a market presence. Everything described above are important pieces and as such they should be measured and managed properly. Here we can argue that not only measuring the internal system capacity is important, but also the performance regarding to the specific environment where the system is integrated, based on the specific work the system is intended to do.

7 Conclusions

The main contribution of present work is the investigation that gives guidelines on what information system should look like to be viable. Also, this work gives a possibility to have an information system which is resilient to the changes in the environment. We have concluded that such system can take advantage of all the benefits provided by the Viable System Model. Given that some may use this work to support their decisions about information systems. One of the difficulties that were faced during the development of the current work is that no known existence of the well-defined taxonomy that represent all elements of the information system. So, in that sense, the work was limited to the current knowledge of the author about the information systems artifacts and to the knowledge gained during the literature review. Other limitation, is that we are not able now to test the architecture, proposed here, in the real-world organization, and see all outcomes that might come out in the real world. But, we already have seen the real-life scenarios of VSM implementation (in the field of management) and the outcome of that work. [16] But at the same time, there are no known cases of VSM implementations into the information systems. The suggestion for the future work would be to study better the influence of the human factor on the implementation (and post implementation) of the Viable Information System. So, the idea would be to implement this architecture in the organization following all the rules described here, and then try to measure the impact that the human factor has on that system, and, otherwise what is the impact of the system on humans (employees) that interacts with a system.

Another suggestion would be to elaborate the guideline or framework which will allow implementing the truly viable information systems in the organizations. This framework should include more deep study and step by step guide to allow transform information system into viable information system at any stage.

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