A VALUE BASED BUSINESS PROCESS MANAGEMENT NETWORK MODEL

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As in the foundation and principles for complex process science and engineering, a major problem is the lack of formal specification language to treat the dynamics of modeling complex processes with its simulations, emulations and enactments. This paper defines a formal specification language which allows integrating the complex thinking with software engineering principles for guiding the characterization of minimum requirements to design technology within living complex processes. There is a lack of research in the literature referring to the model process structural complexity. Such a model complex process can be directed toward acquiring good maintainability attributes according to the principles of complex process science and engineering. In this work a Value Based Business Process Management Network Model (VBPMN) is developed to acquire directly from the target complex process codes the knowledge hidden among and within composite and elementary complex processes.

Keywords: design and process science, process management, process specification languages, process design principles, complex process, management of complexity, process notations, process languages, process modeling, process simulation, process emulation, process enacting

1. Introduction

When facing any complex process it is necessary to identify the basic elements of the development and specify the axiomatic, algebraic and transitional properties of the architecture of complexity. The basic elements which will define the process base are built upon the foundations and principles of complex process science and engineering (Gattaz Sobrinho, 2000, Yeh, 2000, Simon, 1973). The foundations of the art of complexity are presented and the design principles facing governance of the dynamics of reality behavior will be discussed (Gattaz, 2010, Johnson, 2009, Nash, 1950a, 1950b). A formal specification language, to help design complex process, is shown through grammar and some operators to help navigate and develop measuring criteria is shown (Chechik & Gannon, 2001, Bartussek & Parnas, 1977). With the lack of formality there is an absence of research in the literature in the modeling of process structural complexity. Such a model complex process can be directed toward acquiring good maintainability attributes according to the principles of complex process science and engineering. In this work a complex Value Based Business Process Management Network Model
(VBPMN) is developed to acquire directly from the target complex process codes where knowledge is hidden among and within composite and elementary complex processes. With the knowledge acquired by the VBPMN, measures of Alignment and Efficacy, Work Effort for Changes, Productivity, Synchronicity, Parallelism, Inclusion, Traceability and other measures to help one may develop management criteria and mechanisms to guide the process co-evolution. The current literature describes, formally or informally, graph, activity, entity, event based process models and languages as it is in the latest Business Process Management Norms (BPMN), BPM Languages, BPM Systems, while none of these literatures conceptualize process based on VALUE and/or upon the foundations and principles of complex theory (OMG, 2011, Bock, 2005, 2006, Bock & Gruninger, 2005, Pouchard, 2004, Schlenoff et al., 2000, Knutilla et al., 1998). Value is meant by a difference of one or more subjects of interest conceptualized or abstracted from a reality and materialized as a result in a given context (Gattaz, 2001). The Value Based Models may be able to represent activity, entity and event based models but not the other way around simply because those classical models do not enable the share of multidimensional values (Value to be added, Value added, Reference, Human and Technological Resources in the VBM activities, events, fixed graphs, entities, objects and agents may be captured throughout the elements and also captures ill-structured, Traceability, Unending and other properties of Values one can not capture with the classical models) (Gattaz Sobrinho, 1999, Simon, 1973, Ramamoorthy, 1966).

Section 2 describes 21 foundations and principles of process engineering. Using complex theory, the authors have experienced it’s concepts, methods, techniques, and tools in the last 15 years in a variety of segments of the economy, including agriculture, airspace, software, legislation, banks, small business, telecommunication, science, technology, innovation and education in different countries in South and North America, Asia, Europe and Medium Orient (Gattaz Sobrinho, 2000, Yeh, 2000, Gattaz, 2001).

Section 3 presents both lexical and syntactical representations of VBPMN using Backus Normal Form (BNF) and its corresponding semantics using the cooperative games (Nash, 1950a, 1950b) and automatic consistency verification between requirements and design (Chechik & Gannon, 2001, Gattaz Sobrinho, 1999).

Section 4 will describe an integrated framework of Process Network and Software Engineering based on VBPMN.

Section 5 will finally point out contributions and new research avenues.


Systems Dynamic Theories have been confused with Complex Systems in literature. The dynamic requirements for simple systems have been very different from those dynamic properties required for complex systems, even in nature. Simplicity becomes complex as the level of precision increases and the interactions among elements are governed by different theories. For instance, industry systems are based on simplicity theories while biology and social systems are based upon complexity theories. While in industry it is easy to imagine a closed system, biology or social systems are naturally opened based systems (Gattaz, 2010, Johnson, 2009). There are principles for Classical/Simple industry systems, which have helped to find context-free performance measures and indicators to help one to lead with efficacy, efficiency and effectiveness. However, there is a lack in literature of context-free measures and indicators to face decision making in complex systems (Gattaz, 2010). While one is centered in Activity Based Systems to lead with context-free problems and languages, another should be centered in Value Based Systems to face context dependent complex processes. The difference is that the Activity is a function which one may previously abstract or define as to be a reality and Value is not a function but known as an expected transition result based upon a given knowledge, complemented with unknown universal laws, which depending on the context, may have different
meanings. For instance, a tool may be considered a surgical instrument to save a life and at the same time, in a different context it may be considered as an arm to kill someone. A person may have a role of being a father, professor, husband and son at the same time in different contexts. One can see fixed components in classical or simple processes, and in complex processes the components are contextually changed and networked with its wicked structure, different treatments and knowledge may be required to face problems and solutions. Nanotechnologies may allow us to see different diseases than micro technologies on the same subject and different treatments are recommended to be applied. The principles described in this section are intended to help to build or rebuild theories for process engineering. Some of these principles are already pointed out in the literature and others were observed in real experiments (Gattaz, 2010, Ertas et al., 2003, Gattaz Sobrinho, 1999, 2000, Yeh, Pearlson and Kozmetsky, 2000, Simon, 1973, Ramamoorthy, 1966). They will be described in the following subsections.

2.1. Inclusion

The same Value in the complex world may conflict in two different contexts. However it may exist and must be considered in the same process. All results are not judged but refuted from reality. In many different interpretations, a Value may have conflicting meanings in different contexts and only the reality in the respective context may refuse its meaning in that context. One may not imagine that a Value added in a process may be different as many arrangements of environmental, social, economical, cultural, science, technological and educational contexts in the same reality.

2.2. Exponentiation

A result may be sliced as an input Value or Value to be added. A difference is to be considered in a transformation effort. A reference is used to guide or give a direction to someone to make a decision. It also is recognized as an environmental, technological or human resource effort to be utilized by someone in a decision making position. Finally as a traced Value added, there is an expected achieved difference, as a service or as a product to someone. Each Value is sliced or traced exponentially as these three kinds at the same time.

2.3. Recognition

A set of Values influences or ripple effects each other automatically by nature or by means of Value validity and synchronism. The human being may recognize them as reference, infrastructure, Value to be added, Value added, product or service dependent on the context. These recognitions may explain a complex behavior within a context.

2.4. Duality

The Duality of a Value may represent a characteristic of the Value not expected in its specification. Duality of a Value A is not necessarily the Value A. The Duality of Value A contributes essentially with the meaning of the evolution of complex ripple effects of Value A in which more real complexity is required to face with it is visualized.

2.5. Unending

The meaning of a Value always exists as it is in its reality. It is unending since it does not depend upon the abstraction, since it is observed from reality. The interpretation of its rule or transformation in reality in a context may vary the Value but its continuity is a reality property.
2.6. Unity
The given nature of a system and its complexity is dependent on the precision and properties of its Unit and the Unit must be considered to be the Value when the reality is being studied as it is their communication, content, interface, systems protocols and its legacy. That is the Unity of the reality in study helps us to conceptualize and configure the Values to be recognized with minimizing its illusion.

2.7. Zero-Time
When a perception of a value is uncovered it exists at that time. This is zero time to make its existence. As much as we delay to perceive the value more time is needed and one may say its positive time. As early as one perceive the time for its purpose of study, one may say its negative time. Planning a value which is consistently expected to be built and observed in a study one may say is negative time, however if it is not consistent with the specified expectation observed the time is not negative neither positive it simply does not exist.

2.8. Self-Defense
A Value may not occur with the presence of other self-defense Values. In other words, a disease may not occur if the organism has the required immunology. Value may not exist in cases where we have have procedures occurring in real time to face with social disasters or some of the Values which would only occur for the effect of the lack of the self-defense.

2.9. Transition
All known interactions should be explicit by means of transitions among Values which may contribute to knowledge domains. These transitions are not functions, but procedures, for the incompleteness and fuzzy meaning of the domain and counter domain Value results. Composed Transitions may be decomposed in most simple transitions, dividing and conquering as more precise theories require.

2.10. Contextualization
A Value may be conflicting with itself when considered the same in a different context. It is strongly recommended to understand the context to conceptualize a Value. The roles of the same agent may differ with contexts such as supplier and client, teacher and student. Also it may suffer exponentiation for instance viewing yourself in different mirrors and integrating different roles of the same agent into only one. A Value may be differentiated as a reference, an infrastructure and as an input in the same decision in three different contexts, which integrate into one context.

2.11. Zero-Effort-Integration
The Value may be integrated from many different existing Values, which use natural universal laws with no human or machine intervention. It maximizes intelligence formally when one is explicit.

2.12. Trans-disciplinary
A Value is obtained from a fusion of the cores of disciplines, arts, sciences and culture. It builds problem-solution spaces in which separation of concerns does not work or those fused disciplines, arts, sciences, and cultures creates new being or behaviors.

2.13. Proto-Interaction
A Value is obtained from abstracting reality and the interaction of the created abstract world. The respective reality is visualized and practiced to reduce the differences.
2.14. Self-Recurrence

The produced Value and the input Value is the same, or self-generated, and it may never stop as it is a functional recursion. You only know it will stop if and only if the Value does not change with its own generation or the Value requires different Value characteristics as its input.

2.15. Changeability

Changeability is the ability to accept and visualize that the Value is constantly changing independently of time and space according to the universal laws.

2.16. Ill-Structured

The Value produced or generated defines the production or generation structure and not the other way around. The same Value may have different and conflicting structures in the same context.

2.17. Traceability

One may always visualize the dependencies by what Value A is viewed. Those include the Values or Legacies that may influence it and at the same time visualize the Values, dependencies, and Legacies which may be affected by Value A.

2.18. Co-evolution

A Value evolves or reduces the differences among the abstraction and realities depending on its own characteristics.

2.19. Veracity

The Value is always measured to see the differences between its abstraction and reality upon which it explicates itself.

2.20. Synchronicity

Synchronicity is the validity and the moment of all Values required by a context when making decision to generate other Values.

2.21. Parallelism

Parallelism is the ability to see different transitions of different Values without the need for the dependency on any sequencing among them. That is to see parallel transition, which may occur in different synchronicity or there is no need to see their interactions by their interdependencies.

2.22. Reconstruction

Reconstruction is the use of the same properties of the design of different Values, Synchronisms, Transitions, and Contexts to synthesize different Values. For instance, synthesize music with the same networked design properties of a different system which may be a community, or a city. It seems to be the recognition of a city as living organism and treat it using algebraically equivalent properties (acupuncture) to provoke positive energy change effects to achieve better harmony results.

3. A Formal Specification of VBPMN

There are many ways to formally specify a complex network. It will be a chosen language production system and the semantics of the basic elements.
3.1. The Language Production System

There are many ways to formally specify a complex network. It will choose a language production system to specify it and any valid sentence must obey the structure derived by applying the substitution rules below:

VALUES \(\rightarrow\) INP/OUT/REF/INT/INF
  \(\text{INP} \rightarrow \text{inp}\langle\text{INP}\rangle/\Omega\)
  \(\text{PROD} \rightarrow \text{prod}\langle\text{PROD}\rangle/\Omega\)
  \(\text{REF} \rightarrow \text{ref}\langle\text{REF}\rangle/\Omega\)
  \(\text{INT} \rightarrow \text{int}\langle\text{INT}\rangle/\Omega\)
  \(\text{INF} \rightarrow \text{inf-amb}\langle\text{INF}\rangle/\text{inf-rh}\langle\text{INF}\rangle/\text{inf-tec}\langle\text{INF}\rangle/\Omega\)

TIMER \(\rightarrow\) Timer

CONECTORS \(\rightarrow\) \langle CONECTORS-IN\rangle/CONECTORS-OUT
  \(\text{CONECTORS-IN} \rightarrow \langle\text{INP}\rangle/\langle\text{REF}\rangle/\langle\text{INT}\rangle\rangle/\langle\text{CONECTORS-IN}\rangle/\langle\text{INP}\rangle/\langle\text{REF}\rangle/\langle\text{INT}\rangle\rangle/\langle\text{ORin}\rangle<\text{CONECTORS-IN}\rangle/\langle\text{ORin}\rangle<\text{INP}\rangle/\langle\text{REF}\rangle/\langle\text{INT}\rangle\rangle/\langle\text{Ain}\rangle<\text{CONECTORS-IN}\rangle/\langle\text{ORin}\rangle<\text{INP}\rangle/\langle\text{REF}\rangle/\langle\text{INT}\rangle\rangle/\langle\text{IN}\rangle/<\text{INT}\rangle/<\text{Ain}\rangle<\text{CONECTORS-IN}\rangle/\langle\text{Aou}\rangle<\text{CONECTORS-OUT}\rangle/<\text{PROD}\rangle/<\text{INT}\rangle/<\text{ORout}\rangle<\text{CONECTORS-OUT}\rangle/<\text{Aout}\rangle<\text{CONECTORS-OUT}\rangle/<\text{ORout}\rangle/<\text{Aout}\rangle<\text{CONECTORS-OUT}\rangle/<\text{OUuou}\rangle<\langle\text{PROD}\rangle/<\text{INT}\rangle\rangle/<\text{CONECTORS-OUT}\rangle/<\langle\text{PROD}\rangle/<\text{INT}\rangle\rangle/<\text{CONECTORS-OUT}\rangle/<\Omega\rangle

PROTOCOLS \(\rightarrow\) \langle P-inp\rangle/<\text{P-prod}\rangle/<\text{P-inf}\rangle/<\text{P-ref}\rangle/<\Omega\rangle
  \(\text{P-inp} \rightarrow \text{p-inp}\langle\text{P-inp}\rangle/\Omega\)
  \(\text{P-prod} \rightarrow \text{p-prod}\langle\text{P-prod}\rangle/\Omega\)
  \(\text{P-inf} \rightarrow \text{p-inf}\langle\text{P-inf}\rangle/\Omega\)
  \(\text{P-ref} \rightarrow \text{p-ref}\langle\text{P-ref}\rangle/\Omega\)

TRANSITIONS \(\rightarrow\) \langle TRAN-C\rangle/<\text{TRAN-S}\rangle/<\Omega\rangle
  \(\text{TRAN-C} \rightarrow \langle\text{SINC-C}\rangle/<\text{TRAN-C}\rangle/<\text{SINC-C}\rangle/<\text{TRANS-C}\rangle/<\text{SINC-C}\rangle/<\text{SINC-C}\rangle/<\text{TRANS-S}\rangle/<\Omega\rangle\)

SYTEMS \(\rightarrow\) \langle sistema\rangle/<\text{SYSTEMS}\rangle/<\Omega\rangle

PROCESSES \(\rightarrow\) \langle PROC-C\rangle/<\text{PROCESSES}\rangle/<\Omega\rangle

The semantics of each element of the language are described below.

3.2. The Governing Dynamics of the Language

The governing dynamics of the language describes the behavior specification of the following elements (Gattaz, 2010).
3.2.1. VALUE
The possible values are the inputs/values to be added, outputs/values added, reference values, infrastructure values (roles of human resources, environments, technologies and tools) described as follows. Any Value is composed by two lists.
   a. values to be added: those input differences or weaknesses which are intended to be transitioned;
   b. added values: the output differences of a transition or transformation/action results intended to be obtained;
   c. reference values: the directions, guidelines, laws, norms, bibliographical references, opportunities, threats to respect, to deviate, to be obeyed, or to be followed in a transition;
   d. infrastructure values: competences in which roles of human resources, environments, or technologies are needed to perform a transition to produce an added value with its necessary tools;
   e. intermediate values: all possible values excluding output of a transition and input to another or the same transition.

3.2.2. TIMER
   a. It is a temporizer to model periodic events or events that occur at a specific time.

3.2.3. CONNECTORS-IN
   a. Input_AND allows multiple input value flows to be joined and all inputs are recognized and synchronized by a transition;
   b. Input_OR allows multiple input data flows to be joined, but allows only one input to be recognized by a transition.

3.2.4. CONNECTORS-OUT
   a. Output_AND allows multiple output value flows to be joined but only one of the flows is to be followed;
   b. Output_OR allows multiple output value flows to be joined at the same synchronicity and all the flows are to be followed.

3.2.5. PROTOCOL
   a. Input Protocol associates input values and transitions. Once a transition is performed, the input values are “reset” to indicate that they have been consumed and need to be produced again before they can be used by that transition again;
   b. Output Protocol associates output values and transitions. Once a transition is performed, the output values are “reset” to indicate that they have been consumed and need to be produced again before they can be used by that transition again;
   c. Reference protocol associates a reference value and a transition and once the existence of the reference value is established the synchronicity is validated for all times required to perform the transition;
   d. Infrastructure Protocol associates an infrastructure resource value to an activity or a tool to explicating an added value;
   e. Timer Protocol associates a timer as input to manual and automatic simple activities. Timers send their input at a specified time or at intervals determined by the timer attributes and the system clock.
3.2.6. TRANSITION
   a. **Simple Transition** is also known as a manual simple transition. This represents the decision making and actions to take when the transition is performed;
   b. **Automatic Simple Transition** is also known as a natural or mechanical automated simple transition. This represents the automated decision making and actions to be taken when the transition is performed;
   c. **Composite Transition** represents a complex transition which composes any kind of transition including its own kind.

3.2.7. PROCESS/COMPONENT
   a. **A Simple Process/Component** is an ill-structured network of interactions among all the elements specified above in this section. The interactions among all Transitions are legalized only thru Values and the interactions among all Values and other elements are legalized only thru Transitions.
   b. **Composed Process/Component** is a network of processes/components.

3.2.8. COMPLEX SYSTEM
   a. **System of Interactions among values** in which the sum of all its parts/components is not enough to explain it is centered on the result of transformation transitions, defined by the synchronisms of the interactions among values to generate or compose a common result. It satisfies the Principles described in the section 2 of this paper.
   b. **Contextual System** in which its dynamics are context-dependent and it is centered on an indivisible unit of interest.
   c. **Retraceable System** allows the dynamic traces and slices of values which reflects the common result of the system.

4. The VBPMN Framework

The architecture of the Value based Business Process Management Network is depicted in the Figure 1 below.

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**Fig. 1** Value Based Business Process Management Network.
The Business Process Network is a virtual bus to share Values with their own interfaces and process generators thru encapsulated fingers (communication, interface, content and platform protocols). This is realized by the Emulators and Synthesizers when managing the required adaptations of the process network from the business context. According to the current literature the only set of tools based on values is the P3tech tools – PArchitect (Modeler, Simulator, Fingers Encapsulator and Synthesizer) as depicted in the Figure 1 above. These tools implement the syntax and the semantics of the VBPMN language shown in session three of this work. All the work available in the literature are models based on functional activities and events which cannot solve problems of synchronization of valid values generated by the business network agent. Also this does not allow multiple protocols within the same component decision among other complex network problems.

The methodologies to solve complex network problems are based on research action approaches since their governing dynamics are context dependent. A process reality intelligence method – PRIMETHOD – is depicted in Figure 2. The problem resolution is based on differences which may require a change, a value to be added, and are abstracted from reality. These differences are modeled, simulated, emulated and synthesized using the VBPMN presented in section 3 and the principles in section 2 of this paper.

![Process Reality Intelligence Method (PRIMETHOD).](image)

5. Contributions

A value based approach for process network management shows the possibility to generate traceability, interoperability, synchronization among different and conflicting contexts. The other activity, functional and event based approaches, do not make it possible. In the value based approach, a value change or value added is the interface to a transition, so multiple transitions may share the same value and the lack of synchronism among transitions is detected. These findings contribute to the design and process science as well as with the software engineering when facing with lack of harmony in complex cooperation network. Future research avenues should be explored with the knowledge.
acquired by the VBPMN, the metrics of Alignment and Efficacy, Work Effort for Changes, Productivity, Synchronicity, Parallelism, Inclusion, Traceability and other measures will help one to develop management criteria and mechanisms to guide the process network co-evolution.

6. References


