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Cross-Functional Operations Modeling as a Nexus of Commitments: A New Approach for Improving Business Performance and Value-Creation

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Abstract

Business processes have played a central role in improving enterprise performance. These improvements have taken place through the implementation of maturing processes with enterprise resource planning systems and the redesign of operations by using business process management methods. However, even in those organizations that have benefited from these practices, performance problems still persist. In particular, operations that go across the enterprise are a cause of bottlenecks. While this topic has been the target of models and consulting methods, performance shortfalls still persist, thus showing that organizations have not dealt with this integration challenge successfully.

The integration problem is about the main processes in an enterprise that go across different functions and competences. Each of these processes has the purpose of delivering well-defined *business outcomes.* These *business outcomes* are modeled as *deliverables* available at the different stages of evolution of a core *business value subject* (BVS). BVSs' are the key subjects that the organization has to deal with and consequently, they are an essential part of the modeling approach. Each BVS is endowed with a partially ordered set of key *commitments* exposing the deliverables that are simultaneously needed and other specific agreements among the responsible role-players. Thus, a *commitment* is an organizational "contract" in the sense that it defines the set of business conditions and deliverables agreed upon by the responsible *role-players* as being essential to ensure progress of the BVS in the pursuit of the sought outcomes. When a *Commitment is* met and completed, the evolution of the involved BVS reaches a fundamental *business milestone,* i.e., a 'check-point' where evidence of value is verified as originally committed, and gets measured through cost, quality and other significant *performance indicators* for decision-making and monitoring.

The notion of *Nexus of Commitments* across a family of BVSs' is then introduced as a governance mechanism for ensuring visibility and value-creation. The set of *commitments* associated to a BVS has a natural ordering defining its desired evolution and thus, captures functional dependencies across the involved deliverables. These dependencies may include deliverables from other BVSs', thus extending the nexus across an entire web of BVSs'. Finally, *capabilities* and other elements in a *Resource-based View* of the enterprise are the necessary enablers to ensure the specific evolution of each individual BVS between consecutive *milestones*.

This model of the enterprise operations departs fundamentally from workflows, cases, and other behavior-centric modeling principles. We also relate this model to other practical contributions in the context of the broad lean six-sigma techniques such as value-stream mapping (VSM) and SIPOC, as well as the fields of business process management and the resource-based view of organizations.

In this paper, we address the foundational principles, formal definitions, and some examples. We introduce the main model by using some real-world examples and also, present a rigorous formalization under the form of a metamodel. In addition, we present an Information System realization of the model with the goal of providing a business visibility and performance management instrumentation. In companion papers in this series, we also present some field evidence obtained through practical cases in different organizations.

1. Introduction and Motivation

The operations we are concerned with are typically characterized as a family of business activities involving different line-of-businesses (LOBs) in an enterprise. At times these operations have been called *value-streams* [**Martin,** 1995] and in other cases, just simply *business processes*. At a high-level, these cross-LOB operations are often characterized with "from-to" English constructs, indicating the beginning and end of a larger set of "stages" that an organization goes through in pursuing a significant or valuable outcome. Examples of such constructs commonly used by business specialists and consultants are "order-to-cash", "opportunity-to-cash", "cost-to-payables", "procure-to-pay" and so on. An important feature of these broad operations is that the main outcomes being pursued may serve any significant stakeholder of the enterprise (internal to the organization, such as employees) and also external such as clients and providers. For example, "applicant-to-employee" and "procurement-to-pay" are both critical operations and involve work across functions to produce key outcomes affecting employees and providers as fundamental enterprise stakeholders [1].

The modeling of business operations has attracted a great deal of attention from different communities of practice and scholars for several decades. In particular, Business Process Management (BPM), i.e., the analysis, design, implementation, optimization and oversight of business processes, has emerged as an area of multidisciplinary study and applied work [**Van Brocke,** 2010]. The growing market interest around BPM experienced in the past couple of decades comes from the need to reduce enterprise operating costs through process automation and optimization, achieve more quality of common operations by following best-practices and increase business performance across an enterprise [**Gartner**, 2008; 2012]. The BPM literature enjoys contributions from several domains of research such as economics, social sciences, engineering and computing but most of the field activity relates to automation through information systems. In fact, Enterprise Resource Planning (ERP) systems are an outstanding example of business process deployment and they have been adopted by the vast majority of large enterprises. Very recently, comprehensive methodology and experience around BPM as a value-driver discipline in organizations was reported [**Franz et al,** 2011; **Franz,** 2012], process architecture work recently addressed business analysts [**Miers,** 2009] and vivid position papers on potential failures in past BPM research as well as discussions about the need for new research directions [**Olbrich**, 2011], [**Fleischman,** 2011], [**S-BPM Conferences**]. These activities show that the field continues to advance through new practical methodology and find inroads toward more effective modeling of business operations.

In spite of substantial value-stream analysis work, numerous BPM systems and consulting activities (**[Atmaca,** 2011], [**George**, 2004], [**Smith,** 2006], [**Lee,** 2011**],** [**Johnston,** 2012], **[Franz,** 2012]**)** organizations continue to struggle with performance problems originated in large cross-functional operations. As stated in [**Barjis,** 2009], key challenges in enterprise business process modeling are to capture complex inter-departmental and organizational processes, and to integrate different perspectives on the operation of the enterprise. Even

[1] In many cases of practical importance, these value-streams involve role-players and work that are external to the boundaries of the enterprise or firm, such as Procure-to-Pay. For the modeling to be carried out in this paper there is always an internal role-player that has accountability for any result or outcome coming from interactions with other external parties such as customers or providers.

those enterprises that have gone through the deployment of Enterprise Resource Management systems and other industry-specific packaged applications still face lack of visibility of how the 'pieces come together' to deliver intended performance results. A recent survey carried out by business analysts confirms this situation and identifies root causes that are closely related to the scope and motivation of our work [**Kennedy**, 2011]. While levels of maturity may be different across firms and industry variation affects the specific nature of cross-enterprise processes, the challenges of integrating operations are commonplace. This problem is not new and has been the target of many models of operations, improvement methods and management practices in the last several decades [**Davenport** 1993], [**Weske**, 2007]; [**Hammer,** 1993]; [**Van der Aalst** 2003b], [**George,** 2004], **APQC**]. In part, this deficiency can be explained by the fact that modeling cross-enterprise processes as flows of tasks, decomposing value-streams into activities, viewing the firm through resource-based models and other related approaches are not sufficient to express and resolve the main issues faced in the integration of cross-enterprise operations.

In spite of sustained progress through several decades of academic and industry work, the BPM field still struggles with some basic modeling challenges. In particular, there seems to be a need for a common definition of the term "process" [**Sanz**, 2011]. In part, this ambiguity is due to the great variety of disciplines dealing with processes and contributing to its advancement. The fast pace of growth in the last couple of decades and also the multidisciplinary nature of the technical field originated some divergent point-of-views and also created some confusion on basic semantics.

In an extensive and seminal investigation, [**Van de Ven,** 1992 the author proposed to "*reduce the confusion*" (sic) by distinguishing between three meanings of process, namely, (1) a logic that explains a causal relationship between independent and dependent variables, (2) a category of concepts of variables that refers to actions of individuals or organizations, and (3) a sequence of events that describes how things change over time. In fact, Van de Ven's work went a lot deeper and addressed these concepts in the context of one of the most complex and critical types of processes in organizations, i.e., the strategy process. The depth of Van de Ven's classification reveals the foundations underlying most definitions of a business process. In spite of having been published two decades ago, this work has gone unnoticed in most of the BPM literature [**Toussaint et al,** 1997], [**Aguilar-Saven,** 2004], [**Ould,** 2005], [**Ko et al,** 2009], [**Recker et al,** 2009], [**Trkman,** 2010], [**Gartner Report,** 2012]. [**Craggs,** 2011].

In agreement with DEMO [**Dietz,** 2006; DEMO], we also believe that the operating principle of organizations is that human beings enter into and comply with *commitments* regarding the establishment of things. Furthermore, for the performance issues arising from the disconnection across complex operations, these commitments occur in complex patterns as the result of combining different streams of work and a variety of roles in organizations. In that sense, our approach is situated at a higher level than a coordination act involving two actors (i.e., the *initiator* or client and the *executor* or producer, in DEMO terminology). In our approach, the *nexus of commitments* which organizations enter into are the key milestones toward achieving desired outcomes. These commitments capture the essential understanding, expected conditions and explicit prerequisites for completion that key responsible role-players agree as being fundamental for the organization to progress toward achieving a desired result.

Another important trend in the operations modeling literature is the Information Engineering notion of *entity life-cycle* [**Sanz**, 2011], [**Sanz-Nandi,** 2013]. Entity life-cycle has been shown as a useful information-centric concept for designing complex workflows and cases [**Nandi et al.,** 2010]. The notions of *states* and *control rules* that allow an entity to go through these states, bifurcate and loop closely resemble the traditional principles characterizing *state machines.* Indeed, in the tradition of business process modeling, life-cycle is synchronous and transitions between states are about conditions defined as data-level check-points. This approach to process modeling has some important touch-points with the early work done in the data-base tradition: the identification of "significant" entities results from an aggregation of fragmented data chunks into a single data object. Processes models result from modeling the life of such *entities*. These concepts, well-known and documented for several decades, provide some important unification concepts to BPM, including families of processes not covered by conventional BPM systems, such as those in Case Management [**Sanz,** 2011].

While readers familiar with entity life-cycle modeling may find some commonalities with the approach presented in this paper, it is important to state that the contexts and objectives at play in both modeling approaches are different. Unquestionably, organizations seldom work by following the synchronization dictated by a state-machine. In fact, none of the cross-functional operations where performance problems occur are nearly well-represented by a flow of tasks. While entities go beyond just *things* and include conceptual abstractions of those typical *objects* present in an organization, business operations deal with more complex *subjects* [2]. Furthermore, typical *subjects* organizations deal with exhibit a much deeper form of evolution in its life-cycle than the one captured by simple artifactual representations. In some cases, *subjects* reflect conventional entities in the tradition of Jackson, Ould and other more recent authors [**Nandi et al**, 2010; **Sanz,** 2011] and examples of such *subjects* are well illustrated by "Order" or "Order Item". In other situations, *subjects* capture a much deeper notion of value being modeled in the organization, as it is the case of "Customer Relationship" in the telecommunications industry or "Compound Testing" in the pharmaceutical industry. Indeed, "Customer Relationship" and "Compound Testing" are major *value subjects* and their descriptions and evolution are much more involved and richer than a bundle of states of a simple information entity.

The business operation modeling we propose helps prescribe change through better value-creation processes and the identification of performance bottlenecks. But it is not about a modeling technique for processes in the common Computer Science meaning of the activity, i.e., workflow modeling. Furthermore, our approach departs from the tradition of Computer Science work also in the sense that we do not expect our models to "run" or "execute" in any information technology system. We regard cross-functional operations as forms of *coordinated commitments* across multiple organizations involving well-identified role players, valuable deliverables and measures that define expectations and goals in clear qualitative or quantitative forms. The purpose of modeling an operation is not always its automation by information technologies. Analyzing and optimizing enterprises also requires good models whose adequacy ultimately depends on the specific goal at hand. While such a modeling exercise may not necessarily yield anything "executable" by a computer, it may still offer a powerful foundation for analyzing business performance.

[2] These *subjects* could also be called *subjects* but we prefer the former term because *subject* has been used recently to emphasize specific actors participating in a process such as in the Subject-BPM work [**S-BPM Conferences**].

The organization of this paper is as follows. In Section 2, we present a summarized version of the new modeling approach and some examples to illustrate the main concepts. In Section 3, we discuss an abstract metamodel to provide a more formal description of the model proposed. In Section 4, we present the early ideas of an information system for business visibility and performance management whose business requirements are captured by the operations modeling introduced in Section 2. Finally, in Section 5 we discuss related work and other techniques with which the modeling approach presented in this paper has some important touch-points. In a companion paper of this series, we will present several case-studies showing the application of the new approach in several cross-functional operations yielding substantial performance improvements or more focused efforts on value-creation.

2. Description of the New Approach

Modeling operations in an enterprise is usually a complex endeavor. Thus, it is important to choose those elements that matter for addressing the specific problem at hand while keeping abstractions simple. In our experience, the root of the performance problems and loss of value-creation opportunities in cross-functional operations is that enterprises lack enough *visibility* of what is happening across complex inter-divisional work. This visibility challenge is not new and has been recognized as a significant hindrance for value-creation. At times, visibility has gone under different names. In a recent book [**Franz,** 2012], the authors use the term *transparency* to denote the need for an organization to *see* the relationships between people, processes and technology as a vehicle for a better optimization. The goal then becomes one of modeling those aspects of the operations that are necessary to address the performance challenges and enhance value-creation capabilities. The new approach presented in this paper hinges upon a simple way of modeling such cross-functional operations with the intent of making them more visible to all involved stakeholders.

The words "operation" and "process" may be used interchangeably in this paper, but with a caveat worth clarifying. The work that an organization does in typical cross-functional operations is usually much more involved that a linear sequence of tasks. Our goal is then different from "process modeling" as understood in the tradition of most Computer Science contributions in which process is a synonym of workflow (see [**Van der Aalst,** 2001; 2003a; 2003b], [**Sharp,** 2001] among many others). As we have stated in Section 1, the word "process" has been overloaded in both academic and professional communities and confusion still persists about its meaning [**Sanz,** 2011]. This trend is confirmed with different announcements of Case Management systems from the Information Technology industry, including the needs for "adaptation", i.e., a "case" comes to address organizational work in which a flow does not do the job or simply makes the understanding of the intended model semantics impossible.

The byproduct of this legacy from different disciplines is that several interpretations exists today of the meaning of process. We adhere to the definition from Van de Ven whereby a process "… *takes an historical developmental perspective, and focuses on the sequences of incidents, activities, and stages that unfold over the duration of a central subject's existence*". This definition is deep and quite inspiring. Van de Ven states that process is the *development* of a central *subject* [3] describing its *existence* along a sequence of unfolding *stages*. This concept is clearly much broader than reducing a process to a workflow [**Dietz,** 2011], Petri Nets [**Van der Aalst,** 1998], cases [**De Man,** 2009], [**Swenson,** 2010] and so forth. Admittedly, other researchers whose work lies at the confluence of Engineering and Social Sciences also remind us that "process" is much more than a "flow". Indeed, this observation has been brought up in Enterprise Engineering work and related multidisciplinary schools, as documented in [**Dietz**, 2006; 2011].

A central concept in our modeling approach is the coupled notions of *Subject-Commitment.* The notion of *subject* is inspired by the concept of *subject* or "*substance*" as treated in the metaphysics of process. The term *subject* captures better the inseparable notion of "*things*" from "*things in the making*", the latter being preferred in process metaphysics and chosen by advocates of a process-view of the world [**Rescher,** 1996], [**Hernes,** 2010]. For the purpose of our modeling approach, a *subject* is an essential leit-motif that brings different pieces of an organization to integrate their work together. This concept is general enough so that it can be applied to different levels of operations modeling and thus, the proper choice of granularity will depend on the objectives at hand. In other words, there may be many different *subjects* that matter in an organization and examples range from significant aggregates of business concern such as "Customer Problem", "Work Order", "Claim Form", "Drug" and "Compound Pipeline", "Service Request" to others of less significance in value-creation like "Ticket", "Receipt", "Coffee" (particularly if the organization is not in the business of selling or making tickets, receipts or coffee).

The concept of what specific *value* is being pursued by having the enterprise deal with a specific *subject* serves as a filter for such a wide family of options. As we are dealing with performance problems at the enterprise level, we focus on such value-creation at a broad inter-LOB level of concern. Thus, significant *subjects* for the purpose of modeling and analyzing core operations are found by searching value-generation across operations in the enterprise. Any statement of "value" is obviously relative to the problem being addressed and this is why we remind ourselves about this imperative context by also using the term *business value subject* (BVS). **BVSs are the main *subjects* that an organization needs to deal with and evolve in order to produce the necessary outcomes that drive value for the enterprise**. A given inter-LOB operations and scope can be described by a *set* of such interacting BVSs'. **We call such a complete set as the *Business Value Model* (BVM).**

It would be worthwhile to discuss BVSs that are *routine* from ones that are *value-driven. Routine* BVSs are commonly known and well-understood domain terms and more than likely have an existing physical representation (e.g., a document, a form, a database table etc.). *Value-driven* BVSs are more conceptual, driven by significant business outcomes. To illustrate, consider a Marketing Operations looking to improve customer retention. One of the obvious *things* to analyze would be customer "Complaints" and work towards reducing the same. However, over the long run the relationships an organization establishes and nurtures with its customer is probably the best harbinger of customer behavior (thus identifying and resolving possible retention issues proactively). What is the key *subject* the operation should take care of in this case? It is the 'Customer Relationship'. Marketing

[3] We will always use the term "*subject*" in the sense of "*subject matter*" unlike other BPM literature where the word means an agent that realizes an action [**S-BPM Conferences**].

Operations will look to evolve and monitor the 'Customer Relationship' (one customer at a time), agreeing as a team on the evolution Commitments and using that as a central basis to drive operational activities and decision making. Returning to our initial point, the 'Complaint' is an example of a *routine* BVS, whereas the 'Customer Relationship' is that of a *value-driven* BVS. Let's consider another example from Manufacturing Operations – the process of bringing a change to an existing Product. In simple terms a Product change is delivered through the addition or update of a set of Parts. The obvious choice for the BVS would be the 'Part' that is (re)designed, purchased/manufactured, and assembled into the new version of the Product. However, considering the 'Change' (noun) itself as the BVS, provides an unique perspective to first get an handle over this complex operation[4] and secondly, to drive immediate insights to the effectiveness of the organization to drive value (by managing the Change lifecycle as it evolves from being *Identified* (defined), *Analyzed* (root cause), *Solution Confirmed* and finally to *Implemented*,). Needless to say, the 'Part' is an example of a *routine* BVS whereas the 'Change' of a *value-driven* one. Although, we need both types for the precise modeling of the domain, but we envisage and propose *value-driven* BVSs as foundations for the next generation process architectures, simply because they provide the natural bridge between business outcomes with organizational processes.

Thus, operations across different LOBs in the enterprise can be represented as the progress or evolution of one or more BVSs toward a desired end while producing a number of valuable *deliverables*. The conclusion of such progress signals that the development of the BVS has reached its final state and desired results produced along its entire evolution should be available. Central to the progress of a BVS is the concept of *commitment*, inseparably from a BVS. A *commitment* is defined as a specific set of available *deliverables* and related *agreements* that involved stakeholders take responsibility to provide for a BVS to accomplish an incremental evolution from a previous stage. *Commitments* can be conceived as an organizational understanding or a weak form of "contract". When *commitments* are met and completed, the BVS is said to have reached a significant *milestone* in its development. In short, the common enterprise pursues across LOBs should be expressed into some form of BVS development established by the organizations in the form of a *nexus of commitments* across responsible role-players.

For example, "Requisition" is a BVS in a model of Procure-to-Pay operations. "Sourced" is an essential *commitment* in "Requisition", i.e., an understanding among involved role-players in the organization delivered when all items in a request have been adequately sourced according to suitable policies. Likewise, "Products Identified" is a typical *commitment* for the "Customer Problem" BVS. This *commitment* is met once all involved products (owned by the organization or third party) have been identified as involved in a client complaint. More details on these examples can be found in Figures 5 and 9.

We occasionally use the terms *commitment* and *milestone* interchangeably. The reason for caution is that the word "milestone" has been overloaded heavily in traditional process modeling techniques and also in related tools. Our specific concern is the fact that the meaning of "milestone" as used in some of the extant literature is not the one we are using in this paper. As an example, "milestone" was used in [**Hull,** 2011] to denote a bundle of tasks that need to be carried out strictly between a given starting point and an end point. On

[4] Managing a change for complicated products (eg. an automobile) involves substantial amount of time, effort and resources.

the contrary, our *milestones* are not ontologically speaking a collection of verbs (or activities to execute).

The concept of *outcome* is another important upper-ontology construct for business architecture (see, for example, [**McDavid,** 1999]) relevant to our modeling approach. *Outcomes* represent the visible byproducts of value-creation from the evolution of a BVS. *Outcomes* in a BVS should be understood as the set of all *deliverables* involved across all its *commitments.* For example, in the Plan-to-Production operations, "Plan" is a BVS. The first *commitment* in the evolution of "Plan" is called "Market Planned". Key *deliverables* defining this stage are "Business Plan", "Forecast", "Demand and Volume-driven Mix" and "Planning Horizon". These deliverables are of essential value for the organization because they are critical (in addition to "Supply Plan" whose provisioning is external to the BVS under consideration) for building an overall Production Plan. Notice that these *deliverables* need <u>all</u> to be available as part of the <u>same</u> "Market Planned" *commitment* for declaring such a *milestone* in the evolution of "Plan" achieved. In some cases, the main outcomes of a BVS are found within the deliverables of the last *commitment* in its evolution but this is not necessarily always the case as intermediate *deliverables* may also sustainable value beyond the main objective of BVS being reached at its final stage.

While an *outcome* does not necessarily need to be artifactual, it will be practical to assume, given the goals of our modeling, that the 'results' obtained from the evolution of a *subject* can be represented with some form of information recording the essential characteristics achieved through the BVS development. Unquestionably, this representation is quite limiting if compared with the depth of all cognitive transitions experienced by an organization in dealing with a subject (or alternatively, also called an *issue* in the language used by Van de Ven in his seminal strategy process studies [**Van de Ven,** 1992]). But the need for maintaining evidence of such cognition in those cross-enterprise operations targeted by our modeling approach makes the artifactual representation necessary. For example, the *outcomes* of the BVS "Customer Problem" are a family of *deliverables* in the form documents including the history of the customer report, specific actions taken by one or more LOBs, and *agreements* about the corrective changes needed in the process of managing the problem, and other organizational understanding about a successful or negative conclusion in the management of the problem.

A very important feature of the BVS-Commitment construct is that the set of *commitments* in a BVS development takes place by following some well-defined order. This is quite natural since BVS progress implies that certain additional changes are needed for a subject to evolve or mature from an existing stage to the next one. This requirement resonates very well with the concept "*…stages that unfold over the duration of a central subject's existence*" from Van de Ven [5]. But the BVS-Commitment model goes further by imposing that the progress of a *subject* always "moves forward", i.e., all *Commitments* are visited only once. While this condition may appear restrictive, it represents well the typical cross-functional operations being studied. Other deeper cognitive operations such as strategy processes may require a more complex type of progression but this topic goes beyond the scope of our paper.

[5] It is important to remark that our model characterizes a stage in the evolution of a subject in terms of the outcomes and agreements that the organization will need to accomplish for such a stage to be completed. This means that our focus is on the outcomes and agreements and on not the specific activities / tasks that the organization pursues to transition from commitment to commitment.

The order established in the set of *commitments* is defined by *functional dependencies* across the *deliverables* in consecutive *commitments.* In Figure 1, we show a graphical notation with a simple example of a BVS with two *commitments,* X and Y. The black *arrow* from X to Y means that the achievement of Y cannot happen without the achievement of X. This functional dependence is the result from the modeling principle by which at least one *deliverable* in Y must depend on one or more *deliverables* in X. For example, *deliverable* **D** in Y depends on *deliverables* **A** and **B** in X. In general, not all *deliverables* in a *commitment* need to depend on *deliverables* from previous *commitments.* For example, in Figure 1, *deliverable* **F** is necessary as part of the agreement established in *commitment* Y (and thus, in the same *commitment* where **D** is needed). However, **F** may not depend on any of **A**, **B** or **C**.

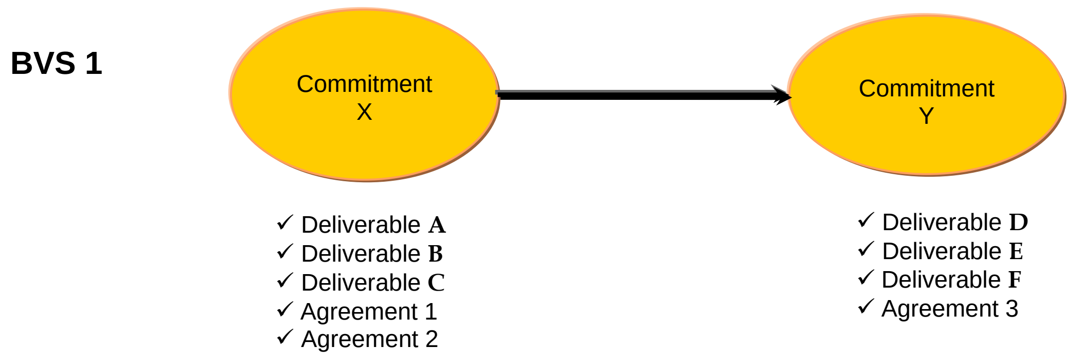

Figure 1, **Two *Commitments* X and Y in the evolution of Business Value Subject 1 and their corresponding set of *Deliverables***

We should remark that the order between *commitments* in a BVS does not imply that *deliverables* are produced through work in the organization that necessarily has to take place in that order. In other words, the actual work needed to deliver **D** may have begun in the organization earlier or later than Commitment X is met. This means that there is no work synchronization "in between" the *commitments* except for the work which depends on the availability of **A**, **B**, and **C**. Consequently, the work needed to accomplish **D** cannot complete until Commitment X is fully achieved.

This is the opportunity to introduce the other main element present in a *Commitment*, i.e., the *agreements* established among the role-players that determine the conditions of successful completion of their contract. Thus, *commitments* go beyond the sole availability of the *deliverables* and include, for example, qualitative and quantitative goals on these *deliverables*, check conditions on key performance indicators, and other organizational understanding that is necessary at that stage to determine the adequate course in the evolution of the BVS. From a modeling point of view, this means that Commitment Y in Figure 1 cannot be fully delivered until Commitment X is fully achieved, i.e., any reason for an *agreement* in X to be unmet requires resolution before Y can be declared achieved or met. From a diagrammatic point of view, the meaning of the solid black arrow connecting two consecutive commitments in the drawing of a BVS is then the result of the combination of the two semantics described above.

Given the complex nature of the operations being modeled, it is uncommon that a BVS will have an entire life independent of all other BVSs present in the model. In our experience, the case is actually the opposite, i.e., it is most common that models will involve interdependences across two or more BVSs. In Figure 2, we show a case of a *commitment* of a BVS (BVS 1) generating dependence on a *commitment* from another BVS (BVS 2). The meaning of this dependency is denoted by the same solid black arrow and thus, it has an identical semantics as above. In particular, for the example at hand, we will have **E** functionally dependent on **G** (a deliverable from Commitment C4) and **C** (from Commitment X) and in addition, Commitment Y also requires the full achievement of Commitment C4 as a necessary condition for its conclusion. However, Commitment C4 can be independently achieved with no dependency whatsoever on Commitment Y.

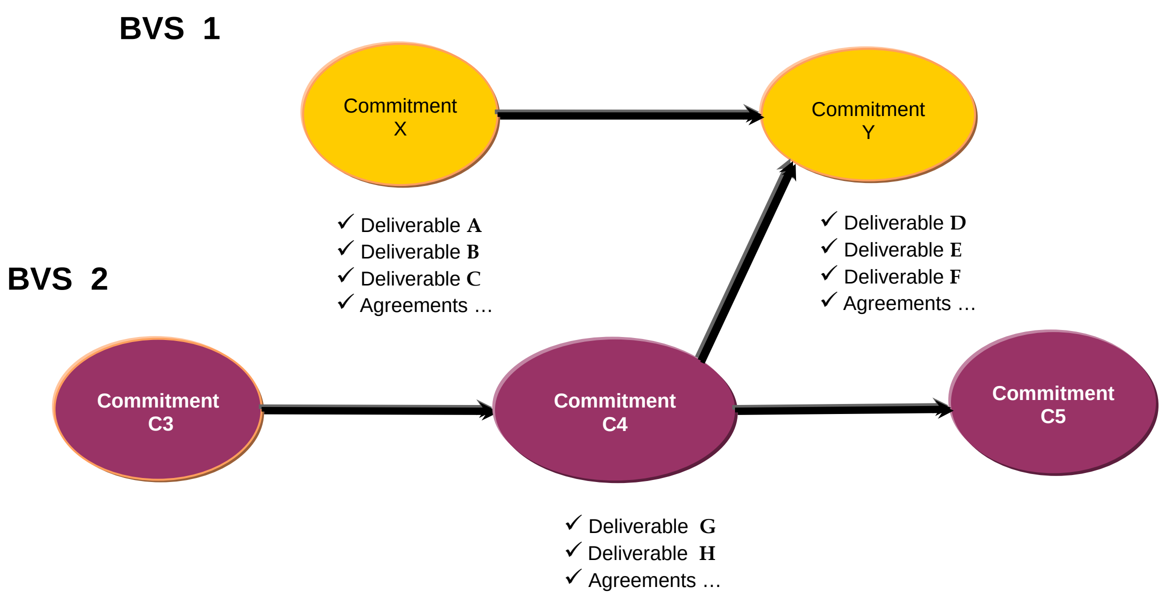

Figure 2. Two BVSs with *Commitments* linked through functional dependencies across some of their corresponding *Deliverables*

In many cases, two or more BVSs may require some additional form of *coordination* from the one introduced above. This case arises when the organization needs to establish that some *commitments* from two or more BVS have to be met all together for each involved BVS to continue along its individual evolution. In other words, the joint conclusion of all the *commitments* is a necessary condition for any further progress to occur in the individual life of the involved BVSs. This coordination, at times also called gate, is a common form of understanding across the corresponding stakeholders in an organization. This *coordination* implies the existence of some role-player that oversees the successful achievement of all involved individual *commitments* for allowing further *commitments* to be met. In simple language, one would always need to have a specific stakeholder in charge of a *coordination point.*

The term *gate* is used to informally suggest that 'all progress is on hold' in the individual BVSs involved until all *commitments* are successfully met. But it should be clear that this *gate* is not a "behavioral barrier" or "synchronization" in the sense that no further work in the organization will be done until the *gate* is cleared. Thus, we prefer the term *coordination point*. All *commitments* after a *coordination point* involve additional resources and more work done in the organization, and thus, they needed to be taken into consideration for a model that reflects the sources of delay, value being wasted or a need for visibility. As an illustration, Figure 3 depicts this case with a *coordination point* across three *commitments* Y, C4 and T2. The diagramming notation introduced includes inverted triangles on the black solid arrows and a black dotted line joining them. Notice that the *coordination point* ensures, among other things, that the achievement of Commitment Y requires Commitment C4 and Commitment T2 to be met "together". This means that individual deliverables in the Commitments can be met at its own pace, as long as all 3 BVSs reach the 3 coordinated milestones at the *same time*. However, the black solid arrow is still necessary to highlight the functional dependence of Deliverable **E** upon Deliverable G.

Before we move on to discuss the next modeling nuance, it is probably appropriate at this point to draw attention to the power of this model in enabling improved *communication* and *visibility* amongst the line of business stakeholders. Improvement occurs along 3 dimensions

- **Along the BVS**: people responsible for delivering Commitment X can now discuss meaningfully with people responsible for delivering Commitment Y. As an example, the Commitments in the evolution of the "Part" BVS being modeled to improve the Engineering Change process for a major auto OEM, served as communication anchor across multiple LOBs eg. Engineering (Part design and specification commitments), Purchasing (Part sourcing and contracting commitments), Testing (testing of manufactured Parts), QA, Manufacturing (commitments to put changed Parts on a vehicle, also known as Part Break-point) etc. Several "a-ha" moments were documented leading to barrier-breaking consensus.

- **Synchronization along coordination points**: the cross-BVS coordination points serve as formal expression of *quality gates* [6]. Work executing across the enterprise (likely, asynchronously and in parallel) will need to coordinate at these points, before proceeding further. These coordination points communicate the organization's desire to insert quality checks for the work already done (in terms of the Deliverables produced for the Commitments), get all parallel independent streams of work to synchronize, sign-off on the Commitments met as result, before proceeding further on potentially divergent paths along the separate BVSs. As an example from Product Lifecycle Management (PLM) operations, the 'Idea' BVS needs to be *Promoted,* 'Market Requirement' BVS to be *Consolidated* and the 'Portfolio Item' BVS to be *Identified* at the 'Product Kick-off' coordination point (or *quality gate*), before the 'Product' BVS can be launched.

[6] http://en.wikipedia.org/wiki/Quality_gate

- **Across variations**: different regions / service lines can now communicate effectively using a shared abstract model. They all can agree on the common set of Commitments and Deliverables/Agreements thereof at the global level, but retain flexibility to optimize how to meet the Commitments, based on local geo-specific needs and/or service line variations. For example, the "Product" BVS used to model the PLM operations for a Navigation Software vendor continued to retain the stable set of Commitments when challenged across different service lines (Aerospace, Marine, Logistics etc.) located across different parts of the world (Norway, Italy, ..)

- **Up / down management chain**: In practice, Deliverables and Agreements for a Commitment are tagged with organization of roles and responsibilities. Although it varies based on the particular need, some subset of the RASCI (Responsible, Accountable, Supportive, Consulted & Informed) are typically assigned to the Deliverables and Agreements. These roles will go across management chains eg. a Manager is likely to be Accountable, but an employee is probably Responsible. This leads to increased visibility and accountability up/down the management chain.

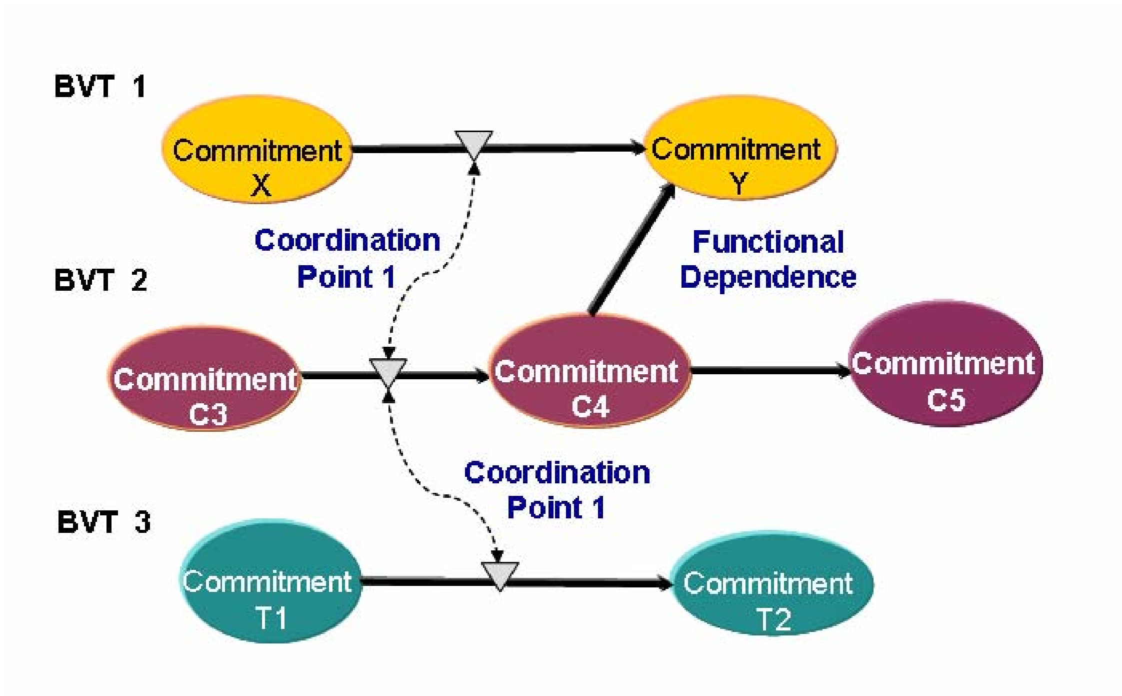

Figure 3. Three **BVSs with a *coordination point* across three *Commitments*, i.e., Y, C4 and T2**

Finally, the evolution of a BVS may be subjected to more than one path as possible options for its progress. This requires the introduction of the concept that certain *commitments* (and corresponding *milestones*) may be optional depending on actual conditions encountered in the business. These options are important for our modeling approach to the extent that they help explain potential reasons for delay in an operation. In some cases, these options are implicit and not necessary to be highlighted in the model while in other cases, the situation these options generate is critical and thus, they need to be accounted for explicitly. The latter case will be illustrated in the real-world examples presented later in this Section and shown in Figures 5 and 9.

In what follows, we will use two examples of the modeling approach to illustrate the concepts introduced in this Section. The examples deal with significant cross-company operations that arise from real-world practice in different industries. These are important value-streams expressed in the form of "from-to" operations as explained in Section 1 and are known to cause performance issues or visibility problems in organizations while offering an opportunity to enhance value-creation in the organization.

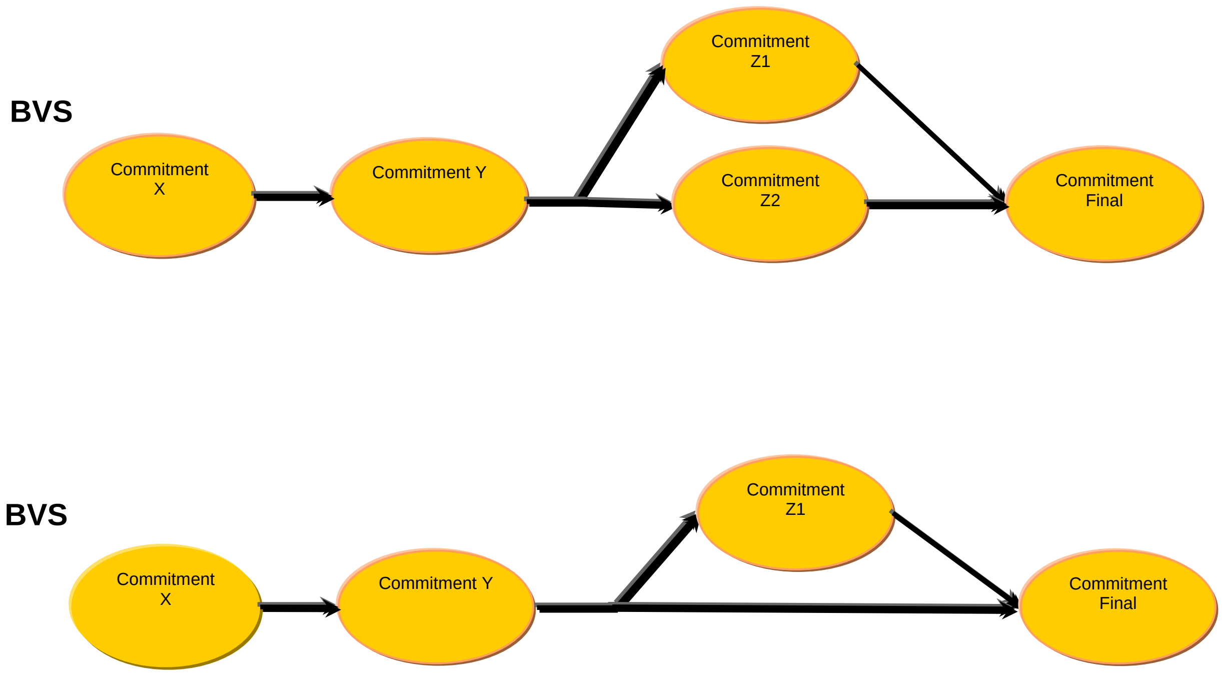

Figure 4. Two examples of a BVS with optional evolution paths. In the first case (top drawing) Commitments Z1 and Z2 are different options followed by Commitment Final. In the second case (bottom drawing), Commitment Z1 is an exception in the evolution of the BVS toward Final

The first example is **Plan-to-Production** and the corresponding model is shown in Figure 5. The business context is an automobile OEM creating and adjusting its production schedule (desired mix of automobile models and options) based on perceived market demands, supplier constraints and actual dealer orders. The overarching goal is to be able to sell what is built. Failing to accomplish this goal leads to undesired inventory and incentive levels, constrained option availability and sub-target financial results. Creation and adjustment of the production schedule is cyclic, carried out through planning cycles ranging from 6 months to a year.

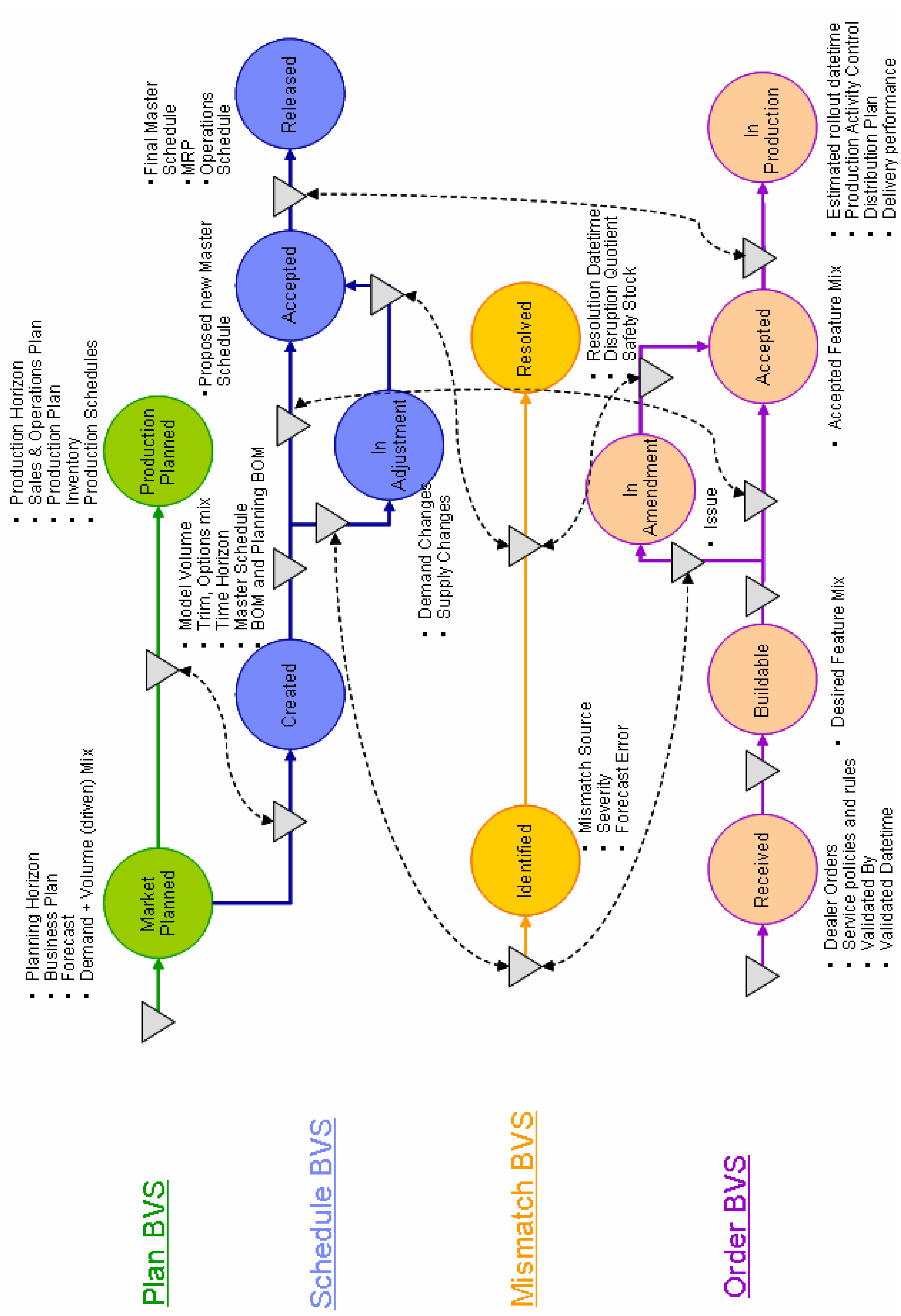

Figure 5. A BVM example for Plan-to-Production operations

In order to ensure that the progress of operations take place to satisfy the above goals, there are four Business Value Subjects representing this operational scope, namely:

- **Plan –** The Plan represents the output of the overall planning cycle. It takes into account the Demand Forecast, Volume Forecast and Supplier constraints to generate the Production Plan for a particular production horizon. The Production Plan is essentially the desired mix of models with specific features that appear to satisfy the demand/volume forecast and whose components can be supplied in time by the suppliers.
- **Schedule –** The Schedule is the set of production schedules passed to the manufacturing locations, specifying what mix of car models and options needed to manufacture at what times. It is driven from the overall Plan, but will be adjusted to match actual demand / volume as per dealer orders and change in supplier capacity.
- **Order** – The Order represents the demand from dealers. Each Order represents a Vehicle of certain model having certain set of options (leather seat, GPS etc.). All dealer Orders are rolled up and matched up with production schedule. Mismatches are resolved through negotiations resulting in adjustment to the production schedule or a change in the Orders itself.
- **Mismatch –** The core value proposition of this process is to reduce mismatches between the production schedule and dealer demands and possible market/volume changes. The Mismatch BVS tracks all mismatches to provide visibility against this KPI. Further it provides a basis for rich analysis to find ways and means to reduce the mismatch count.

Let's zoom into sections of the model, to clarify *functional dependencies* and *coordination points* introduced earlier.

<u>Commitment Causalities and Functional Dependencies along the causality chain</u>

The solid arrows from *Market Planned* to *Production Planned* of the Plan BVS and from *Market Planned* of the Plan BVS to *Created* of the Schedule BVS in Figure 6, depicts two constraints, namely,

(1) Causality in occurrence of the Commitments i.e. *Market Planned* occurs before *Production Planned* and *Created*
(2) Functional dependencies between Deliverables along the causality chain. As shown in the figure, Deliverables *Sales & Operations Plan, Production Plan* & *Inventory* to realize the *Production Planned* Commitment are functionally dependant on the *Business Plan* & *Forecast* produced for the *Market Planned* Commitment. Similarly. *Model Volume, Trims Options mix* & *BOM and Planning BOM* are dependant on *Demand* + *Volume (driven) Mix*. In the later case, the dependencies are across different BVSs.

In spite of the functional dependencies between deliverables, the same Commitment could have a mixture of Deliverables, functionally dependant mixed in with others that can be created stand-alone with no dependencies (eg. *Dealer Orders, Service policies and rules* for the *Received* milestone of the 'Order' BVS as show in Figure 7). To emphasize the points made earlier, in spite of the mixed bag, work structuring and scheduling (to produce the deliverables) can be as flexible with the goal of realizing the Commitments *just-in-time* but no later in order to maximize efficiency .

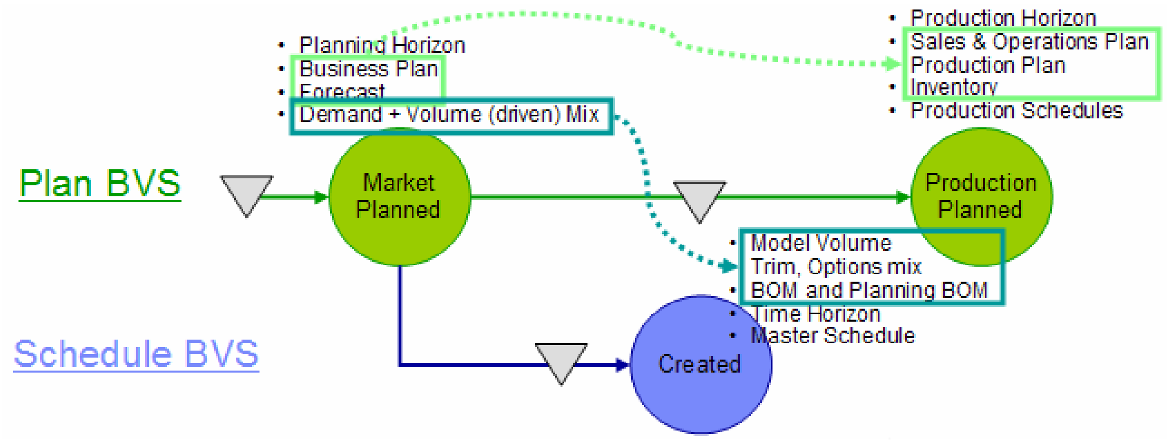

Figure 6. Detailed dependencies from BVSs involved in BVM of Figure 5

<u>Coordination Points</u>

The dotted line and double arrows connecting the inverted triangles in the Figure 5 are an example of a 3-set coordination point. It is generally the case, that there is a *lead* or *trigger* BVS at a coordination point. In this example, *Created* to *Accepted* and *Buildable* to *Accepted* are the normal evolution paths of the 'Schedule' and 'Order' BVS respectively i.e. a set of (production) 'Schedules' are being evolved to fulfill a set of 'Orders'. However, if a mismatch is identified and needs to be recorded as such, all Orders and Schedules (that mismatch) may need modifications. As such the 'Mismatch' BVS and matching 'Schedule' and 'Order' BVSs need to coordinate and together reach the *Identified, In Adjustment* and *In Amendment* milestones respectively.

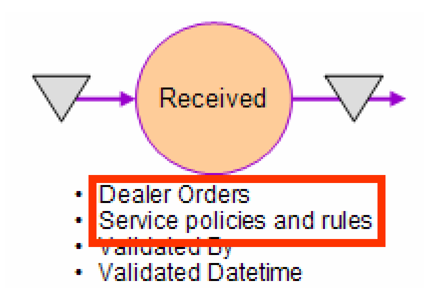

Figure 7. Receive milestone and corresponding deliverables

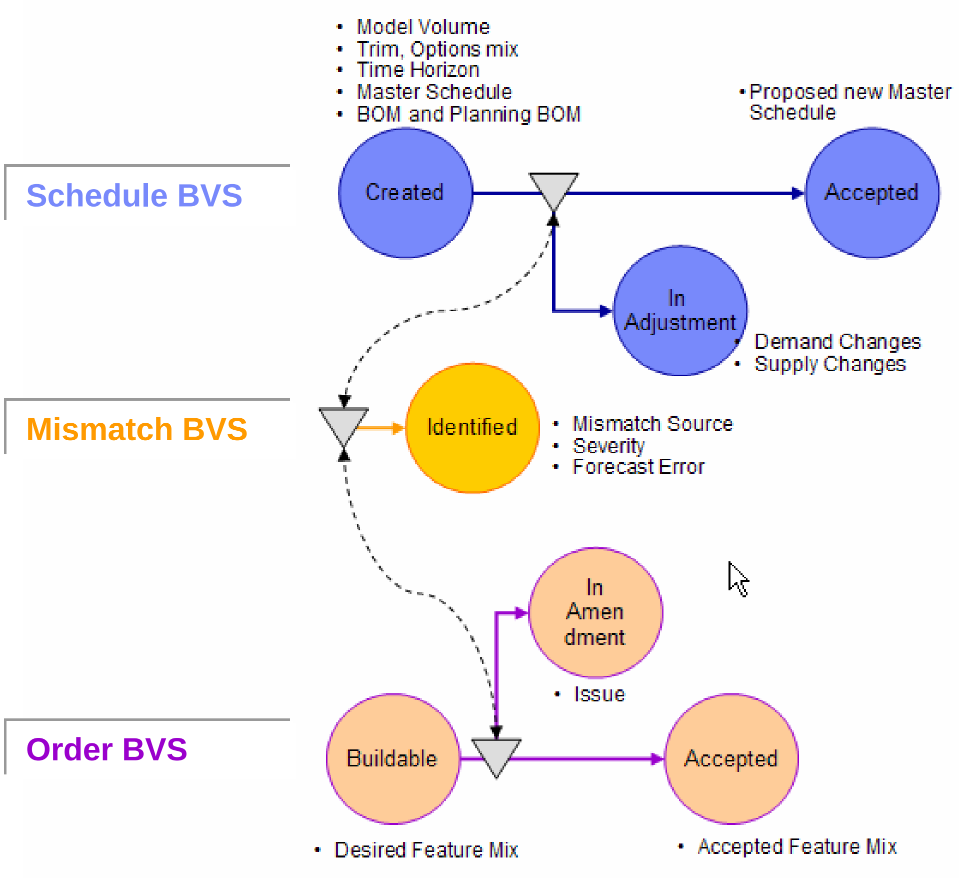

Figure 8. A fragment of the BVM presented in Figure 5

It is often the case, that although the diagram shows 3 different inverted triangles coordinating, in reality there is really a single workstream (see Metamodel in Section 3), encapsulating the coordination logic and pushing the 3 BVSs forward together.

The second example is another important cross-enterprise operation, called "Problem-to-Fix" and the corresponding diagram is shown in Figure 9. The business context is providing maintenance service for IT and related equipment in large retail stores. A typical large retail store uses a plethora of IT related equipment from a multitude of vendors in the day-to-day operations. IT related equipment is not restricted to just computing equipment, but also include item scanners, point of sale registers, printers, software and more; and all possibly from different OEM vendors. The business value from a service provider is about the provision of managed maintenance services covering all equipments under the retail company, saving the hassle to the retailer to deal with multiple OEM vendors individually. The retailer calls a single number to register a problem caused by one or multiple pieces of store equipment. The service provider registers the problem, analyzes the root cause and launches work orders with appropriate vendors and oversees the work to completion, resulting in the resolution of the problem.

The BVSs from the Service Provider's perspective are as follows:

- **Customer Problem** - This BVS tracks the customer problem from the moment it is registered at the Service Provider call center (or online) till it is finally resolved. Each Customer Problem could involve multiple pieces of mal-functioning equipment.
- **Service Request** – This Service Request BVS is the key construct at the Service Provider. This records the entitlement (as per contract) for the customer. It will track the analysis of the problem needed to route to the appropriate OEM vendors, the problem as determined and resolution options back from the vendors and finally initiate appropriate work for each vendor.
- **Work Order –** The Work Order BVS is issued against each repair vendor and is used to track vendor work as they go about fixing the problem at the customer (either on-site or in their depot). The repair vendor does not necessarily always have to be the OEM vendor. In some cases, if it makes business sense, the repair vendor could be the Service Provider itself. A Work Order could generate Part Orders if replacement parts are needed for the repair.
- **Part Order -** Part Orders track a set of replacement parts needed for repair
- **Part Order Line -** Part Order Line is the individual part (with an associated part number) sourced from appropriate vendors. Part Order Line will also track the delivery of the part (onsite or depot) and its final disposition as the result of the repair.

In closing this Section, a summary of some of the characteristics and advantages of the model presented is provided below and discussed further:

- BVS-Commitments provide the right level of aggregation in a model for business visibility and control purposes.
- The modeling paradigm is more suited to work with *business-wide or a global (company-wide) processes* as they try to establish their capabilities or agree upon common milestones.
- The models focus on Commitments and Deliverables, as such *stable* across functional groups and variations
- The introduced constructs are ideal to build a metric framework around them. Indeed, *commitments* include conditions on the deliverables for their acceptance that are reflected into qualitative or quantitative performance indicators. *Commitments* are the right spots to monitor the progress of those business metrics that matter to the final outcomes of the entire BVS evolution.
- This model can be used by other optimization techniques such as Suppliers-Inputs-Process-Outputs-Customers (SIPOC) and others for further detailed analysis work, particularly details involving the workstreams carried out to produce the deliverables in each *commitment*.

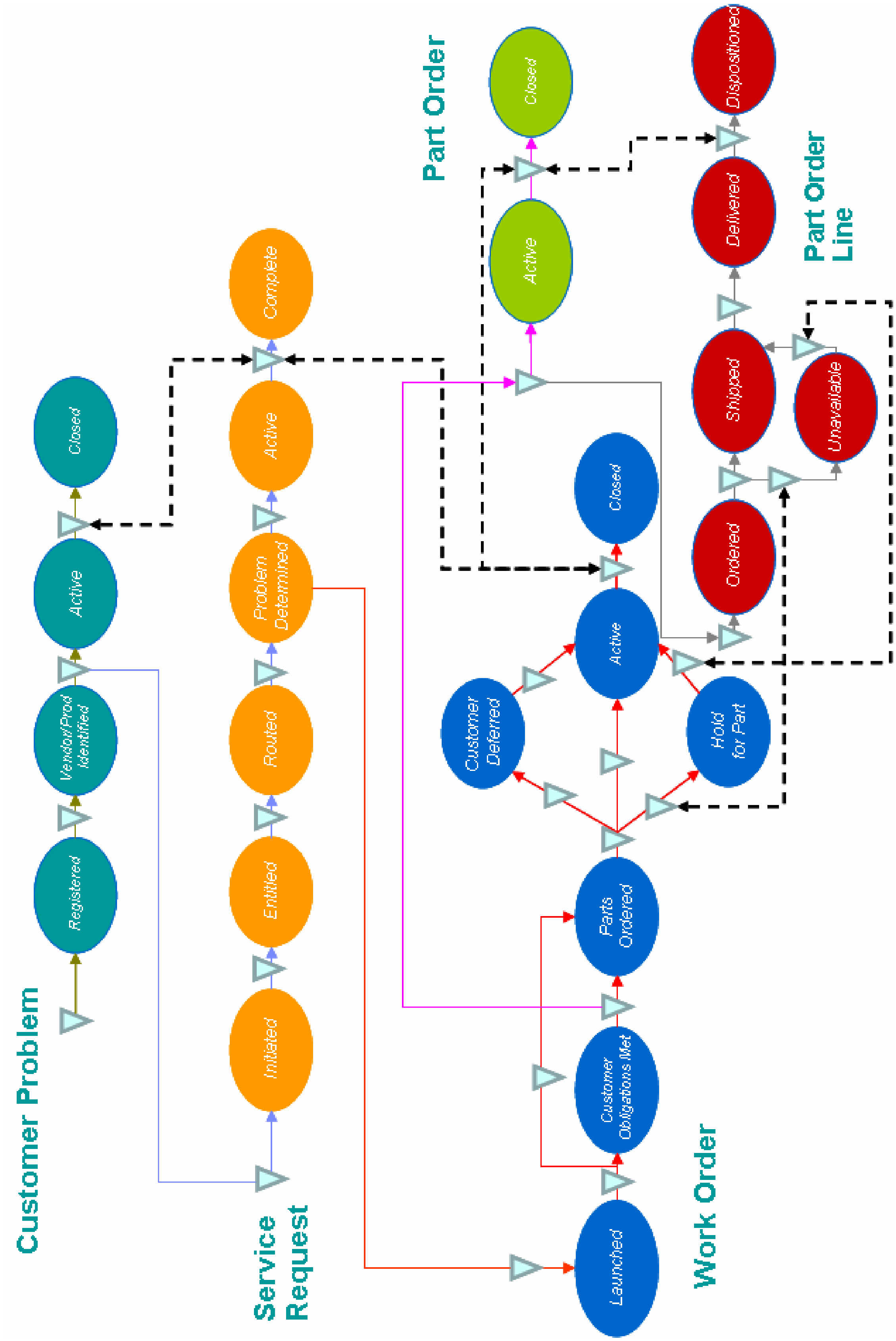

Figure 9. Problem-to-Fix BVM

- *Deliverables* in the *commitments* and dependencies across BVSs drive cross-functional coordination and collaboration in the enterprise.
- *Coordination points* provide a mechanism for identifying the spots where complex operations require to coordinate and synchronize primarily to ensure the quality of the work thus far (aka *quality gate)* and in some cases handle exceptions elegantly across functions.

3. Metamodel

The modeling approach introduced in Section 2 can be described in more formal terms through a metamodel. The metamodel presents the main concepts used in a model and key relationships across these main concepts. We use an UML notation for providing some rigor to the definition of the metamodel, i.e., the meaning of the main concepts (boxes) and the connections (arrows) linking concepts. The metamodel is shown in Figure 10. While UML has been widely used to create metamodels like the one shown here, we are conscious that UML is not necessarily a convenient language or visual notation for business researchers and practitioners. Actually, some business people find these diagrams hard to read or understand. Thus, we try to keep the diagram simple and above all, informal in terms of the specific constraints imposed by UML. Also for simplicity we add verbs in present tense or passive voice on the arrows to facilitate the understanding of semantics. Finally, the numbers on any arrow (particularly, whether 0 or 1) and the * symbol, mean that there may be none, one or more than one element of the same type as the one represented by the box pointed by the arrow associated with the concept where the arrow is emanating from.

At the center of this metamodel resides the concept of **Business Value Subject** with a name as its main attribute. Inseparable to each BVS there are one or more **Commitments**, being the latter characterized by the name of the **Milestone** reached and including a series of **Agreements** and **Deliverables**.

Once the achievement of a Commitment is completed, i.e., all its Agreements and the availability of all required Deliverables have been realized, we say that the corresponding BVS has reached a **Milestone**. We reserve the term Milestone to indicate the state-of-things in the world being modeled after the completion of the corresponding Commitment. Among other things that can be used to characterize such states, the measurement of the main variables associated to BVS Deliverables and Agreements at each Milestone as reflected by a family of **Business Metrics** is very useful for business monitoring and analysis purposes. These Business Metrics are those quantitative indicators that characterize the progression of the BVS toward the **Business Outcome** being pursued. These metrics are also usually called **Key Performance Indicators** (KPIs).

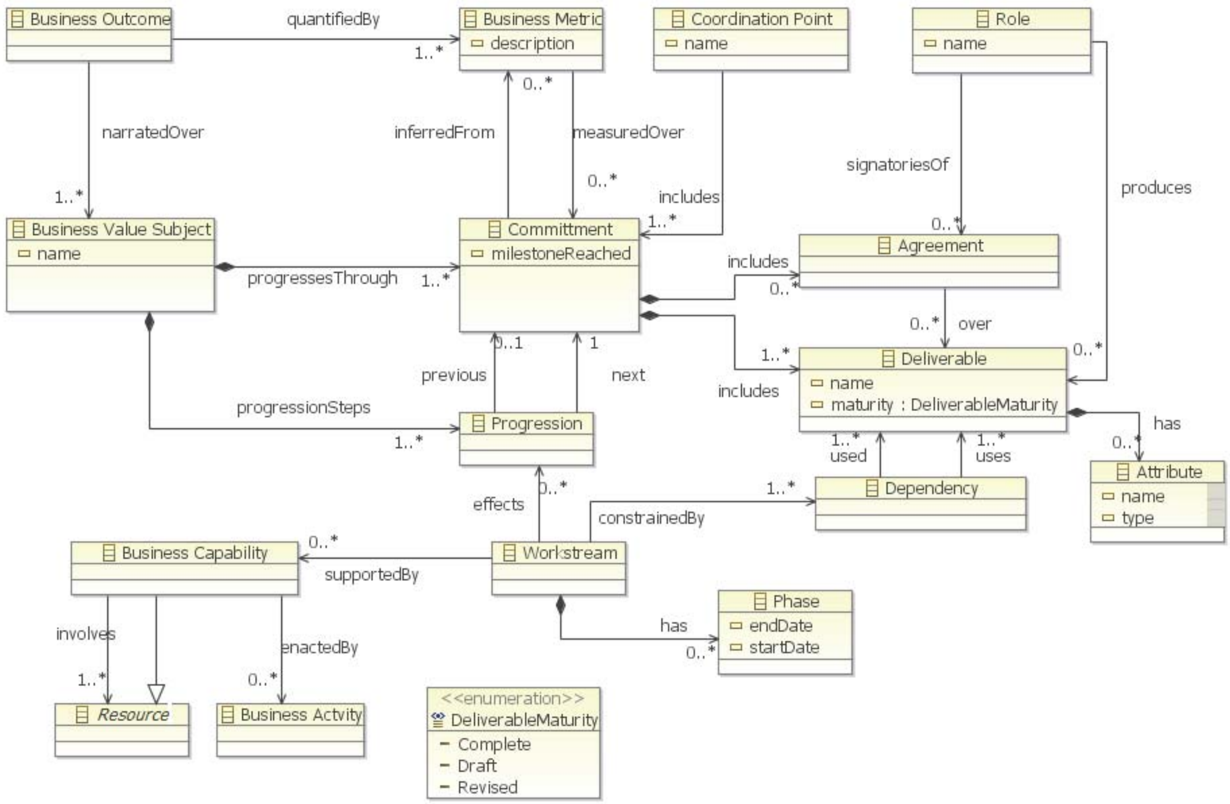

Figure 10. Metamodel of BVM

The advantage of introducing KPIs in close association with a Milestone is that the context and intent of the definition is unambiguously associated with a Deliverable, an Agreement or the accomplishment of the entire Milestone in the organization. Also as shown in Figure 11 the KPI can be applied over different expanding scopes starting at lowest level at Deliverables – Scope A, then onto an Agreements – Scope B (comprising of Deliverables) and finally to the Milestone entirely – Scope C (comprises of Agreements and Deliverables)

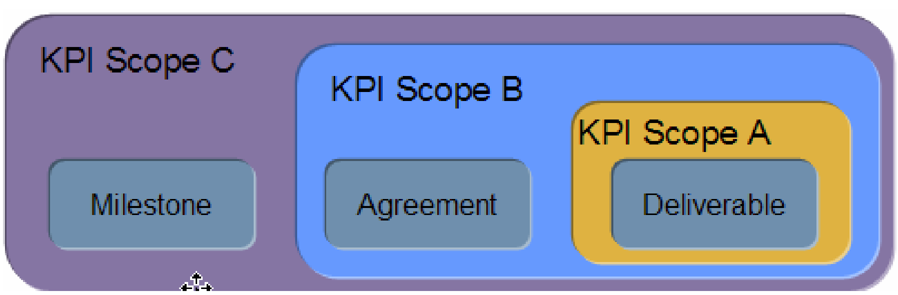

Figure 11. KPIs and different contexts in Deliverables, Agreements and Milestones

Agreements and Deliverables require the active participation of people from different organizations or more generally, role players that have different level of responsibility and participation in the realization of the corresponding Commitments. This concept amounts to the typical definition of **Role** or **Role Player** used in most of the literature and commonly encountered in Business Architecture foundations [**McDavid**, 1999]. The important aspect of a Role is that it attempts to identify and established explicitly those individuals and responsibilities that are inseparable from the ability of an organization to declare a Milestone completed. The responsibility of the Roles participating in a Commitment aims at insuring the satisfaction of all the conditions established upon Deliverables which should be explicitly captured in the Agreements. These Role Players have to ultimately be well-identified individuals in the actual realization of the model in practice.

Finally, the modeling approach introduced in this paper brings the opportunity to define the work an organization does and what core capabilities are enacted by using the evolution of a BVS between neighboring Milestones. The definition of behavior and capability has been a complex task in operations modeling approaches and is still the source of significant confusion. The challenges relate to the attempt to describe what organizations do in functional terms and proceed by further 'decomposition' into smaller chunks of functionality. This "black box" approach to describe behavior is troubled by the fact that the representation truly amounts to enumerating a set of capabilities and not describing the actual things being done by the organization. While this is perfectly acceptable from a modeling point of view, albeit yielding an incomplete model of behavior, this fact is rarely stated explicitly to the point that these capability frameworks have run under process taxonomies or process classifications [**PCF-APQC]** thus implying that they provide a description of the behavior being done when in fact, they do not.

The thorough exposition and resolution of the above challenges goes well beyond the goal of this paper but it is worth mentioning that the new modeling approach presented in this paper leads to clear boundaries in which capabilities are used in an organization across inter-divisional operations. Specifically, the work done to progress a BVS from a Milestone to the next may have been typically in existence from times that go completely beyond the specific interval in between the achievement of the two corresponding Commitments at play. Thus the work done strictly in the "transition" between two consecutive Milestones is exposing a unique set of discrete **Capabilities** in the organization. These Capabilities become enacted only as the consequence of moving the BVS to the next Milestone. In that sense, Commitments become a very natural "boundary" to unravel the identification of a Capability, i.e., a functional ability of the enterprise to progress the BVS in between two consecutive milestones. While significant and critical work may have been done in the organization to support the "transition" some specific work is the sole consequence of the first Commitment being achieved (i.e., the fraction of the work begins only then) and lasts at most until the next Commitment is also achieved.

Workstreams is the language introduced in the metamodel of Figure 10 to highlight the specific body of organizational behavior that pertains to the specific needs of the evolution of the BVS from a Milestone to the next. Thus, the associated Capabilities shown in the metamodel diagram are the manifestation of the functional description of the work done strictly in the transition between the two Milestones. Said in informal terms, Commitments introduce a well-defined boundary for the identification and enactment of Capabilities in an organization. This is also an important connection between the Resource-based View of a firm and the modeling work presented in this paper. This topic will be addressed in more depth in upcoming work by the authors [**Sanz-Nandi**, 2013]. In the context of Workstreams, the metamodel introduces 2 more elements – **Dependencies** and **Progressions.** Dependencies model relationships between Deliverables independent of the Commitments that those Deliverables may contribute to. In other words, functions may organize (flexibly) in ways to *start* working on Deliverables (if the Dependencies have been met or there is none) needed in later Commitments with the goal of producing them *just-in-time* as each Commitment becomes *available to be met* after the completion of the previous one. Progressions chalk out the legal path for a BVS through Commitments i.e if a Commitment is *next* in line to be met, then the *previous* Commitment has to be the one that has been achieved immediately before. Worksteams can thus execute and organize work as long as the Deliverable dependencies are met, meeting BVS Commitments as per Progression needs and evolving it through Milestones.

The last elements of the metamodel are the **Phase** and **Coordination Point.** Phase depicts top level logical blocks of Workstreams, primarily to ascertain the scope in which the modeling will be performed. A Coordination Point is a useful and easy mechanism to realize a *quality gate*, used extensively in manufacturing processes. Essentially, the Milestones included in the Coordination Point will all need to reach, before further work is allowed. It is a useful mechanism to assert that work done up to a logical point meets requisite quality parameters and checks, before investment is approved for next phase(s).

4. Information System for Business Performance Management and Visibility

In this section we will present some important connections between the modeling approach introduced in this paper and the creation of Information Technology (IT) solutions to provide cross-functional, enterprise scale *performance management* and *visibility.* The basic approach is essentially detecting and reporting on the evolution of each BVS and managing performance based on the various performance indicators presented through the Commitments in the model. The reference architecture for visibility and performance management information system is as shown in Figure 12.

At the heart of our information system is Module 3, the *enabled* or *instrumented* BVM. The *BVS Information Model* is based on a data model that is extracted from BVM. Essentially, each BVS and Deliverables from BVM are rationalized / normalized and included as Entities in the *Information Model*. The BVS (an Entity by itself) will have in addition a Field to capture the current Milestone. The *BVS Information Store* will store *instances* of the BVS and other information Entities. A BVS *instance* is a unique copy of the BVS type. The Agreements and Coordination Points can be represented as Business Rules that evaluate using instance information from the *Information Store.* As Commitments are met for BVS *instances* the BVS Milestone field will be marked appropriately.

The realization of the *BVS Information Store* is worthy of some discussion. The BVS Information Model is an overlay into the data generated and stored in the legacy systems (the “system of record”, so to speak). To avoid unnecessary duplication of data, the *Information Store* should ideally be a “View”, serving as an interface for data access from the systems of record. Control and management data (e.g., milestone, history etc.) needed for proper evaluation of the Commitments will still be stored locally in the *BVS Information Store*.

Module 2 provides the integration and interim data manipulation needed to map data from legacy and existing systems to the *BVS Information Store.* The mapping may or may not be (later most likely) one to one. In addition, some parts of the BVS Information Model may have no representation entirely and needs to be derived (i.e., the field has no direct representation, instead is derived from some logical combination of data from the legacy systems). Module 2 will host all that logic as well as any architectural semantics (e.g. SOA) to integrate with and obtain data from the legacy systems.

Module 1 comprises the existing data and (legacy) systems that generate and store data to support operations in the scope of the BVM. Each system likely represents a good chunk of business functionality[7] and based on the IT maturity and lineage, they can be quite disparate, storing data ranging from highly unstructured to structured and anywhere in between. However, the clear delineation amongst the milestones of the BVM model, allows for progressive integration of the systems, one milestone at a time. The information system can be deployed and value derived, as long as data is available to support the single milestone of a single BVS.

Module 4 is the reports and dashboards to support business visibility and decision making[8] for both management stakeholders as well as line of business people. It is based on the instrumented BVM (model and the data, including the management data) captured in the *BVS Data Store.*

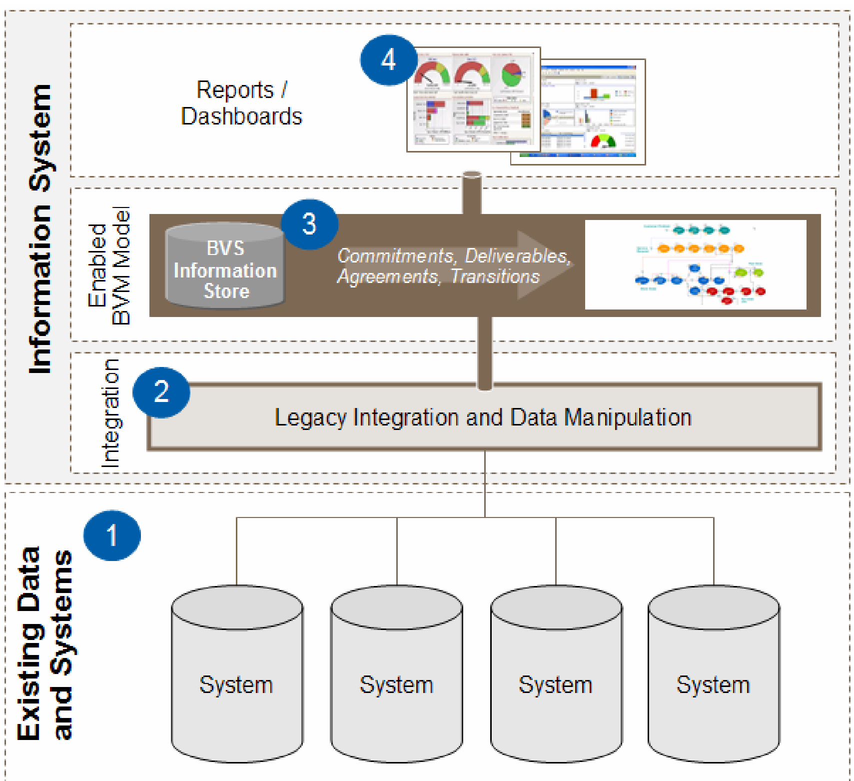

Figure 12. Information System in Support of Business Visibility and Performance Management

[7] In our experience, ERP systems form the bulk followed by legacy custom applications.
[8] For this paper, we limit ourselves to address the concerns of business visibility, but it is probably not a stretch to use the BVS Information Store as the basis to drive deeper analytics and insight, e.g. *quickly identify potential Order (the BVO) backlog issues.*

An example of a *dashboard* for *business performance management* based on BVM is shown in Figure 13. Note, this is just sample visualization for demonstration purposes only. Other, more effective, form of visualization is certainly possible and is likely be driven by the user-centric designs of the particular project. The BVM *management dashboard is* about *aggregated views* over many instances of in-flight BVSs. The left panel provides navigational controls to help filter and navigate to the subset of BVS instances interesting for this particular dashboard user. The right panels reports on the selected set of BVS type and instances. Some of the typical reports as shown in the figure are:

- *Inventory of BVS instances (categorized by the BVS type or attributes) in each milestone.*
- *Operational performance based on timeliness of BVSs (eg. on-time, warned, late etc.) to progress through the milestones (i.e crossed stipulated time thresholds.)*
- *Cycle times (average, min, max) through each milestone and/or end to end.*

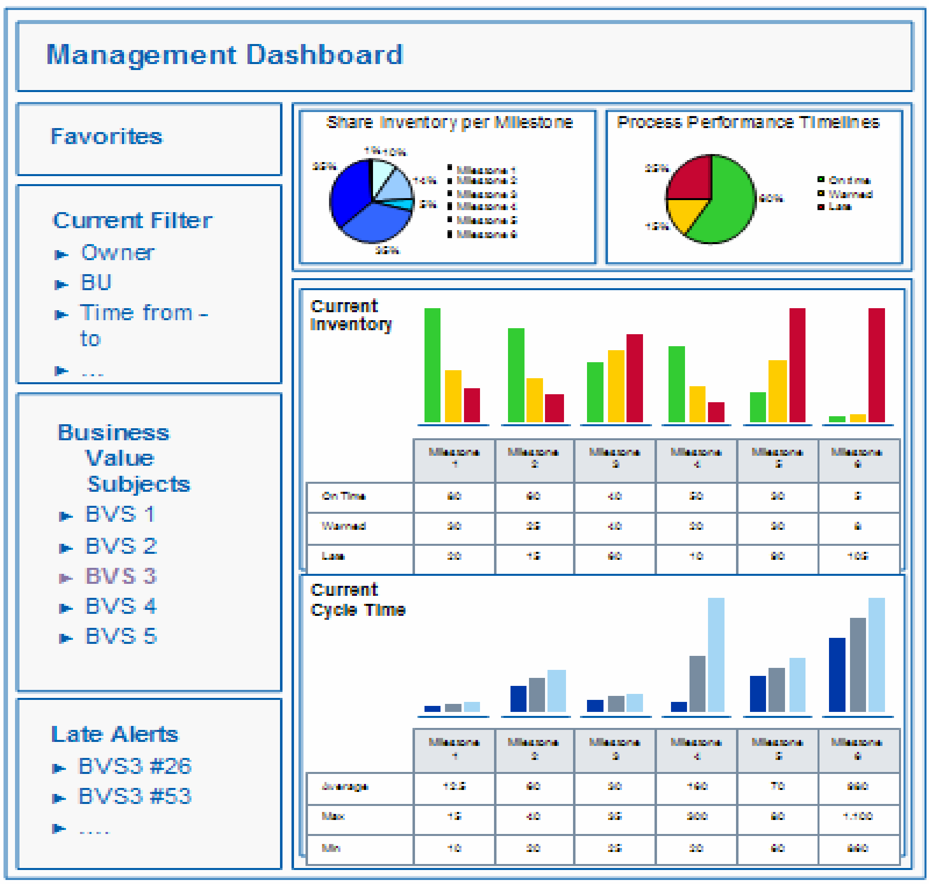

Figure 13. Business Visibility Dashboard – Management View

An example of a *business visibility* dashboard targeted for the line of business users based on the BVM model is shown in Figure 14. This is useful for people who are involved in day to day operations of the business. As such the focus of these dashboards is on particular BVS *instances* rather than on the aggregate. The left panel as before is used for navigation and filtering. The top right panel shows three instances of BVS (of type) 3, identified by the ids

(12, 67 & 41) in each row. The columns are milestones denoted my *M1, M2, M3,* and so on. Each cell shows the completion status of each milestone – green (completed), yellow (partially done) and red (late). On selecting a particular cell (say BVS3 #67, Milestone 4), the next panel below shows the completion status of dependant BVS instances (of other types) on Milestone 4. The bottom panel shows the Deliverable and Agreement status for BVS3 #67 needed to reach Milestone 4. Five Deliverables are due and one Agreement needs to be met. The green, yellow and red colors indicate that of the five Deliverables, four have been produced (green) and one is slightly late (yellow), whereas the fulfillment of the single Agreement is way past due (red).

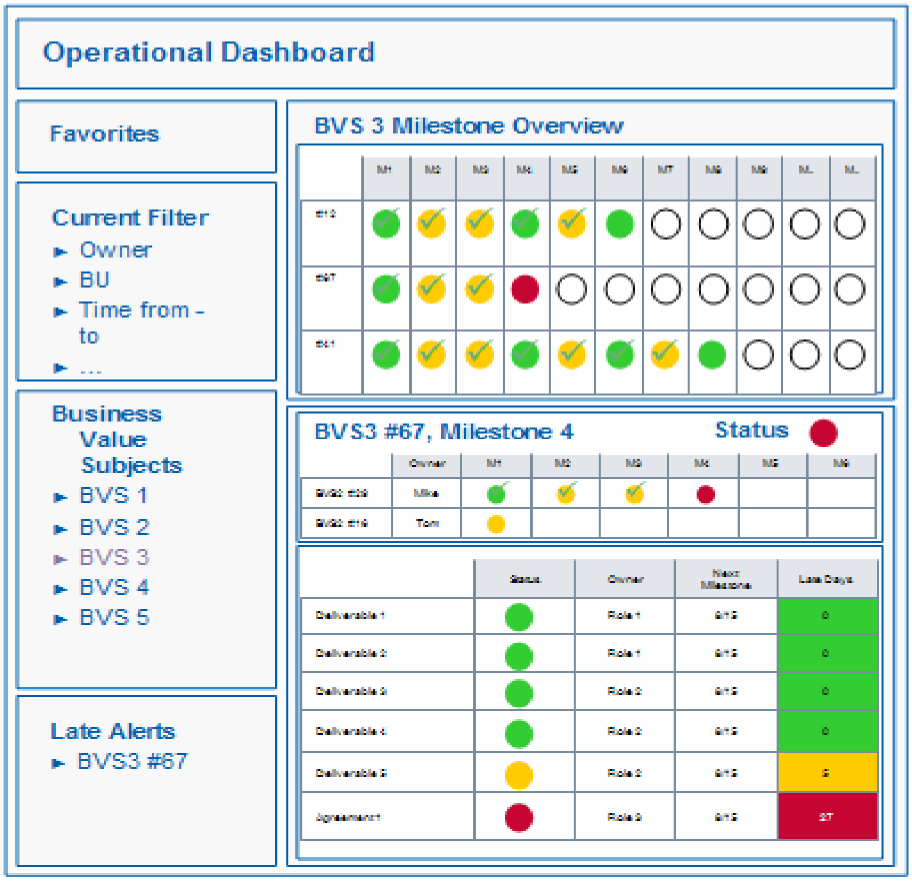

Figure 14. Business Visibility Dashboard – LOB View

5. Discussion and Conclusions

The approach presented in this paper has some interesting and important touch-points with other techniques and methods that have been used and documented in the literature for some time. Two examples are SIPOC and Value Stream Mapping (VSM) in the Lean Six-Sigma toolbox [**George,** 2004], [**Atmaca,** 2011], [**Johnston,** 2012], [**Lee, XXXX**]. The methodology underlying the new modeling work addressed in this work has several attributes that follow Lean Six-Sigma principles. Lean Six-Sigma addresses a wide and broad space of operations improvement practices. We believe that the present work can be very well-considered as a complementary approach to Lean Six-Sigma to model cross-functional operations in an enterprise for the goals of detecting performance bottlenecks and proceed with the organizational understanding necessary to address possible solutions.

SIPOC considers the Suppliers (the 'S' in SIPOC) of the process, the Inputs (the 'I') to the process, the Process (the 'P') being improved, the Outputs (the 'O') of the process, and the Customers (the 'C') that receive the process outputs. In some cases, Requirements of the Customers can be appended to the end of the SIPOC for further detail. The modeling technique presented in this paper exposes a different but complementary view offered by SIPOC. In SIPOC, the focus is on functional (process-oriented) decomposition driven by the value provided to the Customer. In our modeling proposition, the focus is evolution of key cross-functional subjects through milestones and deliverables (outcome-oriented). Establishing the outcomes upfront and breaking down complexity into simple bite-size chunks will lead to a better, robust and faster SIPOC while still maintaining the overall stable context. The 'boundaries' defining inputs and outputs, stakeholders (suppliers and customers in SIPOC) result from the content provided by the Commitments along the life-cycle of each BVS. VSM will be the next step, to perform detailed as-is analysis and drive improvements guided by the BVM-SIPOC outcome, i.e., the combined use of BVM followed by SIPOC for VSM. Naturally, the approach in this paper is more detailed but it may be considered in a broad sense as a SIPOC-complementary idea and simultaneously, as a way to drive SIPOC to a more actionable level of instrumentation into an Information Systems, as shown in Section 4.

On the other hand, the central notion of *Subject* resembles in many ways the concept of business entities as introduced and revisited by many authors in different modeling concerts and applications [**Sanz-Nandi,** 2013]. While the association of BVS with past work done at the realm of operations modeling is definitely valid, we need to emphasize that the nature of these BVSs do not make them data or information records but a *business concept* whose IT representation is irrelevant to the purpose of the modeling goal. Extensive work with the application of this technique done in organizations for the last two years conclusively demonstrated the value of this method to generate significant stakeholder agreements about the nature of performance gaps in large cross-functional operations. These field case-studies are the subject of another upcoming paper.

Some BVSs' are abstractions that have no physical materialization or counterpart in the life of an enterprise. For example, "Drug Pipeline" cannot be found anywhere in a pharmaceutical company. But there are other BVSs' that capture information about things that will somehow materialize and in most cases, in more than one form. For example, the notion of "Order" as a subject encompasses the idea that the organization will deal with many orders in practice. The BVS-Commitment construct says that each of such orders will go through exactly the same evolution as captured into the commitments / milestones. The notion of instance of the BVS matters.

Needless to mention that there may be a cascading parent-child relationship amongst instances of BVSs in reality. For example, in the "Problem-to-Fix" example shown in Figure 9, a single *Customer Problem* could result in a few *Service Requests*. Each *Service Request* could generate few *Work Orders* and each *Work Order* few more *Part Orders* and *Part Order Lines*. As the creation cascades down from that one *Customer Problem*, the completions cascade up i.e. a parent concludes its life when all its children are done and the one Customer Problem is completed (problem resolved) when all the children have reached a "Completed" commitment / milestone.

There is a historical strong separation of “things” from “processes”, whose roots can be found in early philosophy and related modern schools. This is one of the main reasons for the contemporary disconnection between process and information. Several schools at the realm of Information Engineering have dealt with this topic and in fact, some Computer Science researchers and practitioners have explicitly visited the deep liaison across these domains in the eighties [**Sanz,** 2011]. In many cases, this integration has been partially done under technology jargon such as “*entities*”. Perhaps, the first time the term “*subject*” was used in the computing literature is in the work of K. A. Robinson in 1979 when stating: *‘an entity is actually in a state of flux. It is the subject of a process’*. Robinson’s seminal ideas have largely gone unnoticed in subsequent Engineering and Computer Science literature on process modeling and management [**Sanz,** 2011].

On the other hand, Social Science researchers have undertaken significant studies in the way processes and things may oppose each other and still be deeply interrelated (see [**Van de Ven,** 1992], [**Van de Ven & Poole,** 1995; 2005], [**Hernes,** 2010] and others). The Business Value Model (BVM) ideas presented in this paper draw from all these concepts and integrate them for the modeling of cross-functional operations. Thus, BVM resembles in some passages the notion of entity and its life-cycle. But the nature of BVSs and the companion notion of the Commitments that define the evolution of a BVS are not the conventional entity life-cycle modeling. Furthermore, the concept of Milestone bears no relationship to a sibling term defined in the so called Guard-Stage-Milestone (GSM) work [**Hull,** 2011].

In fact, GSM is another evolution of the state-based entity life-cycle formulation [**Bhattacharya**, 2011], [**Chao,** 2009], [**Cohn,** 2009] as it provides a more declarative approach to specifying entity life-cycle models. A distinguishing aspect of GSM is its (re)definition of a *milestone.* In traditional entity life-cycle modeling, a milestone is a *state* of the entity *itself*, described over the entity information content and as has been argued ([**Nandi et al,** 2010]), at the level of granularity for appropriate business visibility and control. However, in GSM, a *milestone* indicates the completion of the Stage (i.e., the bundle of activities and its hierarchy within the Stage). The milestones, thus defined, are likely to be too granular and thus, important to monitor the execution of activities at different levels, but not significant in regarding its contribution to the high level business objectives of BVM. The technique presented in this paper addresses a different business performance concern and it does so more effectively than the potential application of GSM to the modeling of cross-functional operations and related performance problems.

In an upcoming paper, we will also address an extensive set of case-studies illustrating the application of the new modeling approach to real scenarios encountered in organizations.

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