

A Value-Based Business Approach to Product Line Software Engineering

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ABSTRACT

The present conceptual paper is an attempt to provide a Value-Based Business Approach (VBBA) to product line software engineering. It argues that Product line software engineering should be seen as a system and considered as a means towards the end of appropriating more and more value for the business firm; contingent upon the fact that it provides value to customer and customer's customers operating its value creating system with agility, speed, economy and innovation; getting governed by the positive sum value creation outlook and guided by value-based management. With our value-based business triad, the product line engineering process can hope to achieve simultaneously value, variety and volume, product differentiation and cost leadership enabling the business firm to land on the virtuous value spiral.

Keywords: Value-Based Business Approach, Value-Based Business Triad, Positive Sum Value Creation Outlook, Value Creating System, Value-Based Management, Product Line Software Engineering

1. INTRODUCTION

We see increasing efforts towards the integration of value-oriented and economic perspectives into software engineering. Boehm argues for a discipline of Value-Based Software Engineering given the fact that increasingly software and software decisions significantly influence most systems' cost, schedule and value [1]. Schmid in his 'An economic perspective on product line software development' argues that 'performing an economic analysis should be part of any software development approach' [2]. It is thus imperative that the product line engineering, specially the product line software engineering, takes explicit note of these developments; *undertakes economic modeling and econometric analysis and embraces the importance of 'value' explicitly in its attitude and practice.* However, the question that baffles is 'what is this value and whose value that is being discussed' [3]? The extant discussion and research need to be clearer in this respect and it is very important when the efforts are made towards the

integration of value-orientation in the product line engineering. The present conceptual paper is an attempt to provide a Value-Based Business Approach (VBBA) to product line software engineering.

The rest of the present paper is arranged as follows. In Section 2 we describe in detail what we call Value-Based Business Approach. Section 3, presenting a brief overview of Product Line Software Engineering and a short literature survey in the emerging field, attempts to integrate the value-based business approach to the Product Line Engineering (PLE). And the last section 4 contains concluding comments.

2. VALUE-BASED BUSINESS APPROACH

The Value Based Business Approach is all about having a systems perspective, following a holistic value-oriented management process and getting guided and governed by a positive sum value creation outlook. Our VBBA presents a triad in terms of a Positive Sum Value Creation Outlook, Value Creating System and Value-Based Management (see fig.1), which enables the business firm to land on the virtuous value spiral helping client or customer business to land on its own virtuous value spiral. In fact, in our VBBA it is argued that customer is the *anchor* and the Business Firm under discussion is the *steerer* in the 'value voyage' of the value creating system [4].

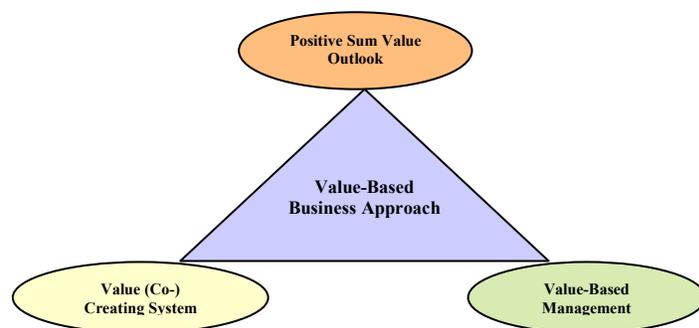


Fig.1 Value-Based Business Triad

According to us, any value based approach in the business context should essentially mean more and more

value appropriation by the business firm but it should not be acquisitive or exploitative in nature. The purpose of business is to create value for its customers helping them create value for themselves and to assure & ensure happiness of *all* involved in the value creating system. *In other words, the purpose is to survive and thrive in a fluctuating; ever-changing environment, to make money with increasing net cash-inflows ever and to ensure positive value to all the stakeholders.* It is no denying that organization of and running of business has to ensure a positive ‘economic value’ all the time i.e. total value created by the business should exceed the totality of all costs including the capital charges or its opportunity costs. As per one of the basic economic principles, a company creates economic value so long as its Net Operating Profit after Tax exceeds its total capital charges; otherwise, it is a destroyer of economic value. So for us, the notion of value is centered around the ‘value to customer’ which refers to ‘net benefits accruing to customer’, which rides on / through business’ offering and which is unique in itself and superior to available, if any competing substitutes in the market. Such a notion of value is based on the belief that the ultimate payer is the customer (and customer’s customers) and thus customer’s satisfaction and delight facilitating its willingness-to-pay holds the key for the survival and sustainability of the business enterprise. In the present day economies, customers are really the scarcest resources and higher the number of profitable customers a business earns, higher is the chances for it to survive and thrive [4].

By a positive sum value creation outlook, we mean business to be considered and conducted as a non-zero positive sum affair. That is, all involved in the business, which is a value creating system with its *dharma* as value creation, should be assured of positive value always. It of course assumes that all involved in the value creating system are contributing their bit enthusiastically towards the expansion of the value universe [3] i.e., to increase the net total value addition by their respective activities.

However, if at any point of time in the value creating system, it becomes essential, may be for the larger benefits of the system as a whole or as a necessary evil like “creative destruction”, for some stakeholders to get non positive value, then there should be adequate compensations to them for their loss so that the value creating system attains a Pareto optimal state and achieves Pareto efficiency¹. Note that in this context, we can adopt some variants of the Pareto criterion which is the fundamental value judgement of modern Welfare Economics. It states, if we have two different allocations of resources or of goods (X) and (Y), a change from X to Y is desirable if and only if it makes some individuals

¹ For details see Samuelson, P.A., 1947, *Foundations of Economic Analysis*, Harvard University Press; Pareto, Vilfred, *Manual of Political Economy*, 1906.

better off without making anyone worse off.

Mathematically,

$If X R_i Y \quad \forall_i$

and

$X P_i Y \quad \text{for at least one } i$

then

$X P Y \quad \text{from society's point of view}$

Where R is ‘as good as’ relation and P is ‘preference’ relation.

In our VBBA, it could be adapted as : If X is as good as Y for all i and X is strictly preferred to Y for at least one i then X is strictly preferred to Y from the value creating system’s point of view. Further, in some cases Kaldor-Hicks compensation criteria, Scitovsky’s ‘double criterion’ can be tried out and some trade-offs can be worked out following economic principles to resolve conflicts.

In the present day software intensive service and knowledge economy, it is not that only the firm or its employees are instrumental for value creation, rather value co-creation happens in a systemic fashion in the value creating system comprising customers and counterparts, shareholders, owners and promoters, associates and employees, suppliers, partners and collaborators, community and the society at large. In our Value-Based Business Approach, the positive sum business outlook imposes certain benign constraints to be satisfied (e.g. value to customers exceed their total cost of ownership, return on investment (ROI) to shareholders exceed the opportunity cost of their capital, compensations to employees exceed their transfer earnings besides providing them ample avenues for self- and career development and finally society benefits in terms of increase in positive externalities and reduction in negative spillovers; making all involved in the value creating system happy [3].

The other important element of the Value-Based Business triad is value-based management which entails the whole gamut of management processes to be value-oriented and focused. In fact, value-based management “instills a mind set where everyone in the organisation learns to prioritize decisions based on their understanding of how those decisions contribute to corporate value” [5]. This means that *all key processes and systems in a corporate or business firm must be oriented not only to the creation of value; but also its credible communication, delivery and appropriation; benefiting all involved in the value creating system.* A comprehensive and holistic value based management program should consider the following elements: Strategic thinking and planning, Capital and Knowledge management, Performance measurement and management, Operations management, Constraints management, Marketing management, Innovations management, Technology management, Change management, Project and Program management,

Risk management, Internal communication, External communication & financial markets management and Systems approach & thinking [5,6,3].

The detail dynamics of the Value-Based Business Approach is depicted in a self-explanatory way in fig.2 which is further discussed in the next section.

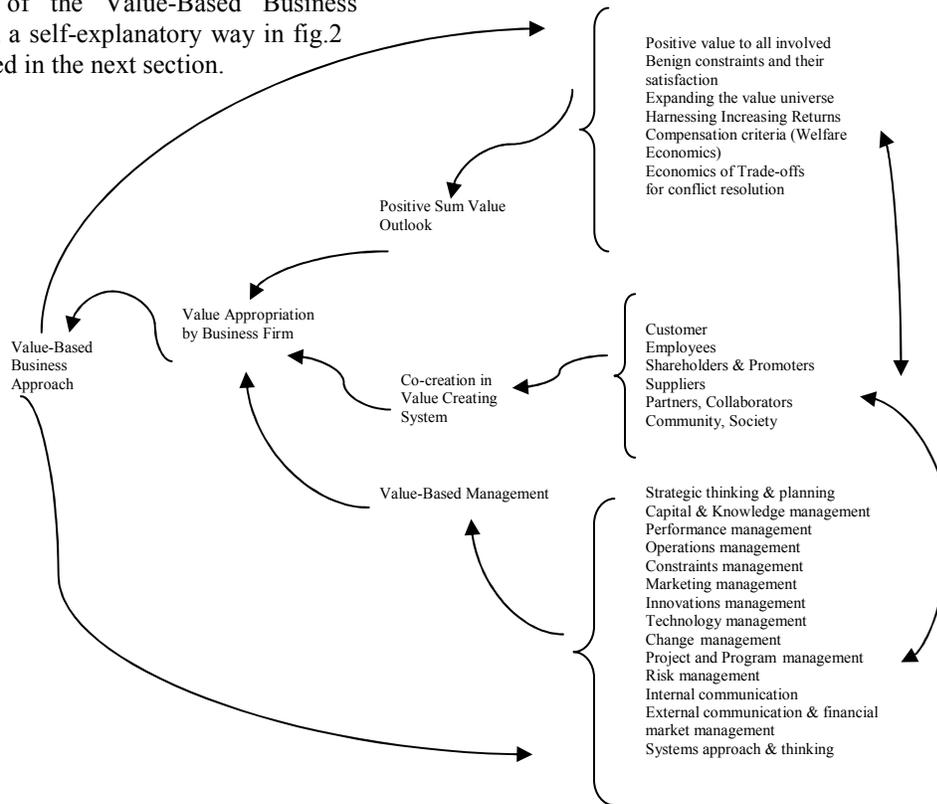


Fig.2 Value-Based Business Approach

architecture, a software component, a process model, a plan, a document, or any other useful result of building a system [8].

3. VALUE-BASED BUSINESS APPROACH TO PRODUCT LINE ENGINEERING

Product Line Software Engineering

A product line is a set of products that together address a particular market segment or fulfill a particular mission [7]. Schmid defines a product line as ‘any set of products for which common (reference) architecture and a set of core assets can be developed so that assets and architectures can be used for all products in the line [2]. The scope of product line specifies its boundaries and describes the context in which the assets will be reused in future.

Product lines are efficiently developed based on product platforms. The product platform is defined by the set of core assets. The core assets are reusable software related assets which are used in the production of more than one product in a product line. A core asset may be an

Product line engineering consists of three intertwined development processes running in parallel: domain engineering, product engineering, and management [9, 10]. Domain engineering is a development-for-reuse process and focuses on the analysis, specification, and implementation of assets in a particular domain for use in the development of multiple software-based products. In the context of product line development, product engineering is a development-with-reuse process. It uses the assets supplied by the domain engineering process (e.g., software components) to build new products. Product engineers typically compare customer requirements for a product with the capabilities of existing assets in the asset base and pick the best-fit ones. Thus, a new member of the product line is generated.

A software product line consists of a family of software systems that have some common functionality and some variable functionality. A better understanding of the

software product line can be obtained by separating the concerns of the common software, in terms of common features, components, and source code, from the variable software. Saleh and Gomma 2005 describe an approach to the separation of concerns in software product lines by separating common source code from variable source code [11]. Commonality and variability is modeled from many different viewpoints in a product family. At the requirements level, the commonality is captured by common features, while the variability is captured by optional and alternative features. A given members of the product line will provide all the common features, but only some of the optional and alternative features, subject to feature dependencies and constraints.

Product line engineering also requires management processes. For instances, project and change management are needed for domain and product engineering. Furthermore, asset management tackles the issues involved in the interface between domain engineering and product development in terms of an asset repository. The fig. 3 illustrates the product line engineering process schematically. Some of the benefits of PLE are higher productivity, higher quality, faster time to market, reduction of costs, lower labor needs, improved planning of projects [2, 10].

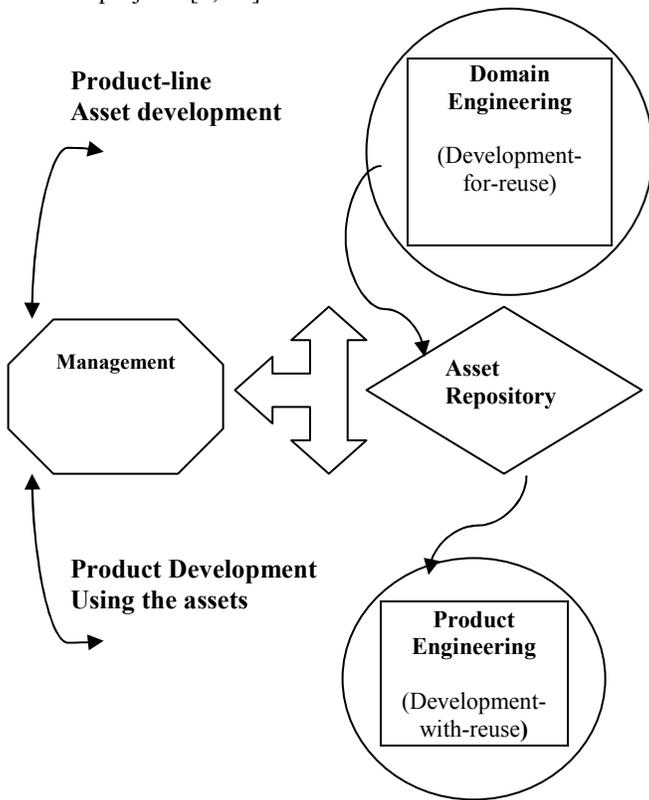


Fig. 3 Product Line engineering process

VBBA to Product Line Software Engineering

In our effort to integrate Value-Based Business Approach to Product Line Engineering, we need to start with the fundamental business question involving the needs of customers. What are the real current needs of customers? What are their unmet, unarticulated, pre-emergent or even emergent needs and what will they pay for towards the satisfaction of their needs and their delight? Value based business approach to product line software engineering is illustrated in Fig.4; integrating our VBB triad with the product line engineering process.

The fig.5 simply but succinctly depicts the kind of mentality and action-orientation the elements in value creating system need to have so that the software and other artifacts that they develop contain 'living' characteristics having potential to simultaneously evolve with the varied needs of customers and users. It is very important in the VBBA to PLSE to build adaptation capabilities, as far as possible, into the software and other artifacts while creating the 'assets repository'.

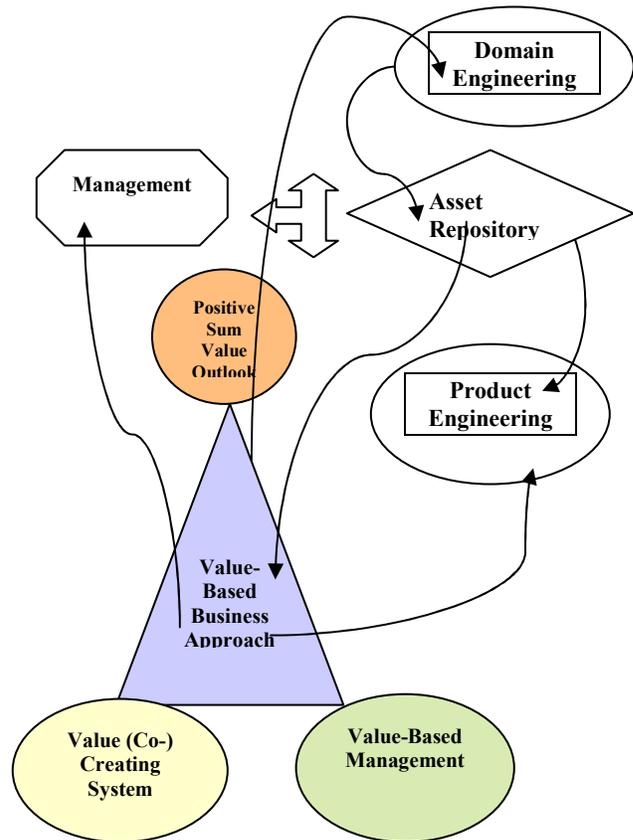


Fig.4 Value-Based Business Approach to Product Line Software Engineering: An integrating effort

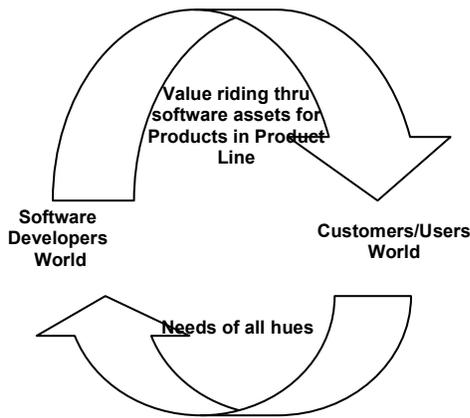


Fig. 5 A simultaneously evolving two-world system dynamically feeding each other for better value

Note that adaptation capabilities can be classified into three types: homeostatic (maintaining control variables within parameters), morphostatic (changing the control algorithms that govern homeostasis) and morphogenetic (the ability to acquire new components and discard others) and the product line/value creating system and its different elements should strive to learn and earn all three types of adaptation capabilities to remain 'viable' [12, 13].

Long back Peter Drucker declared that the purpose of a business is to create a customer. The purpose is to provide something for which an independent outsider, who can choose not to buy, is willing to exchange his purchasing power [14]. In fact, it is customers' willingness to pay which dictates and determines the amount of value or economic profit that the business firm can appropriate and this is primarily a function of the value customers get from the business transactions. In the connected software economy, such value for customers can arise at the pre-transaction, during transaction and even at the post-transaction stages. Higher value appropriation by the business firm is possible only when it manages to harvest optimized profit share per transaction, optimized customer wallet share, optimized market share and even optimized business opportunity share (to reign in the market in the future). That is, the business firm can increase its profit increasing its sales revenue (increasing the sales or increasing the per unit price charged to the customer; which may of course affect the customers' well-being or the both) or reducing the cost of production/ cost of doing business etc. All the same, to put it in simple terms, one of the vital and significant means of increasing value appropriation by the business firm is via increasing benefits to customers boosting his willingness to pay which expands the size of the value universe [3].

As proffered by our VBBA, for better and higher value appropriation by the Business Firm; it has to operate its value creating system systemically with agility,

innovation, and economy and speed (see fig. 6). This means, the business firm under consideration; following the VBBA both in thought and action, attempts at achieving the followings: cost-efficiencies while serving customers, scope and scale economies; successful avoidance of various diseconomies and stopping of value dissipation from the system and above all successfully building and using systems and putting in place mechanisms for value rejuvenation throughout. As evident from fig.6, this improves customer's perception of value from business offering boosting his willingness to pay and inducing him to expand his business transactions with the Business Firm under consideration; both in the extant lines of business and new lines of business. All these positively influence value appropriation by the Business Firm (see fig.6).

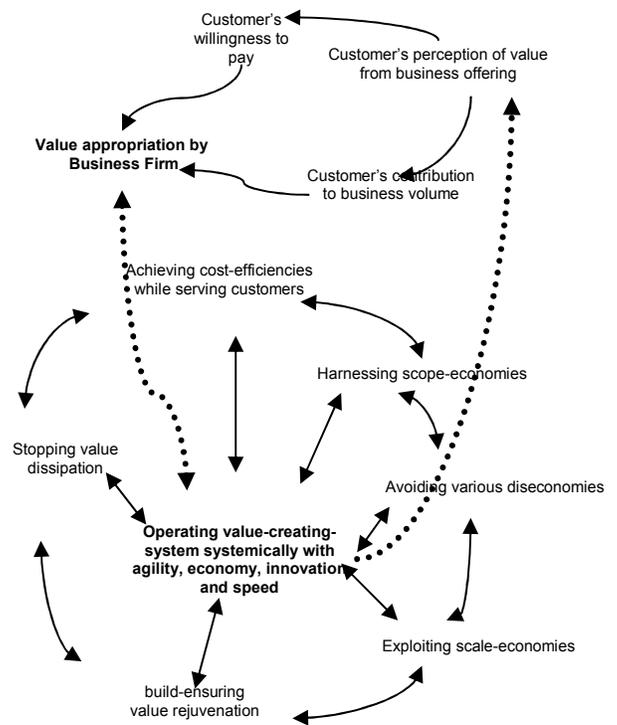


Fig.6 Systemic Value Creation feeding business value appropriation

Note, as part of the value-based management in the VBBA to PLSE the business firm should make its value proposition sufficiently attractive and overtly compelling so that customer makes purchases creating value for firm's various business units. Here again, it is important to ensure that various business units and support units in the business organisation do not operate in silos and the business firm rather takes a systemic view of the whole enterprise while dealing with different customers and resources; or while coordinating and resolving conflicts among various units over shared resources or shared

customers. It is argued that when the business firm aligns its portfolios of business units and support units to create synergy, it not only enables different business units to create more benefits for their customers and to reduce total costs of operation; also it creates additional sources of value i.e. 'enterprise derived value' [15].

No doubt, in the VBBA to PLSE; with right scoping, scope economies are harnessed enabling the Business firm to attain cost leadership. Further, with value-based business approach, some advantages in terms of product differentiation can be achieved. However, *some systems principles should be kept in mind while selecting the product family or line*. For example, one of the relevant systems principles in the current context is that 'there is an optimum size for a system'. If we try to make the system any larger, it will try to break itself up in order to achieve more stability. Another systems principle, also very instructive for the product line engineering is that of homeostasis [16] i.e. systems tend to seek dynamic balance with their environments. Another relevant principle useful for value-based business approach to product line engineering is the one that says 'systems that do not interact with their environment (e.g., get feedback from customers) tend to reach limits'.

4. CONCLUDING COMMENTS

To conclude, our value-based business approach to product line software engineering (VBBA-PLSE) *entails continuous value improvements in software development keeping customers' requirements and needs of all hues in mind*. It helps achieve better quality software and its delivery in shorter time at a reasonable price so that global competitiveness of the software companies can be strengthened-with-sustainability. It is argued that successful implementation of the VBBA-PLSE can convert resources of any kind; including distinct knowledge into economic value in the market place facilitating firm's business-success-and-sustainability. Furthermore, product line software engineering process should be seen as a value creating system (a network of interdependent activities with a shared goal) and be considered as a means toward the end of appropriating more and more value for the business firm; contingent upon the fact that it provides value to customer and customer's customers operating its value creating system with agility, speed, economy and innovation; getting governed by the positive sum value creation and business outlook and guided by value-based management. So, with the value-based business triad, the product line engineering process can achieve simultaneously variety, value and volume, product differentiation and cost leadership enabling the business firm to land on its virtuous value spiral. Of course, one of the limitations of our approach may be that it is very broad in nature, but its next level detail can be worked out in future research toward which we are also committed to.

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