Stored Value Functions

Applications to operational management

Leigh Caldwell
Inon
January 2007

leigh@inon.com
44 Hatton Garden, London EC1N 8ER.

DRAFT

Introduction

An e^{3}value model [Gordijn 2002] is in the following sense a static model. It represents the equilibrium state of a business model, system or market. However in day-to-day management we want to know what is changing over the short term. In order not to have to redesign the e^{3}value model every day to reflect changing circumstances, we seek an approach where changes over time are stored as variables in the model instead of being encoded in its design.

While the equilibrium state may look like [*Fig 1*] when value is "flowing through the pipes", there is a benefit in understanding how the pipes fill up. The amount of value in the pipes is a function of the capital invested in the enterprise. In all parts of the system there is *stored value,* and that is what we investigate in this paper.

Understanding stored value functions in an e^{3}value context

A typical e^{3}value model measures the value at market transaction boundaries. This is useful for understanding the value contributed by each of several entities in a system. However it does not illuminate either the accumulated value, or the process of adding value, within the boundaries of a single entity. This is inevitably an area of strong focus for management of enterprises, and so we seek further understanding of it.

To do so we decompose the value objects passed through a value port into components and intermediate products through a domain modeling exercise. We develop a *stored-value function* (SV-function) for each entity in the model such that (among other constraints discussed later) the result of the SV-function for a domain object entering or exiting the enterprise is equal to that at the relevant transaction boundary. The process of operating the business then becomes a process of increasing the value locally in a series of instantiated entities, according to known valuation formulae.

Each formula can be decomposed into independent variables using a variety of standard algebraic methods. This allows independent variables to be separately optimized – something that can be managed much more firmly than general targets such as profitability, and is more useful than the measurement of rigid process conformance. The system indeed has the potential to become largely self-managing, as local optimization is a simple and mostly automatable principle.

Determining the stored value function for an entity

The shape of the SV-function inside an enterprise is to some degree a matter of declaration rather than inference, provided that it meets the boundary conditions. However there are several approaches which in practice are beneficial in designing it.

- Experiment. We start by estimating the value added over time by various transformations of object state. We then benchmark this against real world value measured, perhaps by conducting test transactions with external market participants – such as buying or selling a sales lead. It is then possible to iteratively adjust the SV-function until its graph best matches the experimental results.
- Postulated principles. By determining boundary conditions and stating principles such as differentiability or conversation of value under certain transformations, we may be able to derive the SV-function or some part of it. This is analogous to the principle used in quantum mechanics, where the Schrodinger equation combined with known boundary conditions gives the wavefunction for a particle or system state.
- Management fiat or judgment. Management may determine the value that it puts on intermediate work products at its own discretion. This then acts to control the behaviour of the enterprise by indirectly signaling the value that management places on certain activities, departments or employees. The function can then be adjusted with experience, for example by comparing value generated by employees in known time with existing estimates of absolute or relative productivity.
- Statistical derivation. For certain entities it is possible to statistically determine the value of an object. For example the value of an invoice which has been issued to a customer can be modeled as: the face value of the invoice discounted by a risk factor based on the client’s credit quality (representing the probability that they will pay). Similarly the value of a work product created by an employee’s time input could be determined by the chargeable hourly rate of the employee multiplied by the average time to create that work product.

Other approaches such as the consumer value function outlined in [Holbrook], [Gordijn 2000] are available.

It is important in all cases that, once a model is operating, subsequent adjustments to the SV-function are made explicit. These may have the effect of changing the total stored value in the enterprise and this can make reporting inconsistent or lead to distorted incentives.

Concepts and operators

We can see the emergence of certain typical operators in the design of stored value functions. These mirror domain modeling relationships to some extent as that is the context in which SV-functions are expressed.

- <u>Composition</u>. One entity may semantically be composed of several others, and its SV-function be calculated from the sum of the SV-functions of the components.
- <u>Supersession</u>. One entity's value may supersede another. For instance if a collection of Task objects, each with a value, are invoiced, the Tasks' values are superseded by the value of the Invoice object. This avoids double-counting while expressing the value of the Invoice more naturally than representing only its value over and above that of the Tasks which are invoiced.
- <u>Conservation</u>. It is possible to determine conservation rules under some assumptions. If we do make such assumptions then the value of an object can only be generated through the consumption or composition of source objects of equivalent value. An example: if a Task object is worth £60 and its only components are two hours of employee's time at a rate of £20/hour, a further £20 of value must be acquired from elsewhere. This can imply the existence of a "profit pool" representing the added value that is intrinsic in the company's business process or intellectual property. The domain modeling involved in such a pool is complex and so in practice, many models will abandon the constraint of value conservation.
- <u>Normalisation</u>. A set of SV-functions which depends on a wide range of variables may be *normalized* or *rebased* by placing the functions in a vector space and re-expressing them in terms of a smaller set of (ideally orthogonal) variables.
- <u>Scalarisation</u>. A variable which cannot be controlled (such as exchange rates) may be translated into a scalar factor, usually as a reduction in value to represent the risk of loss. Statistical

approaches or methods of option pricing can be used to determine the appropriate numeric factors.

Operational management

In order to effectively use stored value to monitor and operationally control a business, the following principles are useful:

1. Know how your value is added
2. Know who adds value
3. Know the factors which influence value
4. Choose variables which match your levers

1. Know how your value is added

An understanding of how value is added derives in many cases directly from an SV-function. It is often possible by inspection to see which actions will increase the value in an object. For example if the value of a Task object is increased by changing its status from Active to Complete, then clearly completing the Task is an action which will add value. Moreover the existence of an SV-function makes visible exactly the amount of value which completing the Task will add.

The purpose in knowing how value is added is to guide behaviour such that value is added frequently and quickly. The benefit for managers is that once it is clear to an employee how to add value, they are usually motivated to go ahead and add it.

2. Know who adds value

The management benefits of knowing who adds value (*value-add attribution*) are clear in the fields of employee selection, design of training, reward structures and motivation. Long-term statistics on value-add attribution are also useful in secondary contexts such as choosing a corporate focus or recognizing core competences.

To determine who adds value requires disciplined analysis and design of IT systems that reflect the stored-value model (see below under heading Value-add Attribution). Once these systems exist, the management gains are easy to achieve – but care is recommended as these metrics can be highly visible and provide harsh messages. Many professionals outside of the salesforce are not accustomed to objective measurement and it can create a culture shock in some companies.

3. Know the factors which influence value

Value is not just affected by explicit actions or transformations of state under the control of the enterprise. External factors can be involved in an SV-function. A very common example is exchange rates. The UK pound value of a contract expressed in US dollars will be affected by movements in the relative price of the two currencies.

Awareness of such factors comes from analysis of the independent variables in the SV-functions of the domain model. The relative importance of those variables can in turn be determined by the amount of stored value in all instances of a given entity across the system. For instance, in a simple domain model composed of the entities Task, Invoice and Money, the SV-function of Invoice may have an exchange rate dependency. If 80% of the enterprise value is in Tasks, 15% in Money and only 5% in Invoices, the importance of exchange rates is low. Whereas if the figures are 30% Tasks, 20% Money and 50% Invoices then mitigation of currency risk becomes more important.

An SV-function which has a dependency on an uncontrolled variable can be converted through scalarisation. With awareness of what the variables are, management has the choice between:

- Accepting the risk and instability of the raw SV-function
- Accepting a discounted, scalarised SV-function as a tradeoff for instability
- Financial hedging or similar strategies to remove the variable from the model – at a cost

The benefits to the enterprise (for motivation, measurement, incentives etc.) of having a stable SV-function can be included in a decision on whether to hedge. This may enable premium pricing of options, or make worthwhile the purchase of options which might be uneconomic purely on the basis of their monetary expectation value.

4. Choose variables which match your levers

The final purpose of value modeling must be to improve the quality of business decisions. Therefore the decisions which are within your competence to make should be those which your model is designed to support. You may have a choice of modeling in terms of estimated profit, or in terms of detailed state changes on individual domain objects. It is likely that you have more direct control over the state of domain objects than over profit. A model which shows the immediate consequences of specific actions is likely to give you more opportunity to make choices which increase value.

Value-add attribution

As stored value changes over time, it is possible to record the attributes of an object whenever such a change occurs. For example in the case study given below, a Task's value will increase over the course of its execution as various Communications take place. We can record each increase and the identity of the employee to whom the task is assigned when the increase happens.

This is a clear, simple and powerful reporting tool as it is simple to add the value contributions of an employee over time to determine their performance. More subtly we can record items such as Task.job.client or Task.type so that we can measure the value-add that is attributable to a client or to a specific step in the business process.

The fact that we have one simple output variable to sum, means that we can analyse easily in terms of the other dimensions. One can look at anything from how much value is added by each type of client, to which days of the week value is most effectively created.

A case study: QRS

[Note that this case study is not based on a real company but on a composite of various Inon clients, whose identities are confidential]

QRS is a provider of credit-related financial services to manufacturing companies. They have a portfolio of services related to checking credit and providing reports to their customers. Each order made by a client results in the provision of a service and ultimately in the output of a specific document which is delivered along with an invoice.

We present a stored-value model expressing the composition of the value delivered in one particular service. Other services within the company are composed of similar domain entities but are omitted for simplicity.

[Insert figures 1-5]

QRS is able to use these models for reporting and day-to-day management of employee performance. It makes a subset of the model visible to individual employees so that they can measure and optimize their own performance. It has also found applications of the stored value calculations in financial reporting and is able to create a more accurate and timely estimate of the value of work in progress and other accounting measures. This has the potential to reduce its capital requirements and enhance its ability to raise money.

Conclusions

Stored-value modeling translates the business design benefits of e^3value modeling into the domain of operational management. It allows the measurement of performance over time for specific instance of domain entities such as employees or clients. And in turn it allows feedback from those measurements to influence and improve performance.

Stored value, apart from being a useful management tool, represents the built-up financial worth of an entity. This starts to offer an understanding of the role of capital in e^3value models.

Acknowledgements

Many thanks to Rajiv Peter, Bastiaan Los, Nabil Elisa and Annette Mees for informative conversations which have contributed to the concepts outlined in this paper.

Bibliography

[to follow]