Quantifying Value in Software Product Line Design

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I wonder how little I’ll be worth when I’m his age...
Value

• The worth of all the **benefits** and **rights** arising from **ownership**. Two **types** of **economic value** are (1) the **utility** of a good or service, and (2) **power** of a good or service to command other **goods**, **services**, or **money**, in **voluntary exchange**.

• The extent to which a good or service is perceived by its customer to **meet** his or her **needs** or **wants**, measured by **customer's willingness to pay** for it. It commonly depends more on the customer's **perception** of the worth of the **product** than on its **intrinsic value**.

• Value changes over time.
Problem - 1

• When determining the scope of the SPL or when asked to create a new core asset or when asked to create an additional variant for an existing asset, what is the basis for making such a decision?
• The answer is to maximize Value – Cost
• For the purposes of this presentation the value of an item will be represented by all possible revenue coming from that item. Products that use it and any licensing fees that might result from leasing it out.
Problem - 2

• We will focus on the value of a variation point with the constraint that only one variation point is allowed per asset – just to keep the math simple.

• We also assume that each asset is independent of other assets.

• Since a finite amount of time is involved and there is some chance of failure we chose to use a Real Options formulation of the problem.
Basic model

\[ v_i(t, T) = \max \left( 0, -E \left[ \sum_{\tau=t}^{T} c_i(\tau) e^{-r(\tau-t)} \right] \right) \]

\[ + p_{i,T} E \left[ \sum_k \max \left( 0, \sum_{\tau=T}^{T^*} X_{i,k}(\tau) e^{-r(\tau-t)} \right) \right] \]

where

\[ X_{i,k}(\tau) = V M P_{i,k}(\tau) - M C_{i,k}(\tau) \]
concept

asset_1 \rightarrow \text{asset}_2 \rightarrow \text{asset}_3 \rightarrow \text{asset}_4

\text{product}_1 \rightarrow \text{product}_2

time
Parameters to the model - 1

• \( r \) is the assumed interest rate – in our case the riskless interest rate – often this is taken to be the interest on US Treasury Bonds

• \( i \) is the \( i^{th} \) variation point in the set. Alternatively we could use asset or variant. Each level of granularity requires changes in how the other parameters are computed.

• \( T \) is the target date for use of the variation point (in our model it is the first use)

• \( T^* \) is the limit of the model in terms of time
Parameters to the model - 2

• $p_{i,T}$ is the probability that variation point $i$ will be ready for use by time $T$

• Currently we assume “ready” means it is completely ready by time $T$ (including all variants).

• It could mean sufficiently complete for the first product that wishes to use it.
Parameters to the model - 3

- $c_i(\tau)$ is the cost of creating the $i^{th}$ variation point and is a function of time. So input data is a vector of expenditures over a set of time intervals.
- Since this is cost data it could be estimated based on past development experience.
- Initially, an organization could estimate the cost to develop the variation point and then evenly distribute the costs. As they gain experience the cost data could be more accurately distributed.
- In the example in the paper we used some different distributions of cost from one asset to another
Parameters to the model - 4

- $VMP_{i,k}(\tau)$ is the marginal value of the $i^{th}$ variation point in the $k^{th}$ product. That value is a function of time.
- Value is a function of revenue – we consider ways of making marketing projections of revenue to be beyond our scope but this is one of the practice areas and should be reasonably available.
- We take projections of revenue (however they were derived) and allocate them across time increments (which is how most revenue projections are stated). Then we divide by each product’s contents, in terms of number of variation points used, to allocate revenue per product per variation point per time period.
- This treats all variation points the same which is certainly not accurate. We will explore parameters such as variation point complexity as a possible weighting factor.
Parameters to the model - 5

• $MC_{i,k}(\tau)$ is the marginal cost of taking the specified variation point and tailoring it to work in a particular product.

• We take this to be similar to the $C_{\text{reuse}}$ factor in the SIMPLE model and use a flat percentage of the original development cost for this and allocate it uniformly over the time periods.

• We could include here the cost of adding a new variant.
Future work

• Build the full surface in which a product may not be built, and for varying deviations from the estimated costs and values.
• Try with real data
• Try numerous scenarios
• Add to the formulation to allow constraints to be relaxed