A Perspective on the Economic Life Span of COTS-based Software Systems: the COTS-LIMO Model

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ABSTRACT

The use of commercial-of-the-shelf (COTS) components is becoming ever more prevalent in the creation of large software systems. The rationale usually cited for this trend is that by using COTS components, immediate short-term gains in direct development effort & schedule are possible—admittedly, often as a trade-off for a more complicated long-term post-deployment maintenance environment. Even so, the conventional wisdom is that generally, the more of the system that can be built using COTS components, the better. Anecdotal evidence recently gathered while conducting data collection interviews for the COCOTS COTS integration cost model [1,2,3] suggests, however, that there may be diminishing returns in trying to maximize the use of COTS components in a system development. Beyond a certain point, an increase in the number of COTS components in a system may actually reduce the system's overall economic life span rather than increase it. This paper discusses why this may be true, at least in some cases, and proposes a new economic COTS lifecycle model, COTS-LIMO, as a way of possibly examining these effects. As of this writing, the suggestion being made here that increasing the number of COTS components in a system ultimately produces diminishing returns can only be called a hypothesis. But if proven true, even in some cases, then this could have significant implications for current policy decisions being made by governments and organizations encouraging an ever expanding use of COTS components in software system developments.

Keywords

COTS software lifecycle, COCOTS, COCOMO II, cost estimation, COTS operations & maintenance costs, equipment replacement, retirement decision analysis, metrics, software engineering

1 MODEL DESCRIPTION

The idea behind COTS-LIMO (COTS-Life span Model) is this: anecdotal evidence collected during data collection interviews performed to gather calibration data for the COCOTS model suggests that generally--though granted not universally--the more COTS software components you include in your overall software system, the shorter the *economic* life will be of that system, particularly if doing present-worth analyses comparing alternative designs using various combinations of COTS components, or when comparing COTS-based designs to simply building the entire system from scratch.

The reason is due to the volatility of COTS components. By "volatility" is meant the frequency with which vendors release new versions of their products and the significance of the changes in those new versions (i.e., minor upgrades vs. major new releases). When you first deploy your system, you of course have selected a suite of components that will provide the functionality you require while at the same time work in concert with each other. Over time, however, those products will likely evolve in different directions in response to the market place, in some cases even disappearing from the market all together. As a consequence, the ability of these diverging products to continue functioning adequately together if and when you install the newer versions will likely also become more problematic; the more COTS components you have, the more severe the consequences of these increasing incompatibilities will become.

Looking at the model itself (see the figure on the following page), the graph is broken into two regions bisected by the line **n**. As long as the number of COTS components in the system is less than **n**, the increase in experience gained by your system maintainers over time and thus the inherent improvements in their productivity will outpace the increased effort required to maintain the system as the

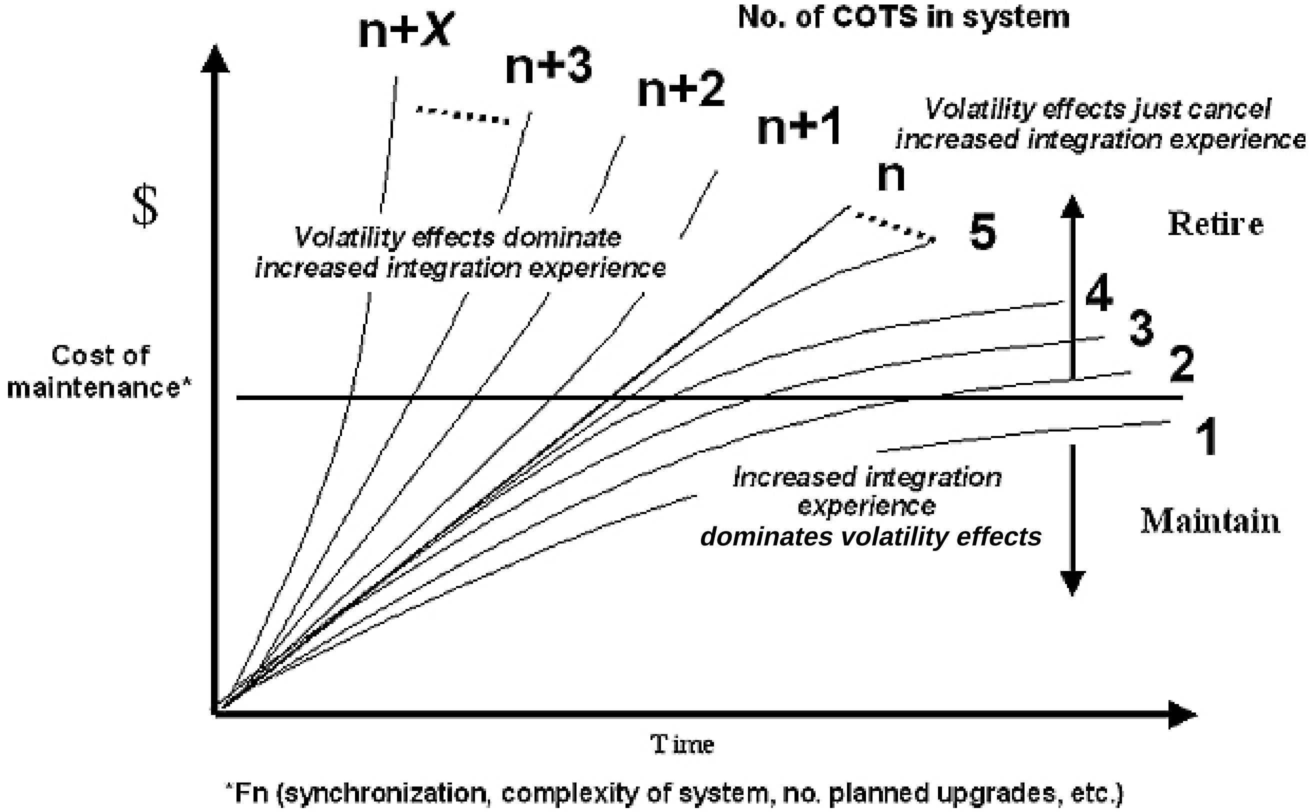

Figure 1. The COTS–LIMO model

COTS products it contains age and evolve in divergent directions. However, at some number of installed COTS components **n**, the breakeven point is surpassed and no matter how skilled and experienced your maintainers become, the increases in their efficiency at maintaining the system can no longer keep pace with the impact of the increasing incompatibilities arising in the evolving COTS components. At this point you have reached the zone in which the useful life of your system has been shortened considerably and a decision to retire the system will soon have to be made.

The actual value of **n,** the specific shape of the individual contour lines , and the location of the M-R (maintain-retire) line will be highly context sensitive, differing for each software system under review. However, I suggest that a meta-model could be developed using systems dynamics simulation modeling techniques [4,5] that would provide a framework for all the curves in the model. An estimator would then do "what if" analyses by supplying specific values for the parameters in the model, generating sets of contour lines on a case-by-case basis.

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