Determining the Reverse Engineering Cost (REC) Estimate of a Software Asset in Software Company Merger and Acquisition and Divesture Transactions.

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Abstract
This early idea paper relates to research in the area of metrics and modeling that can be used in software company Merger and Acquisition (M&A) and divestiture transactions. In particular the paper focuses on the role of estimating the Reversed Engineering Cost (REC) of a software asset that is being acquired or sold, and outlines a preliminary research effort to develop metrics and methodology to estimate REC.

1. Research Problem and Relevance
In Software Company M&A and divestiture transactions methodologies that help estimate costs-to-build the software asset that is being acquired or sold can play an important role in decision making. For example, consider the following two scenarios:

Scenario 1 (Acquirer Perspective): Google, the leading internet search-engine company, entered the user-created video broadcasting market by buying youtube.com for $1.65B [1]. Let’s assume you are the Chief Technology Officer (CTO) at Google. The Board of Directors at Google has asked you to help them to understand the cost of building an application similar to the youtube.com application as a back-up plan if the acquisition does not materialize and to understand the premium the company would be pay over the cost of building the application in-house for synergies in the acquisitions such as reduced time to market and access to content. How would you estimate the cost of reverse engineering the existing youtube.com functionality and develop the application?

Scenario 2 (Divesture or Licensor Perspective): You are the CTO of a leading software research organization that develops advanced software technologies and markets them to software vendors for commercializing your software asset. You have several software assets that use highly complex algorithms, have thousands to millions of lines of code and a varying degree of intellectual property protection such as patents. In preparation for a meeting with a potential buyer/licensor of one of your company’s software assets, the president of your company and you are discussing various variables to take into account in pricing your asset, when the president asks – “What would you estimate it would take the potential buyer we are meeting to reverse engineer our functionality and build the asset?”

From Scenarios 1 and 2 it is easy to envision the important role of a model that can help estimate the Reverse Engineering Cost (REC) of a software asset that is a candidate for potential acquisition, divesture or licensing. The importance of such an estimating model further becomes evident given that the Software Industry is one of the most dynamic industries in terms of mergers and acquisitions.

Software Equity Group, an Investment Bank that specializes in Software Mergers and Acquisitions estimated in 2004 that 1,630 software companies were bought at a cost of $52.1 billion. Software industry M&A activities accounted for 16% of all North American M&A activity [2].

The objective of this research is to identify a model and metrics that will help in determining the Reverse Engineering Cost (REC) estimate of cost of a software asset during software company M&A, software asset divesture or licensing.

2. Literature Review
The literature review was reviewed using key words-merger and acquisition, mergers and acquisition and software, software due diligence and software metrics.

Literature review of M&A analysis provides a large body of information into a variety of business aspects of M&A topics including: financial modeling prior to
acquisition [3], risk assessment [4], leadership alignment [5], industry case studies [6], and social aspects [7].

In contrast, literature review of M&A analysis in the software industry and software due diligence provides insight into IT integration issues during mergers and acquisitions [8]. Limited information specific to conducting a detailed due diligence for acquiring software companies is available. The work by Silva and Iyer on how “complementarily software stacks” creates value in M&A’s between software companies is one of the few articles that maps the evaluation of the software stacks to creating business value[9].

The software metrics literature review provided a large body of work related to software engineering metrics along various fronts including performance [10], architecture [11] and process [12]. Akimgbehin and Maxim provide a three layer model framework that captures key metrics [13]. The three layers include- (a) Primary Metrics: Line of Code (LOC), Function Points (FP), Person Months (PM) and Time, (b) General Purpose Metrics: e.g. productivity, COCOMO and (c) Special Purpose Metrics: e.g. reliability, quality.

There were no studies that leveraged the software metrics in the context of conducting technical due diligence and providing a framework or model with the reverse engineering cost (REC) of a software asset that was a subject of acquisition, divesture or licensing.

3. Research Methodology

The Webster Dictionary defines Intrinsic as- “belonging to the essential nature or constitution of a thing” [14]. In the context of the software asset the intrinsic aspects include software engineering metrics such as the number of lines of code, function points, number of Application Programming Interfaces, number of resources utilized and other variables that constitute a software asset.

The term Value has varied meanings in the Webster Dictionary including – “assigned or computed numerical quantity, something intrinsically valuable or desirable, estimate the monetary worth” [14]. In the context of this research the value of the software asset represents a numerical measure that reflects the effort involved in building a software asset.

The research will involve two phases. In the first phase the research will extend the work that is available in the area of software metrics such as Akimgbehin and Maxim three layer models and apply it to determine the intrinsic book value of a software asset. This phase will baseline the elements that constitute the software, software metrics in the asset and establish a numerical measure of the effort involved in developing the asset. The intrinsic book value sets the lower limit of what the software asset is worth to the organization that developed the asset.

In the second phase of the research the intrinsic book value of the asset is supplemented with a modeling layer that can be used to alter the parameters of the intrinsic book value model developed in the first phase and estimate the Reverse Engineering Cost (REC) of the software asset if a different organization was developing the asset. This sets the potential upper limit of what the asset is worth to a potential buyer if other synergies such as time to market or market share are not taken into account.

Establishing the lower limit of what the asset is worth to the company that developed the asset in phase 1 and providing the ability to dynamically change the REC estimate to a potential buyer in Phase 2 will provide critical inputs to software asset pricing and acquisition decisions.

Given the sensitivity and challenge of obtaining the data from actual multiple mergers and acquisitions, this research will focus on collecting data on 15-25 software assets from a single company and estimating the REC from an asset divestiture and licensor perspective. If the information and software metrics that constitute to the intrinsic book value of a software asset are available as part of the technical due diligence in Acquisition scenario, the REC can be applied in Mergers and Acquisition transaction also.

4. Measures

The key measures that are envisioned include

**Code Metrics**
- Number of lines of code
- Number of classes
- Programming language

**Functional Metrics**
- Number of function points
- Number of use cases
**Intellectual Property**
- Patent protection
- Algorithm complexity
- Open source content
- Third-party content

**Integration**
- Programming APIs
- Sub-system integration APIs

**Resources**
- Number of resources
- Type of resources (architects, analysts, project managers, programmers, testers, etc.)
- Duration of resources

**Software Architecture**
- Component/SDK
- Embedded software
- Web application
- 32 bit client server application
- Web services

5. Hypotheses

1) The intrinsic book value of the asset can be established using software engineering metrics.

2) The intrinsic book value is a better measure than a traditional measure such as person years invested in a software asset to estimate the development effort.

3) The Reverse Engineering Cost (REC) can be modeled from the variables and metrics identified in establishing the intrinsic book value of the asset.

6. Limitations and Conclusion

The research can be used in a variety of decision making situations in Software Company Mergers and Acquisitions or divestiture transactions. The intrinsic book value can be used to establish base line pricing, normalize data across a portfolio of software assets and assist with prioritization efforts/portfolio management. The REC estimate can help with make versus buy and pricing decisions. It is important to recognize that the research does not address market based asset valuation that investment banks, hedge funds, corporate M&A teams use and take into consideration variables such as reduced time to market, cost savings, projected growth rate from synergies during Software Company M&A. This research is a supplement to market based valuation and should not be confused or used as a substitute to market based valuation models.

7. References


