

# Beyond Cost: The Drivers of COTS Application Value

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A survey of 126 management information systems managers evaluated key attributes of COTS software. The results helped create an enterprise COTS software analyzer that should be useful to both buyers and suppliers.

In the early days of business computing, most software was written from scratch. Companies created applications to automate key business processes, such as American Airlines' legendary Sabre computerized reservation system. Such leading-edge applications were challenging to develop; Sabre's first version was three years behind schedule when it became operational in 1964.<sup>1</sup>

While companies still build custom applications today, the advent of COTS software over the past 30 years has dramatically changed the way they acquire software. This trend began with packaged mainframe applications in the 1970s. The rise of packaged material requirements planning systems for manufacturing organizations followed in the 1980s, and enterprise resource planning (ERP) systems, designed to handle virtually all of an organization's business computing needs, evolved in the 1990s. COTS software purchases now represent about 70 percent of corporate business software expenditures,<sup>2</sup> and recent estimates put the annual market for COTS software applications at almost US\$200 billion worldwide.<sup>3</sup> Acquiring COTS software has become an economic necessity because it shortens the implementation timeline and lessens the unpredictability associated with developing custom applications.<sup>4,5</sup> Organizations are increasingly acquiring COTS software at the enterprise level and adapting it to their needs.<sup>6</sup>

Surprisingly little research exists on what attributes of enterprise COTS software organizations value most, leaving COTS developers to make educated—and sometimes arbitrary—guesses about market needs when developing such systems. Although some researchers have done case studies in defense organizations,<sup>7</sup> none have conducted large-scale field studies that generalize to commercial sectors. Experts have cautioned that both software developers and buyers need empirical knowledge to truly make better decisions about COTS-based systems.<sup>8</sup>

In an extensive study involving 126 organizations, we analyzed how management information systems (MIS) managers evaluate key attributes of COTS software. The results provide surprising insights into the COTS soft-

ware characteristics that buyers value most. The findings have important implications for COTS buyers and suppliers. For buyers, we provide an assessment framework for evaluating COTS software. For companies that develop COTS software, we provide insights into what attributes their prospective customers value most.

### **Buying can be just as risky as making**

A desire to lower software costs and to avoid reinventing the wheel has driven the shift toward acquiring enterprise COTS software. The perception also exists that purchasing software applications carries less risk than building them in-house. While this alternative might *appear* risk-free, over half of all enterprise systems implementations fail.<sup>9</sup> The reason? Implementing COTS software often involves customizing it and integrating it with existing systems. Because packaged software embodies the best practices captured from the way other firms do business, implementing the package usually requires organizational changes to adapt business processes to fit the software. With organizational change comes resistance. Ironically, this means that some of the same risks that plague custom software development are associated with COTS software. In some cases, companies can trace implementation failures involving COTS software all the way back to the choices they made during the selection process.

The experience of Wegman & Associates, a Norcross, Georgia-based office furniture company, illustrates this point. The company purchased a COTS package eventually deemed “ill-suited to its business.”<sup>10</sup> Although the company hired a consultant to help select the software, Myles Wegman, the company’s founder, later conceded that “they selected the software on what they thought our needs were. Then they discovered they didn’t really understand our business.”<sup>10</sup>

The company modified the software, but problems persisted and employees became disgruntled. Ultimately, Wegman decided to “eat the \$140,000 he figures it cost” to install and modify the software.<sup>10</sup> But the dollars wasted on this effort didn’t reflect the problem’s true cost, which included lost productivity and declining employee morale. To help his employees vent their anger, Wegman took the unusual step

of hiring an artist to help them express their feelings. One employee created a piece of art he entitled “Momma Told You Not to Play in the Street” by driving his pickup truck over a box that contained the software’s manual. To complete his artwork, “he mounted it with some photos of him driving over the box, and, for a final touch, added two floppy disks he melted by popping them into a microwave oven.”<sup>10</sup>

As humorous as this example is, it reflects some of the real problems that can result from choosing inappropriate COTS software. Unfortunately, most organizations lack a rigorous software procurement process, making effective purchasing decisions difficult. Selecting the right enterprise COTS package can be daunting, yet little research exists to help guide organizations.

### **Our research approach**

The list of possible criteria for evaluating COTS software is long. However, on the basis of prior research, we were able to identify seven characteristics that IT managers repeatedly mention as being important and which represent a reasonable set of evaluation criteria:<sup>4,6,7</sup>

- Functionality
- Reliability
- Cost
- Ease of use
- Vendor reputation
- Ease of customization
- Ease of implementation

While we don’t claim that these characteristics are exhaustive, we believe that they represent good baseline criteria. Organizations can add other characteristics to customize the criteria to a particular setting.

For our study, we randomly surveyed 126 mid- to senior-level MIS managers. MIS managers generally report to their organization’s chief information officer and are frequently responsible for developing their organization’s IT portfolios. Because they’re responsible for software purchasing decisions,<sup>11</sup> they were the ideal respondents for our study. We contacted the managers by mail and provided the URL for a Web-based version of the survey. We asked them to evaluate hypothetical COTS-based systems to gain insight into the relative importance they ascribe to these factors. On

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## Evaluating the COTS Packages

We presented eight COTS packages, one by one, to the study participants. The profiles varied in the extent to which each of the COTS package attributes was present (that is, high or low), following the conjoint study approach. Here's an example of such a profile:

- Functionality: Low
- Reliability: Low
- Cost: Low
- Ease of use: Low
- Vendor reputation: High
- Ease of implementation: High
- Ease of customization: High

Participants evaluated each COTS package on the basis of the information in the profile, using their own considerable purchasing experience and expertise to determine the level of value that they believed that package had for their organization. We used a nine-point semantic-differential scale for these assessments. We provided the following definitions for each COTS package attribute at the study's beginning:

- **Functionality:** The extent to which the COTS package contains all the features and functions that the organization had formally identified for a candidate COTS solution
- **Reliability:** The software's overall quality and stability
- **Cost:** The total software acquisition and implementation cost
- **Ease of use:** The intuitiveness of the user interface
- **Vendor reputation:** The reputation that the vendor has established for unconditionally standing behind its products
- **Ease of customization:** The extent to which the package could be easily modified to meet the responding organization's unique needs
- **Ease of implementation:** The set-up time and effort required to implement this package in respondent's organization

average, the respondents had 16 years of IS experience and had been involved in more than 30 COTS software selection decisions.

Using the conjoint analysis methodology common in marketing research, we asked each respondent to evaluate eight hypothetical profiles of packaged enterprise-level COTS-based systems. Each profile had a different combination of attributes. We generated the profiles using the conjoint algorithm with the goal of maximizing the information generated in the fewest application profiles.

Consider a simple example of this approach. Let's say that a luxury car manufacturer suspects that five attributes—acceleration, price, fuel economy, reliability, and styling—primarily influence whether cus-

tomers will pay \$75,000 for the car. A conjoint study lets the car maker test whether each of these attributes influences the purchase decision and determine the influential characteristics' relative order of importance. The study approach involves showing potential consumers different versions of the car with different levels of each attribute and asking how likely they would be to buy each. Then, using a statistical estimation technique, the manufacturer can estimate each attribute's *part worth utility*.

The "Evaluating the COTS Packages" sidebar shows an example of a COTS profile we used in our study. It also gives the definitions that we provided to our survey respondents for each COTS package characteristic. The analyses revealed whether each of the seven characteristics influenced the COTS software's perceived value and the relative importance that MIS managers ascribed to each characteristic.

We described each package in terms of a different bundle of the seven characteristics. We set their values to either high or low for a given COTS package. For each profile, we asked subjects to assess the perception of overall value associated with an enterprise COTS-based system having these characteristics. We also collected responses for a series of questions on the importance ascribed to vendor firm size, vendor stability, post-acquisition support, and subjects' willingness to adopt a package that runs on a platform different from their organization's dominant standard.

Our survey had a 25.2 percent response rate, providing us with 1,008 COTS software evaluations (8 COTS-based system profiles × 126 responding managers) from 126 organizations. We analyzed the evaluations using multiple regression modeling to deduce whether each of the COTS software characteristics influenced the managers' assessments and to determine the characteristics' relative weights. Using the SPSS 11.5 statistical-analysis program, we performed analyses using multiple-regression techniques to determine each characteristic's statistical influence (beta weight) and to verify that the statistical significance of the relationship between the COTS package's characteristics and its overall perceived value is not due purely to chance. This revealed the relative importance the managers ascribed to the different evaluation criteria. We also measured the willingness to recommend purchase

and obtained nearly identical results in terms of the variables that we found to be significant and their relative importance.

### Functionality and reliability rule

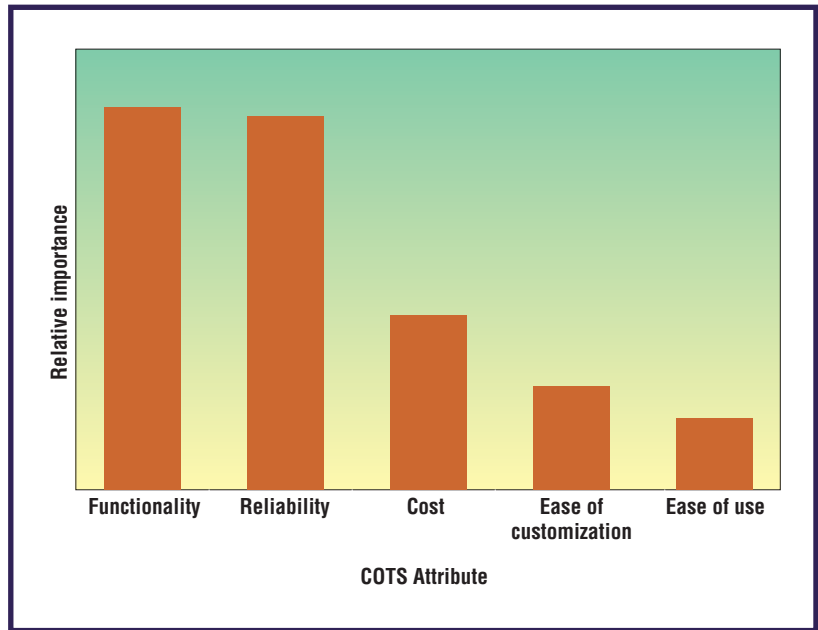
Functionality and reliability emerged as the most important factors affecting a COTS package's perceived value. That functionality would be a central concern is perhaps no surprise. If an organization seeks an enterprise package to replace its current software, making sure that the package delivers the necessary functionality will be of paramount concern. More surprising, perhaps, was that MIS managers felt reliability was almost equally important. When we shared our results with IT managers, they explained that organizations often look to packaged software to replace legacy systems that have become unreliable and difficult to maintain. In these situations, reliability becomes a key driver in the acquisition process.

Figure 1 shows the relative importance of functionality and reliability in relation to the other factors that we also found to be statistically significant (at a 95 percent confidence level) in shaping perceptions of overall COTS package value: cost, ease of customization, and ease of use. Some of these findings are intriguing, because the widespread belief exists that ease of use and flexibility are more important than reliability and application integrity.<sup>4</sup>

### What about the other attributes?

As Figure 1 shows, functionality and reliability are twice as influential as cost in terms of shaping managers' overall value perception of a COTS package. Organizations acquiring enterprise COTS applications often view them as black boxes that provide functionality within some constraints.<sup>6</sup> COTS functionality usually can't be changed extensively to meet the idiosyncratic business needs of the acquiring organization.<sup>5</sup> So, buyers are inclined to weigh functionality higher than other attributes. Ease of customization and ease of use are also important in shaping managers' overall value perception but are less influential than functionality, reliability, or cost.

Interestingly, neither vendor reputation nor ease of implementation was found to be significant in terms of shaping managers' perceived value of COTS packages. Enterprise applications' longevity raises serious concerns



**Figure 1. Five significant factors' relative importance in predicting perceived COTS package value.**

about whether the system will be adaptable to the organization's future needs and whether the vendor will be able to support it in the future.<sup>6</sup> Perhaps managers are unwilling to admit that they place much importance on a factor as subjective as vendor reputation.

With respect to ease of implementation, the results we obtained are surprising, given that most of the obstacles that organizations encounter with ERP software relate to implementation.<sup>2,12,13</sup> COTS integration with other enterprise applications is often necessary for organizations to fully benefit from them, but this is often risky and rarely trivial.<sup>14</sup> Interoperability of COTS software with other enterprise applications can be especially problematic because of architectural mismatches.<sup>5</sup> The cost of integrating COTS within the enterprise infrastructure can therefore be significant, but hidden at the outset. In some cases, this cost can far outweigh the savings of choosing COTS software over custom development. Such costs become most pronounced when the company needs to tightly integrate the COTS-based system with other organizational IT systems. Vendor support is tremendously important for such integration.<sup>5</sup>

### COTS software's true cost: Maintenance

COTS software's true costs become apparent in an implemented system's maintenance phase.<sup>8</sup> These maintenance costs can easily equal or exceed what you'd spend for custom-

## The Enterprise COTS Software Analyzer

Using the following process, you can determine a COTS package's relative value.

1. On a scale of 1–10, where 1 is low and 10 is high, how would you characterize this COTS software package in relation to others you've seen? (See the "Rating" column Table A).
2. Add the five weighted ratings (see the "Weighted rating" column).
3. A higher overall score indicates higher package value. 10 means the least value and 100 means the most value (see Table A's bottom row).
4. Use the overall package value score ranges in Table B as a guide for interpreting the score. You can directly compare different packages using these scores.

**Table A**

### Determining a COTS package's overall value

COTS software characteristics	Rating	×	Weight	=	Weighted rating
Functionality	8	×	3.5	=	28
Reliability	10	×	3.3	=	33
Cost (1 = costly, 10 = inexpensive)	5	×	1.6	=	8
Ease of customization	10	×	0.9	=	9
Ease of use	10	×	0.7	=	7
Overall value score					85

**Table B**

### Overall value score ranges

Score	10–28	29–46	47–64	65–82	83–100
COTS software value level	Low	Moderately low	Medium	Moderately high	High

developed applications, and dealing with new releases that incorporate bug fixes and repairs can become taxing.<sup>8</sup> Customizing COTS software can also add dramatically to the overall cost. Why, then, do IT managers seem to downplay ease of customization and ignore the importance of ease of implementation?

One explanation is that managers' perceptions of value are based on a set of attributes that are most salient during purchasing. Many COTS buyers don't look beyond the up-front costs and ignore the longer-term maintenance costs associated with the software.<sup>4</sup> So, COTS package buyers might be more apt to focus on functionality and purchase price than, say, implementation, which might even come from a separate budget.

For an analogous situation, consider the fact that Hummer H1 buyers' number-one

complaint is poor fuel economy. While one might reasonably ask, "What were they expecting when they purchased a 7,263-pound vehicle?" the fact remains that many car buyers ignore the long-term costs of having to fuel a gas-guzzling vehicle. If this enters into their decision calculus at all, it generally ranks lower than other attributes. Long-term maintenance costs, while not incurred up front, are a large component of the cost of acquiring a COTS application.<sup>5</sup> Buyers might think of software acquisition costs in a fashion similar to Hummer H1 buyers, failing to properly account for the costs associated with buying a package that's difficult or costly to implement. They must, therefore, exercise caution when using our findings to make COTS acquisition decisions because the results might underestimate the associated long-term costs.

### Implications for COTS buyers and suppliers


These findings have important implications for enterprise COTS software buyers and suppliers. For buyers, the list of attributes, along with some suggested relative weights, provides a starting point for developing a customized tool for evaluating and comparing COTS software applications. A simple COTS software evaluation worksheet, derived from our study's results, provides a quick-and-dirty assessment tool (see "The Enterprise COTS Software Analyzer" sidebar). Buyers can combine inputs in the form of ratings for each COTS software attribute to provide a quick overall assessment. The assessment tool produces an overall score ranging from 10 to 100—the higher the score, the greater the COTS software's overall value. The tool helps guide the acquisition process by providing an easy way to compare the relative value propositions that different COTS software packages represent.

You can also use the analyzer to perform what-if analyses to determine the results' sensitivity to changes in software attributes. For example, a manager might use the tool to help answer the question, "If vendor A's software were less expensive, would that make it attractive enough for us to want to purchase it over vendor B's software?" This approach can allow direct comparisons of two or more COTS-based systems. Managers can also use the tool in a group setting, with each key stakeholder participating in the package ac-

quisition process. This can help reveal differences in perception or conflicting views that could spell trouble later if left unresolved.

For COTS software suppliers, the relative weights that we obtained provide valuable information on what influences buyers' overall perceptions of COTS software value. This information provides guidance to software companies who wish to maximize the value proposition their software products represent.

In particular, our results should send suppliers a clear signal that software reliability is critically important in shaping overall perceptions of value. While suppliers have traditionally been attuned to functionality's importance, they've continued to offer products that contain numerous bugs and that would be considered unreliable relative to other types of products. A recent National Institute of Standards and Technology study suggests that software bugs cost the U.S. economy an estimated US\$59.5 billion each year and that users incur 64 percent of these costs, or roughly \$38 billion, each year.<sup>15</sup> It's only a matter of time before buyers begin to exert more pressure on suppliers to further improve reliability. So, suppliers will have to raise the threshold with respect to what they consider to be an acceptable level of software reliability.

**J**ust as vehicle manufacturers have gained insight into consumer behavior by systematically evaluating various product attributes, software vendors can gain similar insights by examining the relative value that prospective buyers ascribe to a relatively small set of core product attributes. In following this marketing-oriented approach, COTS software suppliers should be able to leverage their limited resources in a manner that will let them attract and retain the broadest possible customer base. The alternative is to assume that all product attributes are equally important or to simply guess what attributes buyers value most. While our research leaves many questions unanswered, it represents a solid step forward in understanding what attributes of COTS software matter most in the marketplace. 

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