IT complexity: model, measure and master

Thoughts
IT complexity: A new metric to evaluate the impact of change

What if complexity was a discreet, measurable metric rather than a discretionary, ambiguous term? Could a complexity metric reshape the decisions and activities of a CIO?

The information technology field is filled with quotes and anecdotes about organizations trying to contain, explain and manage complexity. Often these words reflect an inclination to assume that if complexity exists, we should try to reduce it. As computer science pioneer Alan Perlis once said, “Fools ignore complexity. Pragmatists suffer it. Some can avoid it. Geniuses remove it.”

Pure genius, however, rarely exists. And with our world in a state of constant change, we need to master, not remove complexity. The reduction of complexity can reach diminishing returns, and the existence of complexity can allow greater business flexibility. Without a doubt, an appropriate level of complexity is necessary to maximize return.

Leading financial institutions recognize the need to acknowledge, embrace and harness complexity. They understand that the many layers and connected dependencies of today’s IT environments cannot be managed with simple heuristic, or experience-based, approaches alone, but instead require objective, quantifiable measurement of their origins and effects.

This white paper describes a groundbreaking initiative underway by Germany-based Commerzbank and consulting firm Capco to develop a model for measuring IT complexity in the financial services industry. Importantly, individual financial institutions will be able to derive value from this new model through immediate application to their existing environment, while reaping long-term benefits through contribution to an industry database of results.

The power of quantitative metrics

Today, CIO decisions are tied almost exclusively to experience and straightforward financial analyses, such as project costs and estimations. Some companies also apply scenario analysis to technology decisions for risk management purposes.

But if a quantitative metric for complexity was available to complement experience and the typical financial metrics, how might those decisions change?

Historical parallels from other industries help illuminate the possibilities. A mid-20th century auto assembly line manager could not have imagined the possibility of Six Sigma and Lean techniques delivering five-nines production quality. The pharmaceutical industry has made stunning advancements in statistical analysis to prove drug effectiveness.

Securities trading offers an illuminating example in financial services. Trading has come a long way since a century ago when curbstone brokers traded small and speculative stocks outside the New York Stock Exchange. Back then brokers did not stand on the street with a computer in hand. They had no notion of mathematically valuing an instrument and quantitatively evaluating the risk associated with price movements.
Today algorithmic trading using Greeks is an instantaneous activity that leverages risk metrics as a core component of calculation. What was viewed as hard to measure 10 years ago has been made routine by the availability of models and data.

Similarly, IT leaders need a transparent, objective framework to augment the experience they bring to decision making. Such a framework can aid in articulating and communicating decisions both across and outside the organization, an increasingly important requirement as corporate directors and regulators expand their scrutiny of technology decisions.

How decisions related to complexity are made today – and could be made tomorrow

Complexity has become an overworked word in the IT field. It is used with increasing frequency in publications and elsewhere to describe how management views decision making broadly, as well as in relation to specific functions across and within industries, such as IT management and risk management.

All CIOs have biases based on experience. Their understanding of the familiar forms the basis for the gut decision they inevitably must make. The introduction of a complexity metric allows for an exploration of alternatives that experience may not shed light on.

When faced with decisions related to delivering IT change, CIOs must categorize the situation, usually resulting in a subjective measure of complexity: “We will replace system X because the economics indicate lower operational cost and a positive payback.”

Woulnd’t that exercise be more productive, and might that scenario unfold differently, with the introduction of a model-driven complexity measure? “Based on the IT complexity metric in our business case, we’ve determined that if we replace system X, the resulting system will likely be just as complex because of underlying process and integration issues, and we will never realize a positive return.” This type of thought innovation allows for an examination of other methods to address the issue, such as reengineering the system.

CIOs with a lot of experience in complex decisions are arguably in a better position, as they can subjectively associate future change with historical observations. However, if CIOs supplement their hard-earned experience, native intuition, and traditional financial analyses with an IT complexity metric, they will have all of the pieces needed to make critical decisions that benefit both their IT department and the enterprise.

How a complexity metric fits into the CIO agenda

Whether thought about consciously or not, every decision a CIO makes influences overall IT complexity. Complexity in turn drives up cost, makes quality harder to achieve and affects flexibility. Thus the core dimensions that dominate a CIO’s agenda – cost, quality and flexibility – are all influenced by complexity, and IT leaders have to make daily tradeoffs between
them. Consciously taking complexity into account, via a complexity metric, will improve the effectiveness of CIO decisions – and make them easier to explain and defend (See Figure 1 on page 5.)

The cost impact

Cost containment has been one of the most pressing issues for CIOs in recent years. IT is continuously expected to increase efficiency. CIOs of large financial institutions preside over significant IT budgets – often US$1-2 billion – and, by extension, substantial complexity. The decisions they make can influence direction for many years to come and have potentially large financial consequences.

Clearly, complexity drives cost. One or both of the following examples will be familiar to any CIO:

- **Technology complexity** – A new software package offers great functionality to the business. Unfortunately, it runs on technology that requires different skills from those of existing IT employees. Consequently, people need to be retrained, additional upgrades need to be made for the new technology components and expensive external expertise has to be contracted for.

- **Interface complexity** – A major new development is well underway. Then integration testing starts. Suddenly a number of interfaces are affected and need to be tested that were not part of the original scope. There are unexpected effects on the downstream systems, and testing expense climbs exponentially.

Complexity drives cost, and it also is a good indicator of unexpected cost increases. Modeling how complexity increases in the two examples above would have alerted IT managers to the cost impact.

Based on this exercise, managers might mitigate cost increases or at least make more informed choices.

The quality impact

The issue of quality has also become more important on the CIO agenda. There are clear correlations between quality and long-term operational costs. And the maturation of technologies has led IT end-users to be less forgiving of quality issues. Complexity correlates to quality intuitively, as the following examples highlight:

- **Technology and interface complexity** – Production stability is one aspect of system quality. A more complex application landscape is more prone to suffer from incidents after deploying changes because there can be unexpected, and thus untested, interdependencies with systems that were not supposed to be affected by the change.

- **Functional and interface complexity** – Error analysis and resolution is another example. In more complex environments it is harder to identify the root cause of an error and more risky to fix it without introducing other errors.

With a complexity metric, IT executives can manage quality more effectively.
Figure 1. Complexity framework
Consider IT complexity to make more informed decisions

Decision regarding IT change e.g. projects, architecture, transformation

IT Complexity

Dimensions
- Functional
- Interface
- Data
- Technology

Cost
Quality
Flexibility
“Measurement is the first step that leads to control and eventually to improvement. If you can’t measure something, you can’t understand it. If you can’t understand it, you can’t control it. If you can’t control it, you can’t improve it.”

–H. James Harrington

The flexibility impact

The relationship between complexity and flexibility often forms a “vicious circle.” Flexibility gained by adding new functionality and new technology quickly drives up complexity. The more complex the system landscape, the harder and more risky changes become. As a result, flexibility decreases, as these examples show:

• **Data complexity** – When implementing compliance regulations, many banks are hindered by the fact that they do not have all customer data stored consistently in one place in the enterprise.

• **Functional and data complexity** – Product introduction, considered to be a hallmark of flexibility, is more difficult in a highly complex environment because of the interdependencies and effects of systemic changes.

In summary, a complexity metric will increase transparency and provide insights that help in managing cost, quality and flexibility. A metric will also help uncover intelligence associated with every strategic decision, improving appreciation of the delicate intricacies associated with the CIO agenda.

How do you measure complexity?

The observation offered above by the leading performance and quality expert H. James Harrington highlights the central role that measurement plays in addressing complexity. In its current state, the Commerzbank/Capco complexity model applies to the application landscape: single applications, application clusters, application domains and the entire application landscape.

The model consists of several complexity indicators covering the relevant dimensions of application complexity. We have statistically validated these complexity indicators through quantitative research using Commerzbank data on approximately 1,000 applications over three years. (See Figure 2 on page 7.)

A tacit inverse correlation exists between flexibility and complexity that is difficult to quantify. However, we have established a statistically significant correlation between the complexity indicators and both cost indicators, such as maintenance spend, and quality indicators, such as the number of incidents occurring during production.

The complexity indicators of the model cover four dimensions: functional, interface, data and technology.

• **Functional.** One driver of functional complexity is the functional scope of an application cluster. The sum of weighted use cases serves as the figure to measure this. In each use case, a weight factor is assigned, from “one” for simple use cases, such as changing one data field, like address, to “four” for use cases with involved logic. Use cases have been classified by expert judgment. Other indicators measure the functional redundancy and standard conformity of the solution architecture.
Figure 2. Complexity dashboard, a sample view

Top-level view on aggregated complexity metrics – indicates areas for further analysis:

- High Implementation Quotient values for Investment Banking related groups – i.e. implementation of investment banking applications is more “complex” than comparable commercial banking applications (assuming an equal number of functions are covered).
- Functional group, Securities Processing, is characterized by a high number of applications and interfaces with other functional groups.
- Data Warehouse Staging with “only” 8 applications shows the highest value for quantity of interfaces which reflects the number of source systems.

Rise against the quarter before
Descent against the quarter before
• **Interface.** Interface complexity is determined through the sum of weighted interfaces. The weights are calculated by type of interface, such as API, file exchange, database view and broker Web service. This indicator shows the interface intensity. The ratio of internal to external interfaces is another relevant indicator.

• **Data.** Data complexity is measured by the number of database objects in an application cluster.

• **Technology.** Technology complexity is monitored through a number of drivers, including business criticality and prescribed time for recovery of applications under consideration. Another technology indicator is the variety of operating systems employed in the application cluster.

Each indicator measures a relevant aspect of complexity. In our experience, these measures become most powerful if considered in conjunction. Sometimes it is useful to aggregate them into one overall complexity score to simplify matters, such as tracking the complexity of legacy architecture over time. For other problems and decisions, the individual dimensions need to be considered – for example the trade-off between functional scope and interface intensity in defining application domains.

To date, we have measured time series of statistically validated complexity metrics for Commerzbank. We believe that, ultimately, a single company cannot develop a comprehensive approach to complexity modeling on its own. Models evolve when multiple organizations contribute data and experience. For example, think about how risk measures improve when a financial institution has more years of, for example, defaulted bonds to model.

Bottom line, the more companies that use the complexity model and contribute to a standard database over time, the higher the benchmarking quality.

**Immediate application and benefits**

The complexity model, as it stands today, can be applied to important IT decisions at any financial institution after some calibration and data gathering. The model can also help educate IT leaders. And it should foster dialog between the IT department and the business units it serves.

• **Decision and trending analysis.** IT executives will immediately be able to use the complexity model to analyze the impact of decisions and perform trending analysis. This will help them understand how their decisions might affect the future cost, quality and flexibility of IT projects. To achieve these results, a phase of data gathering and calibrating the model is necessary. Depending on the availability of relevant information, such as data on the interfaces of applications under consideration, this process will take a few weeks to a couple of months. Again, this type of analysis will become more precise and robust over time as collected data is enriched.
Similar to the evolution of other analytics-driven metrics as they were applied to different solution spaces, the complexity model will offer a number of possibilities in the not-too-distant future.

- **Educating IT leaders.** The numbers produced through use of the complexity model will vary across organizations. Also, similar to other analytics-driven metrics, the definition of thresholds for the model will be set over time as both IT leaders and business units gain better appreciation of its merits. Each scenario modeled, coupled with the passing of time to observe the outcomes of a metric-driven decision, will enable IT executives to test their own hypotheses and build a stronger foundation of knowledge to support future decisions.

- **Bridging the gap between business and technology.** In addition to informing decision making within the IT organization, a complexity measure should help IT executives to better explain and defend their decisions to the business. An objective measurement of complexity will be a monumental step toward addressing the concerns of business unit managers and other executives regarding IT systems development. CIOs will no longer need to rely on soft, subjective explanations supported by experience. Instead, they will be able to produce a quantifiable metric that provides a new level of transparency.

To date, the complexity model leverages data from a single firm: Commerzbank. Ultimately, the model will improve over time as data from more institutions allows for more accurate benchmarking. Making the model available to others will enable benchmarking across multiple organizations, increasing the credibility of the metric based on comparative data points from across the financial services industry. This ever improving precision will continue to add value for IT executives.

A complexity metric will help CIOs articulate short- and long-term implications of initiatives, costs over time, impacts on existing operations and the business as a whole, and strategic implications and justifications of high-risk projects. By articulating complexity in this way, CIOs will be able to strengthen intercompany partnerships and create new opportunities to achieve measurable results.

**Expansions and possibilities**

While the complexity model at present is focused primarily on IT applications, it is not difficult to envision how it might evolve and be extended to a broader set of technology decisions. Similar to the evolution of other analytics-driven metrics as they were applied to different solution spaces, the complexity model will offer a number of possibilities in the not-too-distant future, including:

- **IT architecture.** Perhaps most interesting to IT leaders is the notion of looking for complexity across not just the application stack but the overall architecture. This will support conclusions regarding the impact of change on the entire infrastructure, including networks and other aspects, and is perhaps one of the most natural
extensions of the complexity model. While this advancement will require expansion of inputs to the model, such as indicators on infrastructure and middleware components, the output will provide IT executives a more rounded perspective.

• **IT processes.** Extensive work has been done over time on IT supply chain modeling. In the future, incorporating this thought leadership could produce a complexity metric that is oriented to the process dimension of IT decisions, which could aid in decisions relating to the software development life cycle – for example, determining the right allocation of time and resources to each leg of the SDLC. This concept could be extended further to include complexity aspects of sourcing decisions.

• **Business processes.** It is easy to intuit a relationship between a business process and the technical complexity needed to support it. In many instances, the technology cannot be simplified without corresponding simplification of the business process. Business process simplification is evident in many initiatives, from reengineering to Six Sigma. In the future, a complexity metric could serve as a process measurement or a heuristic to measure the efficacy of business process changes. These applications could allow for the quantification of business complexity and provide a more holistic view of changes needed to drive the CIO agenda.

Emboldened by insights into IT, organizations might consider measuring the complexity of business architecture, as well. IT decision making on the business side would likely benefit from more explicit and quantitative consideration of complexity.

**Conclusion**

The notion that you can’t manage something you can’t measure has been ingrained in business for many years. The creation of a complexity model presents an extraordinary new opportunity to understand the levers that drive cost, quality and flexibility. Importantly, such a model becomes stronger as more data is added to it.

We hope this white paper has helped stimulate your interest in exploring complexity and how you can harness it to improve your organization. We also invite you to join the conversation as we continue to explore complexity issues. Among topics we plan to address:

• How is complexity calculated, and how would an organization embark on a complexity measurement program?
• How does the complexity metric influence the strategic decision process?
• What is envisioned for the executive dashboard for complexity measurement and scenario modeling, and how would the complexity metric be used in concert with other IT metrics?
• How is complexity modeling different across various corporate paradigms (mid versus large size, new versus old firm, single line versus multiline business, institutional versus retail)?

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About Capco

Capco, a global business and technology consultancy dedicated solely to the financial services industry. We recognize and understand the opportunities and the challenges our clients face. We apply focus, insight and determination to consulting, technology and transformation. We overcome complexity. We remove obstacles. We help our clients realize their potential for increasing success. The value we create, the insights we contribute and the skills of our people mean we are more than consultants. We are a true participant in the industry. Together with our clients we are forming the future of finance. We serve our clients from offices in leading financial centers across North America and Europe.

About Commerzbank

Commerzbank is a leading bank for private and corporate customers in Germany. With the segments Private Customers, Mittelstandsbank, Corporates & Markets, Central & Eastern Europe as well as Asset Based Finance, the Bank offers its customers an attractive product portfolio, and is a strong partner for the export-oriented SME sector in Germany and worldwide. With a future total of some 1,200 branches, Commerzbank has one of the densest networks of branches among German private banks. It has above 60 sites in 50 countries and serves more than 14 million private clients as well as one million business and corporate clients worldwide. In 2010 it posted gross revenues of EUR 12.7 billion with some 59,100 employees.

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