Chapter 2
The Hidden Time Bomb Known as Dynamic Complexity

Abstract Today new business challenges arise because the interdependencies between business's processes, services and infrastructure have become overly complex and exist in a constant state of change, known as dynamic complexity. The impacts of dynamic complexity always result in loss of quality, quantity and/or cost. Most businesses unknowingly witness the effects of dynamic complexity when the performance of business systems unexpectedly begins to degrade—or worse, systems begin to fail. This chapter introduces why it is difficult for businesses to act quickly and decisively before the negative effects of dynamic complexity unfold.

Introduction

Modern businesses are a complex mixture of business processes supported by an infrastructure. Most infrastructures consist of information technology (IT), mechanical components and protocol. These are often highly complex in their design and operations because the patterns of service and interdependencies between components change continuously.

The costs of running business systems and their supporting IT is critical to the efficiency of a business and resulting profits that are made from its products and/or services. Understanding how a business system operates, can be accurately budgeted, and in particular, how they might be changed and improved, is often a challenge. The dynamics of large and global businesses has become more complex than one person or even a committee of people can grasp. In today's world economy it is increasingly difficult to accurately assess the potential impact of critically important decisions. As a result, business leaders are often surprised when the results of their decisions produce unacceptable levels of risk or unintended consequences.

While traditional business intelligence and big data analytic approaches can provide some insight into "What happened?" when something goes wrong, they cannot provide reliable foresight into "What's next?" and "What actions should

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be taken?" as needed to proactively prevent business disasters. To keep pace with these changing dynamics, businesses must be able to understand the hidden challenges of dynamic complexity and develop effective plans to avoid impending crises that arise as a result of its effects.

Understanding the Ticking Time Bomb (a.k.a. Dynamic Complexity)

To understand dynamic complexity, it is best to start with a common understanding of a few, simple characteristics that define the overall dynamics of a business system, its processes and its IT infrastructure.

- The number of processes or functions, and the number of stages in each process
- The usage of the processes and by how many users both within and increasingly outside the business's enterprise
- The number of components and connections in the infrastructure and their diversity in type, model, size, power, efficiency, etc.
- The rate at which changes to the system are needed and applied whether these changes are to the business itself or to the technology of the infrastructure
- The inherent interdependencies of components.

Most of the above characteristics are part of the constraints applied to process flow and execution patterns during the design of a system. For a start-up enterprise they are the result of a set of requirements being formulated and then designs at the business and IT levels being produced. These designs are normally both functional, i.e. what will the system do? And, non-functional, i.e. how will the system deliver on the target?

This is an orderly world that is both clean and well understood with regards to the way that the requirements are engineered into a system and the way that the system works within a defined efficiency—meeting a known workload and throughput. But as time passes, changes occur. As a result of the fast paced nature of business today—which is propelled by 24/7 global communications and rapid technology advances—the duration between system changes is continually being compressed.

A continuous adaptive process emerges:

- The number of processes or functions, and the number of stages in each process increases to meet new markets and support new products and services
- The usage of the processes and by how many users both within and increasingly outside the business's enterprise increases to meet new markets in new geographies and reflects the success of the business against competition
- The number of components and connections in the infrastructure and their diversity in type, model, size, power, efficiency, etc. increases to meet the new demands of the workload and to take opportunity of technology advances

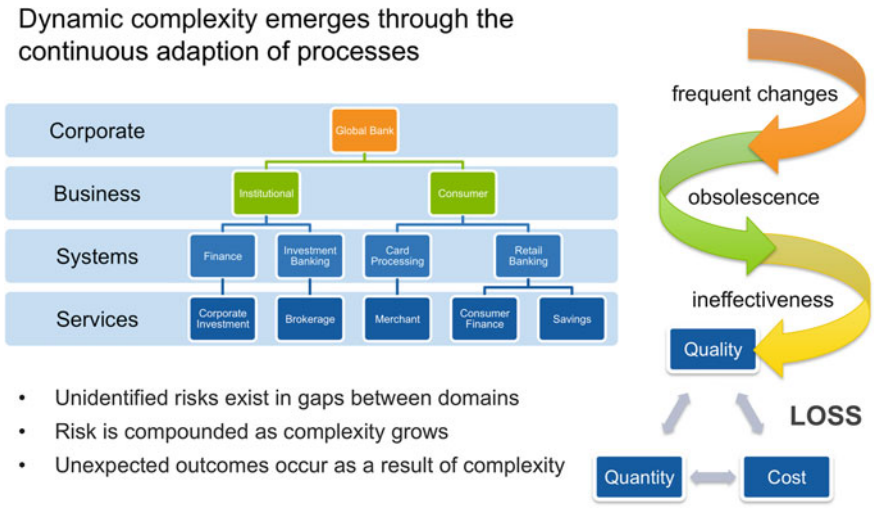

Fig. 2.1 Adaptive processes generate dynamic complexity

- The rate at which changes to the system are needed and applied whether these changes are to the business itself or to the technology of the infrastructure increases (Fig. 2.1).
- The changes in the interdependencies between components

In a perfect world the whole efficiency of the business system increases and the cost of a unit of production or service falls because the fixed costs are now being diluted and any slack in the system is being used. But there are some hidden effects working below the surface that are counter to the positive trend of the expected ideal efficiency.

Firstly, the original design of the system with its known characteristics and formal documentation has changed. The changes are known and their individual effects are understood but their combined effects on the whole system may not be known and realized.

If we consider that a business can be represented as a three-layer structure (Fig. 2.2), it is not just changes in the interactions between the components of a given layer that need to be considered—it is the interaction between layers that compounds risk and produces unexpected outcomes. For instance:

- If the number of customers is increased by 10 %, then the number of transactions increases and the loadings on the infrastructure increase, which of course is obvious
- But if a bottleneck occurs in a server component, this may cause queues at a customer workstation, which when released may swamp the infrastructure.

All interactions across the three layers must be understood because they are the root cause of the complexity changes—the dynamic complexity. The combinations

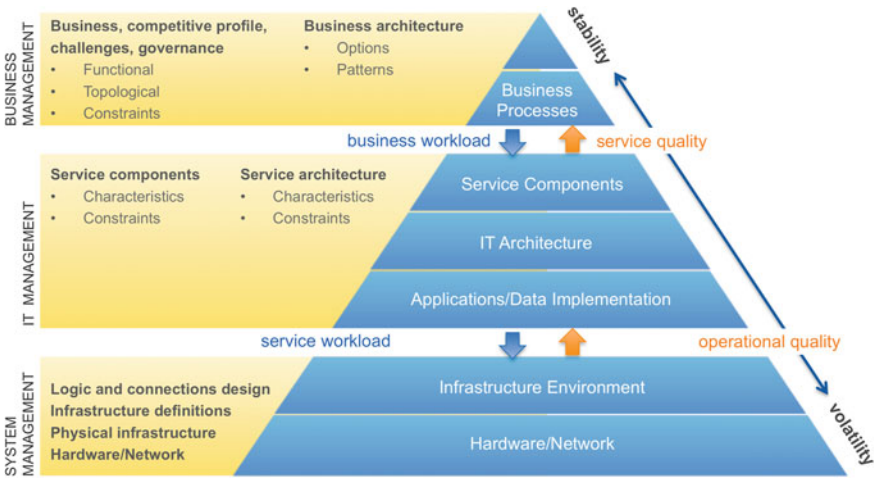

Fig. 2.2 Business systemic representation

of interactions can produce millions of possibilities within a layer and between layers. As a result, analytics are needed to model and accurately predict the possible outcomes of these interactions.

More importantly, the complexity of the system has changed. The system has become more dynamically complex because some, or all, characteristics have changed. As a result, its behavior has evolved. Its costs are different. Its efficiency has changed in ways that are not as expected on a smooth and simple efficiency-of-scale curve Fig. 2.3.

Expected Versus Experienced Efficiency-of-Scale

This happens because the system is 'aging'. The original infrastructure overtime has been adapted to support evolving business requirements.

- The number of servers increase and begin to interact in new ways to support changing business processes
- Though software doesn't wear-out, it gains extra functionality and path-length overtime
- The amount of data in the system increases, so searching for a specific data element can require more time, even if only in small increments of milliseconds.

As a results of the above changes:

- There is an increase in the number of components and connections in the system due to ongoing management decisions

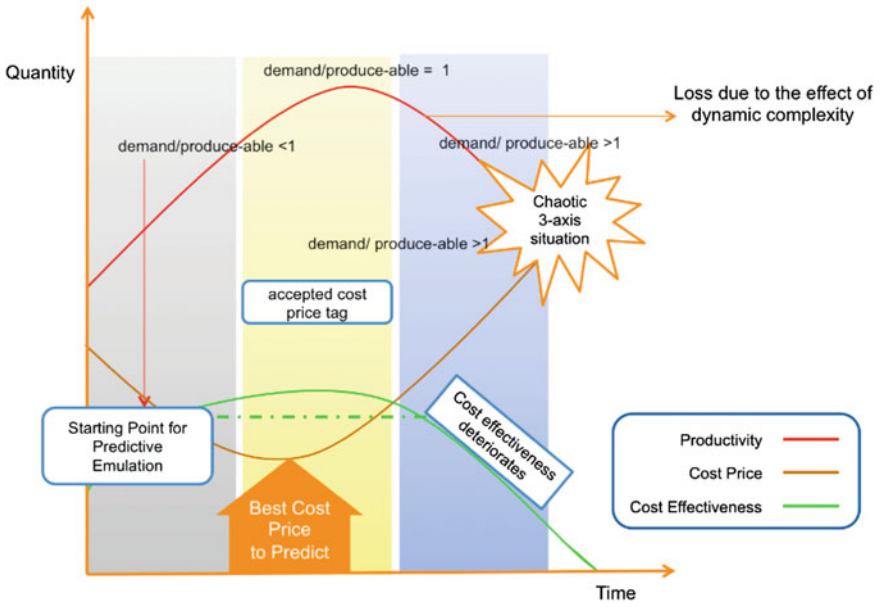

Fig. 2.3 Dynamic complexity generates singularity (Chaos)

- There is an increase in interactions between the components via the connections (business and IT) due to functional changes, maintenance changes, and volume changes—the dynamic complexity of system has changed with negative effects
- Perhaps though, and with less-obvious numeric visibility, the patterns by which the system operates, its behavior at a business and technology level, have changed. It is these changes in patterns—and upon deeper inspection, the accelerating rate of change—that are most threatening to continued efficiencies and cost. Put simply, patterns in behavior that have never been seen before are being to appear.

Failing to Identify Hidden Causes of Performance Loss

The effects of dynamic complexity, which can be referred to as 'complexity drag,' are being encountered (as loss in terms of quality, quantity and/or cost) but the causes are not recognized as a complete and balanced equation. Simply:

$$ExperiencedEfficiency = ExpectedEfficiency - ComplexityDrag$$

In this scenario, complexity drag has become a negative effect. It is like having a car. The efficiency of the car increases as it 'breaks-in'. It then runs smoothly until its components wear and the oils thin. Eventually, the car needs a service and tune-up.

Traditionally businesses have experienced complexity drag. While, they have not understood exactly why it is harmful to their efficiency—they have understood that its effects are negative in two respects.

- Firstly, the cost efficiency is not where it should be.
- Secondly, the ability to make timely and risk-free changes has become so troublesome that the demand to re-engineer seems imminent. Whether the business chooses to re-engineer the business, its processes and the supporting infrastructure, or to re-engineer and rationalize the infrastructure—the ultimate objective is to improve cost efficiencies and enable faster response.

Conclusion

Dynamic complexity results from hidden, unknown factors—or more precisely, interactions between factors—that can unexpectedly impact the performance of systems. When the influences of dynamic complexity are not measured and understood, new never-seen-before behaviors can come as unwelcomed surprises, which disrupt the performance of production environments. Left alone, business processes that were once prized for their efficiency unexpectedly begin to degrade—costs increase, while volumes and quality decline. Evidence of problems may come too late for effective resolution as technology advancements induce rapid change and compress the time available to react to that change.

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