



## Extreme Competition

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## Fractal Enterprise Architecture and Agent-Oriented BPM: Can UML or BPMN Model a Cloud?

As I look at what passes for business process management these days, the thought keeps running through my mind that we don't seem to have moved much beyond the ideas of Rummler and Brache in 1990 (BPM) or the 2003 technology breakthrough described in *BPM: The Third Wave* (the BPMS). The end of BPM history, however, didn't happen in 2003. I know it may sound over the top, but it seems to me that the universe continues to evolve under certain immutable laws. These laws apply to everything: biology, physics, and social systems that, in turn, include these things we call an enterprise and business process management.

### The Current State of Business

As globalization continues its march to becoming the greatest reorganization of the world since the Industrial Revolution, companies in a variety of industries are increasingly adopting a *choreography* role. They are building complex business ecosystems comprised of ever-growing numbers of highly specialized business partners and *prosumers* that place the consumer directly in the heart of business processes that produce value. *Back office* systems of record and transaction processing have been mastered, but *front office* systems for actually *conducting* business with disparate systems of systems that interact across the ecosystem are today's game.

A company is a complex social system, a system that must be treated as such, a complex organism of many dimensions and components – customers, production, and suppliers (and their information systems) fused together as One to create Value Networks. The days of the vertically-integrated, one-dimensional company are over. Linear Porter value chains have morphed into complex, multidimensional business ecosystems that have a lifecycle that goes from birth, to optimization, and on to a state of entropy as do all systems in the universe. Yet we still tend to model our enterprises and processes on a *flat plane* as rather static entities. Worse, Enterprise Architecture is often separate from BPM in the minds of many practitioners in today's companies.

Consider a snippet from the manuscript of Wolf Rivkin's forthcoming book, *The Eloquent Enterprise*, "*Enterprise Growth Dialectics: An Enterprise changes according to the same laws of change that govern any structure: the negation of the negation and the transformation of quantitative changes into qualitative ones according to the pattern of thesis-antithesis-synthesis. Therefore, any prospective framework describing this new qualitative state of an enterprise must offer a new, qualitatively different set of artifacts to describe the highest level of abstraction of the previous state. Only internal dialectic factors push an Enterprise from one Architectural State to another.*" Thus an Enterprise Architecture is a living, changing thing. "Enterprise Architecture is not a theoretical discipline that provides a nice-to-have variably detailed description of a static Enterprise or of one that is moving forward without deep structural changes and can therefore be described by a static, rigid framework. It is, rather, a must-have practical guide for Enterprise Transformation, providing a dynamic description of the profound but smooth structural change of an Enterprise that seeks effectiveness, efficiency, and the resulting competitive edge."

With the emergence of Cloud-based, long-lived, loosely-coupled, stateless architectures, the existing Enterprise Architecture approaches and today's BPM systems will quickly demonstrate their lack of flexibility and inability to choreograph participants in complex business ecosystems made up of large numbers of actors spread across the globe.

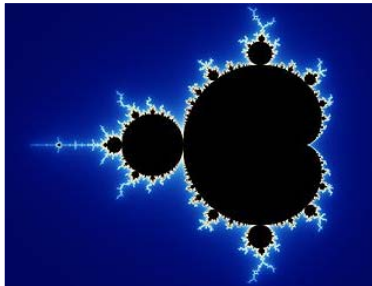
To elaborate, let's turn to social visionary, Dee Hock, the founder and former CEO of VISA International, an organization that he says was founded on chaordic principles – a blending of chaos and order. VISA now connects over 20,000 financial institutions, 14 million merchants, and 600 million consumers in 220 countries. Hock explains, "By chaord, I mean any self-organizing, self governing, adaptive, nonlinear, complex organism, organization, community or system, whether physical, biological, or social, the behavior of which harmoniously blends characteristics of both chaos and order." In his view, today's current forms of organization are almost universally based on compelled behavior, or tyranny. The chaordic organizations of the future will embody community, based on shared purpose. A chaordic organization harmoniously blends characteristics of competition and cooperation [cooperation]. Hock's book, *Birth of the Chaordic Age*, hits broadside against the dominance of today's command-and-control institutions.

Hmm? Is the current state of the BPM lifecycle based on "command-and-control?" Is BPMN ready to model a "self-organizing, self governing, adaptive, nonlinear, complex organism, organization, community or system, whether physical or social, the behavior of which harmoniously blends characteristics of both chaos and order?" Is it time to question the first principles of Enterprise Architecture and BPM in light of global Chaords that are neither centralized nor anarchical business networks?

### Fractal Enterprise Architecture

Euclidean geometry is modeled by our notion of a "flat plane." Other geometries have been introduced to go beyond a flat plane, e.g., Elliptic and Hyperbolic Geometry. To illustrate, on a sphere, the sum of the angles of a triangle is not equal to 180°.

The very physics of traditional business processes might be ripe for change for the complex global enterprise goes well beyond a flat plane, and fractal geometry principles just may provide a fresh foundation for business modeling and Enterprise Architecture.



The main characteristic of fractals is *self-similarity*, implying *recursion*, pattern-inside-of-pattern. The term fractal was coined by Benoît Mandelbrot in 1975 and was derived from the Latin fractus meaning *broken* or *fractured*. A mathematical fractal is based on an equation that undergoes iteration, a form of feedback based on *recursion*. Mandelbrot sets display self-similarity because they not only produce detail at finer scales, but also produce details with certain constant proportions or ratios, though they are not identical. Because they appear similar at all levels of magnification, fractals are often considered to be infinitely complex. Natural objects that are approximated by fractals to a degree include clouds, mountain ranges, lightning bolts, coastlines, snowflakes, and thunderstorms. In nature, small parts resemble the whole: The veins in leaves look like branches; branches look like miniature trees; rocks look like miniature mountains. That's kind of like a company's real business processes distributed throughout today's complex, global ecosystem comprised of ever growing numbers of business partners and social networks – the

fractal business process. Hmm? Can complex, global 21st century enterprises be adequately described without embracing the concept of fractals?

The fractal factory, the fractal company, the fractal business process? Not isolated to academia, Mandelbrot demonstrated the practical application of fractal geometry to financial markets in his 2006 book, *The (Mis)behavior of Markets: A Fractal View of Financial Turbulence*. See also: <http://www.fooledbyrandomness.com/fortune.pdf>

Other practical sightings of fractals in business can be found in the emerging world of Agile Manufacturing, which is seen as the next step after LEAN in the evolution of production methodology. Let's turn to *A Comparison of Emerging Manufacturing Concepts* by Tharumarajah, Wells, and Nemes, "The concept of fractal factories proposes a manufacturing company to be composed of small components, or fractal entities. These entities can be described by specific internal features of the fractals. The first feature is self-organization that implies freedom for the fractals in organizing and executing tasks. They may choose their own methods of problem solving including self-optimization that takes care of process improvements. The second feature is dynamics where the fractals can adapt to influences from the environment without any formal hindrance of organization structure. The third feature is self-similarity interpreted as similarity of goals among the fractals to conform to the objectives in each unit. In addition to the above characteristics, there is a need for the factory fractals to function as a coherent whole. This is achieved through a process of participation and coordination among the fractals, supported by an inheritance mechanism to ensure consistency of the goals. Fractals are structured bottom-up, building fractals of a higher order. Units at a higher level assume only those responsibilities in the process that cannot be fulfilled in the lower order fractals. This principle guarantees teamwork among the fractals and also forces distribution of power and ability in order to coordinate the actions of the individual fractals and put in place mechanisms that permit self-organization and dynamic restructuring": <http://www.fractal.org/Fractal-Research-and-Products/Fractal-factory.pdf>

Hmm? Is Enterprise Architecture and BPM, as practiced today, ready to take on the fundamentals of the fractal factory?

(Read more on fractals in business at <http://www.peterfingar.com/FractalsAndAgents.pdf> )

### **Is There a Mobile Autonomous Intelligent Agent in the House?**

Okay, this new world of fractal Enterprise Architecture and BPM may make sense, but, oh my, the "If-Then-Else" automation built into typical BPM systems, even with Business Rules Engines, simply isn't going to cut it to build the complex adaptive systems needed in today's complex business ecosystems. I suggest that what's needed is Intelligent Agent technology and ontological modeling methods. These ideas aren't new, but today's complexity calls for us to revisit them. So, let's go *way back* to over a decade ago, back before the explosion of the World Wide Web, back before the Enterprise Service Bus (ESB) and Cloud Service Bus (CSB), back before SOA, back before Services superseded Objects, back before the term BPM superseded the term BPR.

From way back then: "Agent-Oriented Business Engineering (AOBE) (Farhoodi and Fingar, 1997) aims to combine the design of agent technology with business engineering to build a new area of research for the prize of enterprise-level computing. This methodology has two models:

- *The agent-oriented lifecycle model*. This model addresses domain modeling for agent-orientation by providing an active modeling metaphor and better analysis models that enable re-use.
- *The Ontology-based domain models*. Ontology defines the basic concepts and entities that are assumed to exist in some area of interest and the relationships that hold among them (a formal specification for conceptualization). This is a critical initial step in producing dynamic business-based systems."

"There are three distinct approaches to business-domain modeling: Business Process Reengineering (BPR), Object Oriented Technology (OO), and Intelligent Agents (IA). All

these approaches are model-based and offer different techniques for describing problem domains. The BPR methods involve process, organization, events, business rules, entities, and relationships. The Object-Oriented Technology (OO) methods involve classes, objects, attributes, associations, operations, events, inheritance, polymorphism, and categories. These are well suited for software engineering modeling and have potential for reuse. However, they are not inherently business oriented, and provide premature commitments to design and implementation strategies. Intelligent Agent Technology (IA) can be leveraged to enhance enterprise modeling as well as offering new techniques for developing intelligent applications and smart technical infrastructure services. An agent-oriented perspective allows us to develop rich and expressive models of the enterprise and provide a foundation for adaptive and reusable business software. The convergence of OO, IA, and BPR results in a significant breakthrough in building models of the enterprise that is capable of end-to-end integration of business analysis and software systems.”

This is enough historical background for our current discussion. If you want to read more background information, see the two-part article starting with

Competing for the Future with Intelligent Agents  
[http://home1.gte.net/pfingar/agents\\_doc\\_rev4.htm](http://home1.gte.net/pfingar/agents_doc_rev4.htm)

Much progress has been accomplished in the field of agent technology. Thanks to my research assistant, Anuradha Potluri, here are some annotated references related to BPM:  
[www.peterfingar.com/FractalsAndAgents.pdf](http://www.peterfingar.com/FractalsAndAgents.pdf)

### The Great Dance of Business

If we consider intelligent agents as fractals in a multidimensional business ecosystem, some of the key components of *multi-agent problem-solving* are essential. To achieve common goals, agents need coordination. Effective coordination requires cooperation, which, in turn, can be achieved through communication and organization.



The difference is between active, central control and adaptive coordination – Orchestra versus Ballet. In orchestration, the conductor tells everybody in the orchestra what to do in real-time and makes sure they all play in synchronization. The conductor is an active leader, corrects for anomalies in real-time, and can introduce new information only he or she has. Orchestration in formation systems also has an equivalent, the orchestration engine.

In choreography, the choreographer coordinates the *plan* but is not part of execution. Each participant “listens to the music” and is responsible for its own adaptive behavior. In information systems each software agent “listens for events” and is responsible for its own adaptive behavior. Orchestration defines a procedure, and Choreography defines a protocol.

Military style “command and control” management is giving way to “connect and collaborate,” and the reason is clear. In today’s world of total global competition, no one company is in control. Thus, orchestration of the entire business ecosystem by a single conductor is of days gone by.

Choreography via the foundation of peer-to-peer multi-agent systems, with autonomous and mobile agents sharing *common goals*, is the future. Of course, no sane person would hand over control of enterprise transactions to an unsupervised network of software agents. To investigate, negotiate, design, implement, monitor, and maintain complex, long-running enterprise partnerships you need a system that not only supports cross-boundary processes natively but has the right governance and policy management model. Such a model isn’t based on the flow of work through a diagram, but on a framework including object types and distributed policy management (Role, Person, Interaction, Entity, Activity, Rule, and so on).

Just consider a human interaction management system as a peer-to-peer multi-agent system. While Web 2.0 usage of the Internet has opened up new frontiers of possible human communication channels, it has also opened Pandora’s box of noise, chaos, and distraction. If we turn to human interaction management systems we find that an agent-based platform can bring management control to all the noise, and the goal-oriented organizational design (GOOD) method can bring about chaordic collaboration despite the onslaught of Web 2.0 communication chaos. (See [humanedj.com](http://humanedj.com)) Now this doesn’t mean that workflow and integration style BPM or ERP systems or transaction management systems “go away.” Instead it means that agent-oriented systems appropriately sit on top of the enterprise software stack and act as front-office choreographers, taking care of business in the brave new world of virtual Value Networks.

### Takeaway: A Reverse Q&A

While I haven’t had the time or cycles to really complete this column to the depth I would like, I would like *you* to help continue this investigation of Fractal Enterprise Architecture and Agent-Oriented BPM. Instead of me being on the receiving end of a Q & A, I’d like to turn the tables and pose the questions to you. What do you suggest as answers to the following questions?

- Can Enterprise Architecture be modeled with fractal geometry just as complex nonlinear systems are modeled in nature?
- Can such Enterprise Architecture become *executable*, at least as a simulation of the real business?
- Because what an enterprise “does” is far more important than “what it is,” can BPM be fused with Enterprise Architecture and both be executed in real-time?
- When a part of a complex business system “dies” (entropy) is that the end, or does entropy extend the march to order? How does this apply to a business or its parts located in the midst of a global business ecosystem?

I’m sure if JFK was asked such questions when considering putting man on the moon in the 1960s, many skeptics shouted, “Impossible. Far too complex. Get real.” But the times were ripe. And, just perhaps, the time is now ripe for Fractal Enterprise Architecture and Agent-Oriented BPM.

Your thoughts?

As I come from a position of learning vs. knowing, I invite you to let me know what you think about Fractal Enterprise Architecture and Agent-Oriented BPM (BPTrends Discussion Group or [pfingar@acm.org](mailto:pfingar@acm.org)).

## Author

Peter Fingar is regarded as one of the original promulgators of business process management since the publication of his book coauthored with Howard Smith, *Business Process Management: The Third Wave* (Meghan-Kiffer Press). As a former CIO and college professor, Peter has been working at the intersection of business and technology for almost 40 years. His recent book, *Dot.Cloud: The 21st Century Business Platform Built on Cloud Computing*, is a best seller, along with Chinese and Russian editions. He has joined forces with Jon Pyke, founder of the Workflow Management Coalition (WfMC), and Andy Mulholland, Global CTO of Capgemini, to pen the highly anticipated book, *Enterprise Cloud Computing: A Strategy Guide for Business and Technology Leaders*. Peter delivers keynote talks across the globe and is speaking this year in Asia, Europe, and the Americas ([www.peterfingar.com](http://www.peterfingar.com)).

## BPTrends LinkedIn Discussion Group

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