BUSINESS PROCESS MODELLING – A BUSINESS FRACTAL APPROACH

Dr Antonie van Rensburg

Department of Industrial and Systems Engineering, University of Pretoria

ABSTRACT
The role and position of operations management in an organization depends on the value it contributes to the sustainability of the organization. Tactical operations management ensures that business strategy is appropriately translated into operational policies and objectives. This is done through the planning and control of resource capacity and operational events. One of the key contributing success factors is the appropriate design and optimization of business processes to do so.

Keywords: Business fractals, business process modelling, systems thinking

INTRODUCTION

The role and position of operations management in an organization depends on the value it contributes to the sustainability of the organization. Tactical operations management ensures that business strategy is appropriately translated into operational policies and objectives. This is done through the planning and control of resource capacity and operational events. One of the key contributing success factors for this is the appropriate design and optimization of business processes.

For the organization to survive, it has to rely on its 'memory' – a memory formed by the collective repository of organizational knowledge. This memory preserves a past, but it is also current, and thinks about and responds to the future that faces the organization. The way the operations manager uses this organizational 'memory' has a profound impact on the performance of the organization. Many managers can testify to the result of initiatives that went wrong because initial business requirements were not correctly understood, formulated, or communicated through the design or optimization of business initiatives.

One of the mechanisms to analyse this organizational 'memory' is through the use of business process modelling. Many methods and techniques exist to assist the manager (via the business analyst) in this process – for example, the Structured Design and Analysis Technique, IDEF, Petri Nets, and Object Oriented Modelling (Van Rensburg, 1996). The purpose of this paper is to introduce the approach of business process modelling through business fractals. The concept of a fractal was conceived by Benoit Mandelbrot forty years ago to explain real-world events in nature and in commodity markets (Mandelbrot, 2004). A business fractal is very similar to a fractal – with the difference that the business fractal depicts descriptive business and organizational patterns.

To demonstrate this business process modelling approach, a telecommunication company's call centre activities are modelled. The objective of this exercise is to determine the appropriate policies for managing the call centre business processes.

APPROACH

In presenting this modelling approach, a number of topics are presented in the paper. The *Business Fractal* topic covers the basic overview and components of business fractals. The static part of the business fractal covers the basic pattern of a business fractal (*Pattern*), as well as the content (*Content*) part of it. *Dynamic Components* deal with the memory and volatility of the business fractal that models dynamic behaviour in the business process. In the *Case Study Application* part, a case study is presented to demonstrate how business process modelling is done through the business fractal approach. *Conclusion* concludes the paper on the use of business fractals as a business process modelling approach.

BUSINESS FRACTALS

Scientific models are defined as abstract representations of reality, based upon scientific rules, to reduce the complexity of the problem situation. Within a model, the business analyst tries to eliminate those real-world details that do not influence the relevant goals of the problem. Therefore, a model will reveal what its creator believes is important in solving the problem. According to Curtis *et al* (Curtis, 1992), this *insight* and *understanding* into the problem form the basic building blocks for a suitable model to study the system. Dijkstra (Dijkstra, 1992) discovered that the idea of structuring problems through models was not futile. He found that in many natural instances, which an observer might describe as chaotic and random, patterns exist that can be described by some kind of mathematical formula.

Many modeling methodologies used in business today try to structure business problems in such a way that certain techniques can be used to solve the problem (Dijkstra, 1992). Unfortunately, it is not easy to study and find solutions to problems: the closer the observer looks at the real world, the more its complexity is revealed (Harry 1990). In Van Rensburg (Van Rensburg, 1996) the research hypothesis was proved that business problems contain organized patterns, being part of larger business systems. Applying this to the modeling of business processes, it can be stated that business processes contain organized patterns of business activities, and therefore fundamental principles for modeling business processes can be defined to model these activities as patterns within the business process.

Using the concept of 'organized patterns of business activities', fractals can be introduced. A fractal is defined as a shape that can be broken into smaller parts, each echoing the whole. A business fractal is a shape (fractal) that echoes the business system as a whole, and that can be broken into smaller parts. In defining a business fractal, pictures or models are used to support the basic business patterns that form fractals in a business system. Mandelbrot maintains that pictures are undervalued in science – due in part to the 200-year legacy of the French mathematicians Lagrange and Laplace, who laboured to reduce all logical thinking to formulae and carefully chosen words (Mandelbrot, 2004).

To mimic the definition of a fractal, a business fractal is defined as a function of memory, volatility, content, and a pattern (www.businessfractals.org). The *pattern* is a simple geometric shape that forms the *static dimension* of the business process model. Supporting the pattern is *content*. Content includes all types of data, information, and knowledge in the business fractal that is stored in the form of documents, forms, templates, procure descriptions, and policy documents. Whereas the pattern and content are static and deterministic, memory and volatility contribute to the *dynamic dimension* view of the business process model. *Memory* (or autocorrelations) defines the shape, size, and timing of recurring events in the business system, while *volatility* defines the power law behaviour of the fractal.

Business Fractal = f(Pattern, content, memory, volatility)

In the real-world system, events create a particular process instance. To be able to create a business process model from this process instance through the business fractal requires the identification of the footprint of the process instance. Finding footprints can vary from case to case, but in most instances the footprint can be discovered from employees' experiences, system information, or investigation into the content of the business system.

STATIC DIMENSION – THE PATTERN

One part of the static dimension of the business fractals deals with patterns. In its most elementary form, this pattern is based on the relationship between *People*, *Process*, *Customer*, *Resource*, and *Alignment*. Using this pattern, the business analyst defines and models any business process on any level of abstraction within the business system. However, to provide a realistic and practical application of the pattern in the business system, three views are used to model the pattern. These views are the 'Business Architecture View', the 'Value Chain View', and the 'Process Library View'.

The *Business Architecture View* allows a functional description of the business system. This view on the pattern can be done via any given enterprise or business architecture approach such as the Zachman Framework (Sowa, 1992), VCOR (www.value-chain.org) or SCOR (www.supply-chain.org). The *Value Chain View* abstracts the business system into a series of value-added business processes. The role and position of business fractals in the business system are important, as some parts of the pattern deal with strategy, others with tactical issues, and some with core operational delivery steps of products and services to customers. The final view, the '*Process Library View'*, shows business fractals in the business system according to its physical deployment in the organizational system. Here it is important to understand the impact of business units, market segments, product groupings, and functional areas in relation to identified business processes (Porter, 1980). In this context, a business process can be shared in the total business system, or it can be dedicated to a certain grouping, or finally, it can be a federal pattern – one that everybody needs to use in the system.

STATIC DIMENSION – CONTENT

The second part of the static dimension of a business fractal deals with the content of the business system. In this definition, content of the business system includes (but is not limited to) objects such as documents, templates, forms, presentations, reports, etc. These are the objects that are used through the business system to compile, collate, edit, change, or update content as the business system executes its own business process instances over time. This part of the fractal forms a large part of the bigger organizational memory as it captures and stores information about all stakeholders involved in the business system, as well as capturing process-related information as process instances pass through the system.

In the understanding and definition of the business process, it is important to realise that these objects are as much a part of the business process as the business process pattern itself. It is thus important to understand where this dimension fits into the business fractal itself, as well as how it contributes to the effectiveness and efficiency of business processes.

In this part of the modelling process, the most important factor to consider is that of configuration management. That is, as process instances happen in the business process, it is important to control the different versions of content through the process, as well as the users allowed to create, update, read or delete content. This implies that roles and responsibilities need to be defined and implemented in such a way that content is visible and manageable in the process. Key to this is linking content to the business process model to enable operational execution of it in the business system.

BUSINESS FRACTAL – DYNAMIC COMPONENTS

Business fractal dynamics deal with the *memory* and *volatility* of the business system under study. Understanding the dynamic behaviour of the business system provides the means to create a business process model that replicates the actual behaviour of the business system over time.

To model *memory*, the technique of simulation modelling is used as practised in the field of Operations Research. In essence, real-world behaviour is captured through statistical distributions to model resource impact and events as they occur through the business process. *Volatility* defines the power law behaviour of the fractal. To model this behaviour, the business analyst needs to understand the relational impact between different elements in the business process. As defined in the discipline of *Business Dynamics* (Sterman, 2002), this behaviour can be triggered by policy decisions in the business system as it creates unexpected results in the system. For a good example of this behaviour impact, see the Beer Game (http://beergame.mit.edu/).

CASE STUDY EXAMPLE

This case study deals with the call centre of a major South African telecommunications company. The call centre aims to resolve queries from its retail partners arising from their customers' in-store queries. In the exercise, a business process model needs to be created to study the impact of various what-if scenarios on the call centre if certain business policies are changed. Call centre log files provide the footprint for this business process as it captures complete events of customers phoning in to resolve queries. (See Table 1 for extract.)

Table 1: Call Centre log file

Problem Type	Ref #	Customer	Location Name	Call Type	Open Date	Close Date	Priority	Assignee	Duration
Connection Setup: Roaming	234953	AA Cellair	Head Office	Request	03/10/2007	03/10/2007	5-LOW	A Hardee	0 d 0:18:48
Connection Setup: SMS	435811	FirstPhone	Region 1	Request	24/10/2007	24/10/2007	4-MED-LOW	O Ithome	0 d 2:4:55

From a tactical perspective, important performance management objectives critical to this business process are a) the query resolution duration, b) quality of query resolutions. To achieve these objectives, the call centre management team needs to determine an optimal configuration of the overall system based on policies covering the following:

a) The number of call centre agents used in a particular shift.
b) Changing the shift duration.
c) Required competency levels for the staff (be able to solve 90% of all technical calls at a level 1 resolution).
d) Agreed performance levels with regards to query resolution time (within 60 minutes).
e) Agreed calls closed on first call (95% resolution level).

In testing the impact of the above scenarios on determining policy parameters to improve the current situation, the team decided to create the following different scenarios (Table 2) to determine the impact of changing the number of call centre staff employed per shift, as well as testing the impact of shortening the shift duration from 720 minutes to 480 minutes.

Table 2: What-if scenarios

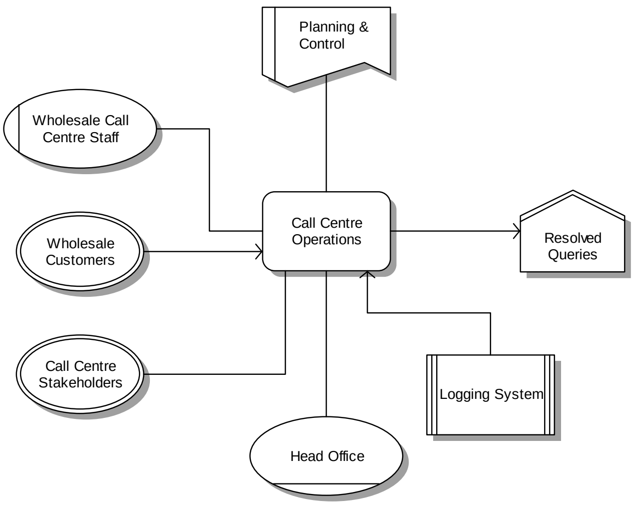
SCENARIO	REPS	# RESRC	SHIFT
Scenario 1	30	5	720
Scenario 2	30	10	720
Scenario 3	30	14	720
Scenario 4	30	20	480

EXPLANATION	EXPLANATION
REPS	Number of replications applied to simulation models
# RESRC	Number of call centre staff dealing with queries
SHIFT	Duration of shifts in minutes

CASE STUDY: CREATING THE PATTERN

Figure 1 shows the elementary business fractal pattern for the call centre business process.

Figure 1: Business Fractal Pattern



Using this as the basis, three different views on the pattern are created to show a complete pattern of the business process. In this case study, the first view, the *Business Architecture View*, is based on the Zachman Framework (Sowa, 1992). *Table 3* shows a summary of this view.

Table 3: Business architecture view

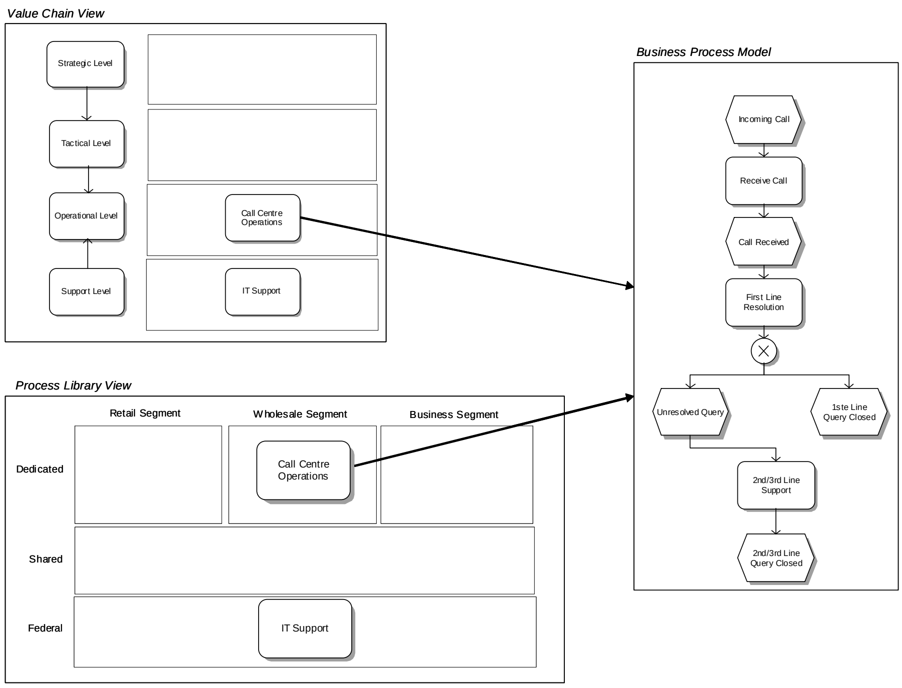
Abstraction	**Data**	**Function**	**Network**	**People**	**Time**	**Motivation**
Viewpoint	What?	How?	Where?	Who?	When?	Why?
Business analyst view	Logged calls Resolved queries	Receive calls Route calls Solve queries Close request	Head-office operations	Call centre agent Functional specialists	7 days X 12 hour X 365 days	Ensure connected customers to the network

In the *Value Chain View*, the call centre operations (Receive calls, Route calls, Solve queries, and Close request) are placed within the operational stream of the Value Chain Model (Figure 2).

For the *Process Library View*, this particular Call Centre Operation is only used in one particular customer segment, 'Wholesale customers'. (The complete customer segmentation is 'Retail customers', 'Business customers', and then 'Wholesale customers' (Figure 2). In the Process Library View, the 'Dedicated' allocation is used, as this process is not shared, prescribed or used by any other segments in the business.

Finally, using the log files from the call centre systems, as well as existing business rules and process information, the simplistic pattern expands to a process model for the call centre operations (Figure 2).

Figure 2: Different pattern views



CASE STUDY: IDENTIFY THE DYNAMICS

Identifying the dynamic side of the business fractal requires a focus on the memory and volatility of the business system. The memory of the system is modelled through simulation modelling. In this instance, Arena from Rockwell Automation (www.arenasimulation.com) provided this capability. Analysis of the call centre log file over one calendar month produces the following stochastic distribution models:

a) Rate of arrivals can be predicated by the statistical model: *4.5 + Lognormal (0.0)*
b) Query resolution time presented by the statistical model: *-0.001 + Weibull(82.2, 0.463)*
c) Grouping of queries, by query types, provides the probability of routing calls in the call centre to the appropriate technical support areas (Figure 3 and Table 4).

Figure 3: Top problem queries

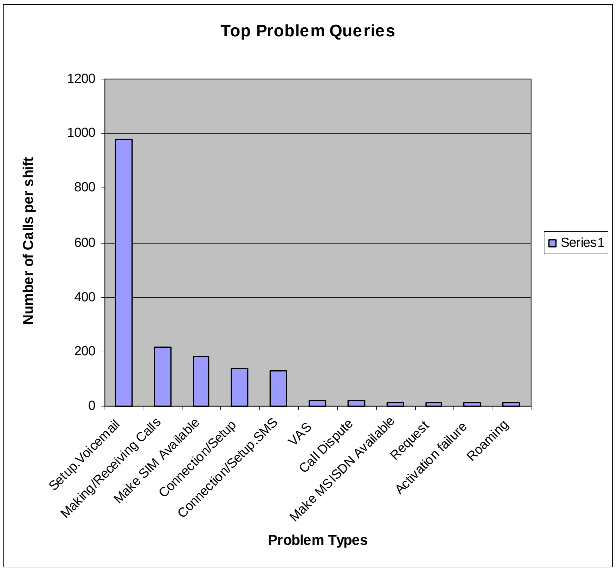


Table 4: Probability of occurrences

Type	Probability of occurrence	Type	Probability of occurrence
Set-up voicemail	0.48	Making/receiving calls	0.15
Make SIM available	0.12	Connection/setup	0.1
Connection/setup SMS	0.09	Value-added Services (VAS)	0.01
Call dispute	0.01	Make MSISDN available	0.01
Request	0.01	Activation failures	0.01
Roaming	0.01		

Creating the power law behaviour of the model requires an understanding of the dependencies between various parts of the model. In this particular model, the following dynamic relationships were discovered to model the power law behaviour:

a) As the quality of service deteriorates, customers will make more return calls to the call centre *(Number of calls X (1+(1/CustomerQuality Change))*.

b) As the same customers flood the call centre as a consequence of poor service quality, the ability of call centre agents to deal with the issues declines according to the following relationship: *(ServiceTime) X (1+(1/CustomerQuality Change)^$^{0.2}$*.

Using the different scenarios in the discrete event simulation modelling tool ARENA, the following measurements per scenario are produced:

Table 5: Simulation results from ARENA

SCENARIO	REPS	# RESRC	SHIFT	NumberIn	NumberOut	UTIL	WaitQ	TotalTime
Scenario 1	30	5	720	72.1	24.567	0.94	124.059	185.301
Scenario 2	30	10	720	72.333	45.7	0.814	41.45	104.408
Scenario 3	30	14	720	71.767	54.167	0.684	9.459	72.898
Scenario 4	30	20	480	48.6	36.267	0.41	0.124	50.283

As can be seen from the modelling results in Table 5, different scenarios show different behaviours of the business process. To reduce the call centre shift hours will not serve any useful purpose, as the number of customers being serviced by the call centre reduces by 35% (NumberIn). In conjunction with this, capacity utilization of call centre staff drops to an unacceptable 41% (Table 5 UTIL column).

From the above scenario, management elects to use 14 staff members (#RESRC) in a normal shift of 720 minutes (SHIFT) which has a 68% utility of staff, and reduces the total waiting time in the system from the original 124 minutes to 9 minutes. The average total time in the system still represents a very high 72 minutes (TotalTime). To address this, analysis of query types (Table 3) may provide the next course of action to improve overall operation, since nearly 50% of all queries to the call centre relate to the setup of voicemail.

CONCLUSION

Managers as decision-makers are always seeking new ways to support their decision-making processes at an acceptable level of risk. Typically the level of risk in a business process can only be determined by understanding and studying the behaviour of the business process, either from historical observations or from simulated experiments. It has been found that traditional modelling routes for creating business process models may not always cover all the inherent behaviours of the business system. Through a business fractal, the business analyst tries to develop more realistic models to understand the dimensions of the business process through the definition of static and dynamic components of the fractal.

As such, the practical application and implication of the business fractal is to provide the means to create business process models that model real-world business processes at an acceptably accurate level for decision-making. The use of a business fractal to enable the modelling of business processes is a new discipline, as well as a paradigm shift. The value of this approach is that it provides the manager with a toolkit that enables the understanding of the organizational memory, thus supporting effective decision-making.

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