

## SECURITY ASPECTS OF PROCESS RESOURCE PLANNING

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**Abstract:** A key contributor to corporate operations security is the availability of resources with provisions for replacement / substitution in an acceptable period of time in the event of shortage. This paper looks into three management approaches. Each has already been put into practice and well-known as well as bearing on business resource planning, which is considered by the author to complement one another and even be ready for combined use. These are the following the Manufacturing Resource Planning (MRP II), the Business Continuity Management (BCM) and the traditional Process Management (process design and control). Highest importance is attached here to security of business processes as well as, or instead of, optimization calculations. The integration and common application of extended MRP II and reinterpreted BCM can provide new opportunities in process management.

**Key words:** MRP II, process management, business continuity, process security, risk

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### Introduction

An existing theory in economics, the so-called 'Resource-Based View' or RBV considers resources (assets, capabilities, processes, information and organizational knowledge) available at a certain moment as the ultimate basis of any corporate business strategy. The competitiveness of a firm depends on the acquisition of adequate resources or inputs (Barney, 1991). The value, rareness and non-substitutability of resources will bring about a competitive advantage which may, in its turn, be translated into lower costs, give rise to unique market opportunities and enable the firm to avoid business risks and improve its corporate performance. A fundamental, though non-exclusive, means of corporate competitiveness is profitable economy. For a steady functionality, a company should also seek to attain security (Caralli et al., 2004).

Enterprise security can be defined as a state in which a business organization can maintain its functionality and value-creating processes permanently and restore those processes in the shortest possible time upon the occurrence of any unexpected event or even disaster. Another criterion of enterprise security is that the company can, on the basis of its strategic plans, keep a firm hand on its own future, while not endangering either its environment or the external or internal

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stakeholders through its activities. Maintenance of enterprise security requires a holistic approach, relying on ongoing risk analysis and resultant control measures. Let us look at an example derived from wildlife (Celik et al., 2012).

During the summer season, worker bees stay alive for 6 to 7 weeks (42 to 44 days) on an average, gathering nectar, pollen and propolis during the 4th and 5th weeks (or between the 22nd and 36th days) of their life span. Even when an 'unlimited' source of raw material is available, the division of labour with these insects is such that about one-third of all workers fit for collection always stay in the hive.

According to researchers, they may have two security reasons for that:

- Potentially, worker bees are exposed to any 'catastrophe' (storms, attacks by predatory animals or insects, fires, environmental pollution). If necessary, the stock staying behind in the hive can resume collection.
- By virtue of their physique, workers are unfit for working through all the two weeks of the gathering season. They may strain themselves by flights.

It may be true that with a view to the maintenance of the hive and the production of honey, security is more important than any increase in output.

In addition, workers do care for information security (confidentiality, integrity and availability of information). They perform movements (or a waggle dance) to an inherent choreography to communicate information to their fellows about the whereabouts and kinds of pollen or nectar they can find within a collection area of about 30 square kms.

### **Manufacturing Resource Planning and Linear Programming**

Manufacturing Resource Planning is a tool for identifying resources, such as base materials and production capacities, necessary for the manufacture of products against actual customer orders either received or forecast, using established corporate databases called Bills of Materials or BOMs (Landvater and Gray, 1989). Adopting the linear programming approach, one can take into account the objective function incorporating contribution margins per unit (as derived from Direct Costing) as well as such details as resource and norm requirements relating to products in question (Starr, 1972).

A resources – products matrix underlying the calculations is shown in Table 1.

Resources ( $R_1 \dots R_m$ ) constitute necessary pre-requisites for the manufacture of products (such as base materials, and machine and labour capacities).

The firm in question offers 'n' different saleable products to the market ( $P_1 \dots P_n$ ).

The last column of the matrix shows amounts of resources available in any given period ( $b_1 \dots b_m$ ).

The two rows in the 'Market Operational Range' section of the matrix show minimum product quantities to be sold ( $M_{P_1-\min} \dots M_{P_n-\min}$ ) and maximum product quantities saleable ( $M_{P_1-\max} \dots M_{P_n-\max}$ ), respectively.

The last row of the matrix shows a specific contribution margin relating to each product.

Considering that the availability of resources is limited, each row of resources can be incorporated into an inequality. Limits of resources:

$$x_1a_{j1} + x_2a_{j2} + \dots + x_ka_{jk} + \dots + x_na_{jn} \leq b_j \quad (1)$$

Product quantities manufactured must meet both market demands and market potentials. Limits of market:

$$M_{Pk-\min} \leq x_k \leq M_{Pk-\max} \quad (2)$$

The objective function of linear programming can be obtained by maximizing contribution margins.

Maximizing contribution margins:

$$Z = \text{MAX} (x_1\text{CM}_{P1} + \dots + x_k\text{CM}_{Pk} + \dots + x_n\text{CM}_{Pn}) \quad (3)$$

**Table 1. Resources-products matrix**

		Manufacturing Operational Range					Periodical quantity of resources
		Products					
		P <sub>1</sub>	P <sub>2</sub>	.....	P <sub>k</sub>	.....	P <sub>n</sub>
Resources	Specific Consumption of Resources						
R <sub>1</sub>	a <sub>11</sub>	a <sub>12</sub>	.....	a <sub>1k</sub>	.....	a <sub>1n</sub>	b <sub>1</sub>
R <sub>2</sub>	a <sub>21</sub>	a <sub>22</sub>	.....	a <sub>2k</sub>	.....	a <sub>2n</sub>	b <sub>2</sub>
:							:
:							:
R <sub>i</sub>	a <sub>i1</sub>	a <sub>i2</sub>	.....	a <sub>ik</sub>	.....	a <sub>in</sub>	b <sub>i</sub>
:							:
:							:
R <sub>m</sub>	a <sub>m1</sub>	a <sub>m2</sub>	.....	a <sub>mk</sub>	.....	a <sub>mn</sub>	b <sub>m</sub>
Market Operational Range							
Minimum (commitment)	M <sub>P1-min</sub>	M <sub>P2-min</sub>	.....	M <sub>Pk-min</sub>	.....	M <sub>Pn-min</sub>	
Maximum (possibility)	M <sub>P1-max</sub>	M <sub>P2-max</sub>	.....	M <sub>Pk-max</sub>	.....	M <sub>Pn-max</sub>	
Contribution Margins							
EUR/unit	CM <sub>P1</sub>	CM <sub>P2</sub>	.....	CM <sub>Pk</sub>	.....	CM <sub>Pn</sub>	

Ideally, a product mix identified by this means will generate profits for the firm. The quantity of products manufactured within any period under review falls somewhere between the minimum and maximum market demands, and that of resources available exceeds the actual requirement or is just enough for production.

Certain products (or product portfolios) can be manufactured using various different combinations of resources, with the result that multiple resources-products matrixes may be required to cover all alternative manufacturing processes. Consequently, calculations or resource planning can be performed in various ways (Riezebos and Zhu, 2015). From the side of information technology, tools are provided for this activity by a set of state-of-the-art ERP systems and Production Scheduling Software programs (Mesjasz-Lech, 2014). Investigations into and use of alternatives constitute a kind of production risk management. On the other hand, MRP II is not interested in all resource requirements, but deals with essential or core or value-creating processes only.

### **Business Continuity Management**

A primary function of Business Continuity Management is to minimize damage a firm may sustain by ensuring at least a necessary minimum level of such activities and services after a shortest possible lapse of time as may be essential for survival of the firm. If a core or critical business activity is disrupted, the firm will have to seek to recover such activity in a shortest possible time (called Maximum Tolerable Downtime) by making use of contingencies or rearranging resources or substituting an alternative activity. A crisis (or disaster) situation will arise when a firm cannot perform one or more of its key business activities for more than a pre-determined period of time, or some of its critical processes (those designed to maintain certain business functions) are disrupted or become limited for more than a pre-determined maximum period of time. Typically or usually, disruption or improper functioning of a critical corporate process is caused by loss or failure of some essential resource(s) (whether human, financial, infrastructural, information or otherwise) necessary for such process, or lack of some obligatory input condition (a special case of this is when a process breaks down or fails to work properly on account of a loss, failure or improper functioning of IT resources or a supporting IT infrastructure. Efforts made to restore an IT infrastructure to normal are called IT Business Continuity Management or IT disaster recovery). A crisis situation may arise from a wide range of possible internal and external hazards. External factors:

- environmental hazards (thunderstorms, thunderbolts, floods, earthquakes, etc.);
- accidents (with airplanes, trains, cars, hazardous substances, etc., involved);
- failure of utilities (electricity, telephone service, etc.);
- acts of violence (civil disobedience, strikes, terrorist attacks, hacking of a system, etc.).

Internal factors:

- failure of infrastructure (servers, data warehouse, etc.);
- accidents (fires, damage caused by water, electric short-circuits, etc.);
- malicious acts (those by discontented employees, sabotage, etc.).

It is almost impossible to take adequate risk management measures against all of them, especially because of their extremely low likeliness in most cases. In spite of rare occurrences, however, the damage done may be extremely high or even fatal. Consequently, firms should nevertheless make provisions for even so-called 'disaster situations'. They are expected to do so for their own sake, or may as well be obliged to do so by law in a number of industries. Furthermore, firms often put their suppliers under a similar obligation. Tools for making such provisions include so-called 'Business Continuity Plans' and 'Disaster Recovery Plans' developed, implemented, tested, and put to use when need be. The Business Continuity Plan (BCP) ensures the availability of business process backup IT resources at given times and functional levels as well as the minimization of damage caused by unexpected events. It is important for this document to include potential threats to the various processes, the likelihood of their occurrence, and the damage potentially resulting from the breakdown of the process. It is in the course of the so-called Business Impact Analysis (BIA) that procedures for the maintenance of operations are determined (Figure 1).

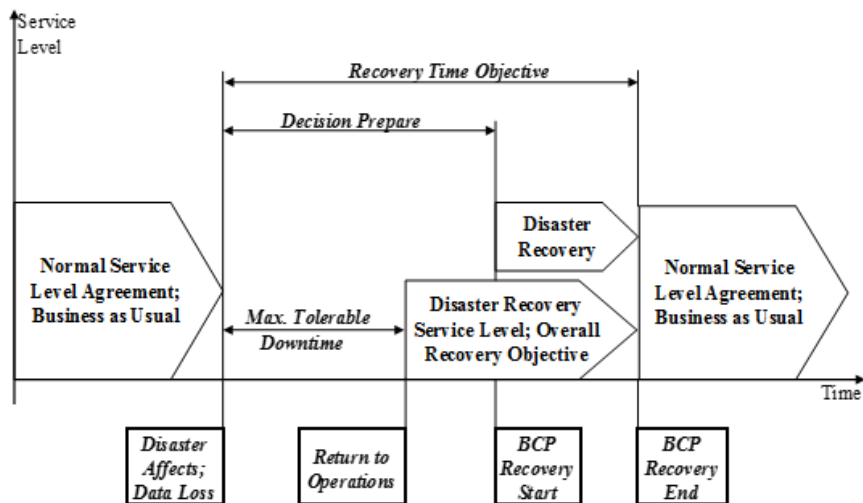


Figure 1. Business Continuity Planning model

The Disaster Recovery Plan (DRP) contains substitute solutions for the case of major damage and events resulting in the breakdown of information technology service. The aim is to facilitate the minimization of negative effects and the fast restoration of original circumstances at acceptable costs. This plan must also include supplementary measures and tools for the case of a limited availability or complete breakdown of resources that ensure the continuity of processes critical for the existence of the organisation. The Disaster Recovery Plan is thus usually linked to the Business Continuity Plan. Good BCPs and DRPs examine organisational processes and consider the links and ties between these two. They contain

practicable and risk-commensurate intervention orders, are known and accepted by the higher management of the organisation, and constantly undergo testing, maintenance and development. The term recovery time objective (RTO) is the maximum time period allowed to resume an activity, recover resources or provide products and services after incident occurs. It must be short enough to ensure that damaging impacts do not become unacceptable.

Business Continuity Management is mainly represented in information security standards and directives. This information-security or information-technology approach can, however, be adapted to any other corporate process when it comes to provision of pre-requisites for and proper implementation of a process or its recovery upon some disturbance (Ojha et al., 2013).

### **Practical Process Management**

Process is one or more tasks that add value by transforming a set of inputs into a specific set of outputs (goods or services) for another person (customer) by a combination of people, methods, and tools' (Tenner and De Toro, 1996).

Designing and setting up a corporate (business) process is more than just defining it. Each process is associated with a set of constituents (pre-requisites, resources, and outcomes) of its own:

- input (such as information, an event to give rise to the process, or some resource);
- output (a product and/or service);
- activity (or cluster of activities; a process can be divided into segments or operations);
- organizational unit or person responsible for execution, and executive staff probably identified activity-wise;
- electronic or paper-based records and documents carrying information necessary for process execution;
- data (external and corporate databases);
- a logical order in which activities or process segments must be performed (whether sequentially or concurrently).

Principally, corporate processes can be categorized by resources used:

- material processes (changes occurring or made to physical / chemical properties or spatial position of material resources);
- management and control processes (in general, processing and transfer of information; in particular, processing and transfer of information specific to or required for execution of a process in close relation with material processes);
- evaluation (at the interface of a firm to its surroundings).

In addition, processes can be categorized by the roles they play in overall operations of a firm:

- operational (essential or core or value-creating) processes (those designed to use inputs to generate outputs for external affected parties, especially customers, such as production, logistics, sales, marketing, product design, etc.);
- supporting or improvement processes (mainly those designed to support value-creating processes, such as procurement, technology development, provision of human resources, information technology, controlling);
- leadership and planning processes (those maintained to specify how the rest of processes should work, such as strategic planning, and various management systems).

According to the ISO/IEC 33002 (earlier ISO/IEC 15504-2) standard, corporate processes can be grouped, evaluated, and improved along two dimensions. Firstly, what is the objective and expected outcome of a particular process? And secondly, what can be achieved by the process? The following process quality levels are defined:

*Level 1* Incomplete process (the process objective is not achieved for certain)

*Level 2* Performed process (the process objective is achieved to some degree)

*Level 3* Managed process (with adequately managed outcome of the process)

*Level 4* Established process (it being designed and performed according to a pattern / standard)

*Level 5* Predictable process (it being measurable and verifiable)

*Level 6* Optimizing process (the process can be improved, and the set of objectives are achieved; some feedback also included)

In assessing processes, and rating their outcomes, one makes a step towards risk assessment. Performed and managed processes involve 'medium' and 'high' risks, while established and predictable processes on capability levels 4 and 5 are associated with 'medium' and 'low' levels of risk. An optimizing process may involve nothing but a low risk. Certainly, an established risk level is always dependent upon the measure an actual process may or does deviate from its pre-defined capability level (BPM-GOSPEL, 2011).

It seems to be reasonable to set up a hierarchy within a process for use in design, analysis, and management of processes (there is no such thing as a general rule for this; processes in various areas of a firm may be so much different in their structure): process level, sub-process level, activity or process segment level, operation level and movement level.

Process Management requires new roles to be added. In relation to each particular process, the respective process owner, a person deeply familiar with sub-processes and process goals, is responsible to monitor process performance indicators, coordinate resources necessary for execution of the process, interact with other process owners and 'conventional' organizational leaders within the firm, and make proposals on process improvement.

The process sponsor is usually a senior manager with thorough knowledge about the firm as a whole (including resources, products, markets, and technologies),



capable of integrating a process-oriented way of thinking into conventional organizational operations. His / her powers and role in the organization is instrumental in securing acceptance of process-centered governance. Heads of conventional organizational units are responsible to execute (or cause to execute) sub-tasks as instructed by the process owner. Their performance is measured by means of a pre-defined set of performance indicators. The usual procedure of sales, a process often modelled using Enterprise Resource Planning systems, may serve as a good example to illustrate business processes:

- receiving an inquiry,
- making an offer,
- receiving an order,
- confirming the order (and initiating relevant production and procurement processes),
- placing finished products in storage,
- notifying the customer,
- making out notes of discharge and deliver,
- making out an invoice on the basis of the delivery note returned,
- receiving counter-value for the goods as shown in the invoice,
- closing the order.

Measuring, assessing, and improving business and technological processes on an ongoing basis, Process Management ensures that corporate targets and goals are achieved. It allows for and conveys to executive roles any changes as may be made to corporate plans. Practically, Process Management means distribution of functional tasks for execution of process segments, and maintenance of a system of responsibilities. It will (or may) lead to improvement in daily operational performance of the firm. Functions of Process Management:

- design new processes, including a hierarchy within each;
- set up an organization as well as spheres of action and responsibilities the best suited to each process;
- create performance indicators and develop corresponding evaluation methods;
- analyse existing processes, and measure their performance;
- adopt and maintain process controls.

### **Identification of Process Resources**

Here again, execution of business / technological processes or their segments requires resources. However, Process Management uses the term 'resources' in a much broader sense than MRP II does. As well as materials and production capacities, Process Management takes into account information, pecuniary resources, and other infrastructural resources (e.g. energy, an environment suitable for production, etc.). Shortage in any of them at a particular place and time may easily lead to process failure (Miller, 2017). Practically, this approach adopts the



7R's principle of customer service and logistics to cover full ranges of corporate processes and resources, respectively. The 7R's or Seven Rights of Customer Service: the right product, to the right customer, at the right time, at the right place, in the right condition, in the right quantity, at the right cost (Rushton et al., 2010). Consequently, availability of all these resources is a key issue for a firm with operations centered on its processes. Provisions must be made for substitute resources for optional use in uncertainty situations. The author of this paper investigates into the latter concept, an area of Process Management little discussed to date, focusing on the security of corporate business operations instead of, or besides, optimization. Most often special software solutions (Business Process Modelling & Analysis Platforms) are used to model or describe the business processes of process-oriented firms. They include so-called process grids showing such additional details as executive organizational unit assigned, process owner, information media necessary for execution, and execution time requirement concerning each process segment. Whoever drafts a process grid like that will, however, take resources for granted, not always checking for their availability or any risk as may be associated therewith (van der Aalst, 2013). It is recommended to assess the risk level of each process resource using a 3-grade scale (low, medium, high). A scale as simple as that should be preferred because corporate business processes may be detailed to significantly different degrees (for example, a quality control process is normally specified to the tiniest detail, while a human resources development process may include multiple optional segments). In preparation for any accidental shortage in some resource, the firm may maintain a substitute resource or alternative process segment, or even have a complete 'replacement' of the process in reserve. Process segments follow one another in chronological order in the process grid, specifying, at the same time, an order in which resources will be used (it is not that evident in the resources – products matrix with MRP II where a product may as well utilize any particular resource multiple times, and hence the respective specific contribution margin may reflect an aggregate figure derived from multiple technological steps. This will necessitate specification of more refined technological data in flow-sheets or recipes). Though a software application designed to support Process Management (such as the Business Process Analysis & Modelling Platform) may keep records of resource requirements, they do not normally calculate availabilities or disposition demands as standard with Material Requirements Planning (MRP) or Manufacturing Resource Planning (MRP II). Even if an enterprise management information system incorporating MRP (e.g. ERP) is centered around processes, it will only look into material and capacity requirements of products, while execution of a business or manufacturing process may as well be hindered by shortage in other kinds of resources. Resources can be categorized as follows: materials, manpower, information, pecuniary sources, and infrastructural resources (e.g. energy, machine capacities, etc.). The amount of a resource required for execution of a process segment may be proportional to the process output or a process output

may be solely dependent upon process initiation (e.g. information). In the latter case, there is no point in specifying any resource amount.

Another reason why regular revisions of availability of process resources are advisable is the ever-changing nature of any process environment. Where a sub-process is associated with a high-risk resource category and at least two resources with a 'medium' risk rating, which means they are not likely to be available at adequate levels, it will be reasonable for the firm to make provisions for a substitute or alternative process or processes by way of risk treatment and Business Continuity Management. It should be noted, however, that a substitute process will never be fully identical with the standard one in terms of costs, lead time, or quality. Always define a hierarchy within a substitute as well.

Replace or substitute for risky resource(s). (For example, where a supplier of parts proves to be risky, find another to source the same parts from.) If it is infeasible, work out new activities or even new processes (or sub-processes).

A good example is offered by a conventional 'risk treatment' solution used in response to disturbances in piece production processes or overload / loss of production capacities. Practically, the firm should set up a ranked list of all available options:

- 1) Do the production job using alternative technological steps, that is to say, select an alternative technological process even though it is likely to be more expensive and/or slower than the one it will substitute for.
- 2) Increase the cumulative work time allocation (i.e. make a demand for overtime work or an additional shift).
- 3) Outsource the production job to a business partner with adequate resources (co-operation).
- 4) Re-design the product.
- 5) Increase production capacities (by purchasing additional means of production and/or hiring additional labour).

A particular resource associated with a process or process segment may happen to be needed in multiple processes. Performing an additional analysis of availability of resources in terms of time, quantity, and quality after they are assigned to a process, may prove to be an adequate means of process risk treatment.

### **Conclusion**

For a firm to be able to execute its business / manufacturing processes and produce corporate outputs, resources must be available at the right place at the right time. Any shortage, insufficiency of quantity or inadequacy of the quality of resources as may arise for whatever reason will constitute a business risk and may result in the impaired productivity of the firm. Process Management seems to be free to borrow tools from other two fields of management:

One of them is a resources – products matrix combined with the linear programming method originally used in Manufacturing Resource Planning (MRP II) in relation to capacities and material resources. When this approach is adapted

to business processes, products will be replaced with process segments and the range of resources will be widened considerably.

Secondly, the expansion of Business Continuity Management (BCM), an approach mainly used in information management (information security, running IT systems) and already supported by international standards, may be a useful means of identifying substitute process resources proactively and assessing a Recovery Time Objective for processes.

The complexity of the subject and the evolution of the scientific 'suggestion' outlined here may necessitate further applied research efforts and the elaboration of Process Management case studies.

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## ASPEKTY BEZPIECZEŃSTWA W ZAKRESIE PLANOWANIA ZASOBÓW PROCESOWYCH

**Streszczenie:** Kluczowym czynnikiem przyczyniającym się do bezpieczeństwa operacji korporacyjnych jest dostępność zasobów wraz z procedurami dotyczącymi wymiany / zamiany w dopuszczalnym okresie czasu, w przypadku niedoborów. W artykule rozważa się trzy podejścia do zarządzania. Każde z nich zostało już wdrożone w praktyce i jest dobrze znane, a także ma wpływ na planowanie zasobów biznesowych, które autorzy uważają za wzajemnie uzupełniające się, a nawet możliwe do łącznego wykorzystania. Są nimi: planowanie zasobów wytwórczych (MRP II), zarządzanie ciągłością działania (BCM) i tradycyjne zarządzanie procesami (projektowanie i kontrola procesów). Największe znaczenie przywiązuje się do bezpieczeństwa procesów biznesowych, jak również do obliczeń optymalizacyjnych. Integracja i powszechne zastosowanie rozszerzonego systemu MRP II i ponownie zinterpretowanego zarządzania ciągłością działania, może zapewnić nowe możliwości w zarządzaniu procesami.

**Słowa kluczowe:** MRPII, zarządzanie procesami, ciągłość działania, bezpieczeństwo procesu, ryzyko.

### 过程资源计划的安全性问题

**摘要:** 公司运营安全的一个关键因素就是资源的可用性, 如果发生短缺, 可以在可接受的时间内更换/替换。本文研究了三种管理方法。各项业务资源规划已经落实到实践和知名度上, 笔者认为相辅相成的, 甚至可以结合使用。这些是制造资源计划(MRP II), 业务连续性管理(BCM)和传统的流程管理(过程设计和控制)。这里最重要的是关于业务流程的安全性以及优化计算。扩展MRPII和重新解释BCM的集成和通用应用可以为流程管理提供新的机遇。

**关键词:** MRP II, 流程管理, 业务连续性, 流程安全性, 风险