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BUSINESS PROCESSES ARCHITECTURE AND DESIGN.

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BUSINESS PROCESSES ARCHITECTURE AND DESIGN

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1.- Introduction

The architecture of the Business Processes (BP) of an enterprise is defined as the type of processes it contains and the relationships among them. We may define an architecture for the whole of an enterprise of for some portion thereof.

The problem of interest to us is how to design such structure, with a particular approach in mind: to start with a general normative structure that gives a pattern from which to derive a design. This idea is related to several proposals for frameworks that enterprises have used to guide architecture design, such as Zachman's framework [13, 25]. But we depart from such proposals in that our intent is to make use of specific business knowledge which allows us to propose more precise and detailed patterns to support design. Our first proposal for such patterns was made in 1998 [4], based on the experience derived from a large number of BP design projects. In summary, we proposed four major grouping of processes, valid for any enterprise, that we called macroprocesses. They are Macro1, the Value Chain; Macro2, for New Capabilities Development –new products, infrastructure, etc.–; Macro3, for Business Planning; and Macro4, for Support Resource –human, financial, etc.– Management. Then, a general architecture was developed which included the relationships among these macroprocesses. The general architecture was detailed by giving, by mean of what we called Business Process Pattern (BPP), the component processes of each macroprocess and the relationships among them by means of flows.

In the next sections we will present in some detail the architecture of macroprocesses and the corresponding BPP.

Our macroprocesses are similar to the ones recently proposed by HP and APQC. HP proposed, along the lines of a SCOR [21] generalization, five major grouping of processes (see Figure 5); Business Development, which correspond to our macroprocess Business Planning; Design Chain, which is part of our New Capabilities Development; Enabling Processes, our Support Resource Management; and Customer Chain and Supply Chain, which together are equivalent to our Value Chain. On the other hand, APQC [1] defines Design and Develop Products and Services, part of our New Capabilities Development; Develop Vision and Strategy, part of our Business Planning; Market and Sell Products and Services, Deliver Products and Services and Manage Customer Service, which together are equivalent to Value Chain; and Management and Support Services that are closely related to our Support Resource Management.

The coincidences above partly validate our intent of having a general structure of processes for an enterprise. In connection with the similar proposals above, we posit that our general structure gives more useful details for design than such proposals, particularly in the explicit relationships it proposes to consider among macroprocesses.

Our BPP have also some features in common with approaches such as SCOR [21], VCOR [24], APQC [1], eTOM [23] and FEA [25], which were also developed after ours. In particular, they provide a process classification structure down to the level of activities, plus, in some cases, metrics for performance, best practices and some information about relationships [10]. Our BPP do all this, but additionally, for all the possible processes in an enterprise, they state the normative relationships that should exist among them, by means of information and other types of flows, in order to have the required coordination to function as a system and optimize overall performance. Also BPP show the explicit IT application support processes should have.

Our general macroprocesses structure and BPP have been used in more than one hundred projects to guide architecture and process design. In the next sections we will present some cases that show how our proposal facilitates design.

2.- A General BP Architecture

2.1. A BP Ontology

In order to give a more solid basis for our architecture proposal, we have built a BP Ontology, based on the ideas of Artificial Intelligence [17, 32]. We will not give the technical details here, but present the final result of our effort in the form of a UML class diagram that details the structure of the BP of an enterprise. The resulting class diagram is shown in Figure 1, which will explain below.

We start by defining the macroprocesses that, according to our empirical base of projects, covers all the processes an enterprise needs to perform in a coordinated way. They are, as shown in Figure 1:

- Macroprocess1 (Macro1): Value Chain or the group of processes that execute the production of the goods and services which define the purpose of a business; it covers all activities from client requests to satisfactory delivery.
- Macroprocess2 (Macro2): Group of processes that a business performs to develop new capabilities that are required to enhance its competitiveness, such as new products, new infrastructure and new processes.
- Macroprocess3 (Macro3): Business Planning or the group of processes that define the future of a business in the form of strategies, plans and programs.
- Macroprocess4 (Macro4): Group of processes that manage the resources needed by other functions: financial, human, infrastructure and others.
- The Ontology also shows that Macro2 and Macro3 have specializations for particular cases.

The structure of processes is recursive, as shown by the relationship Implements in Figure 1, in that the macroprocess *BP Development* generates the *BP Architecture*. This means that such architecture changes in time to adapt to the environment by means of new process capabilities.

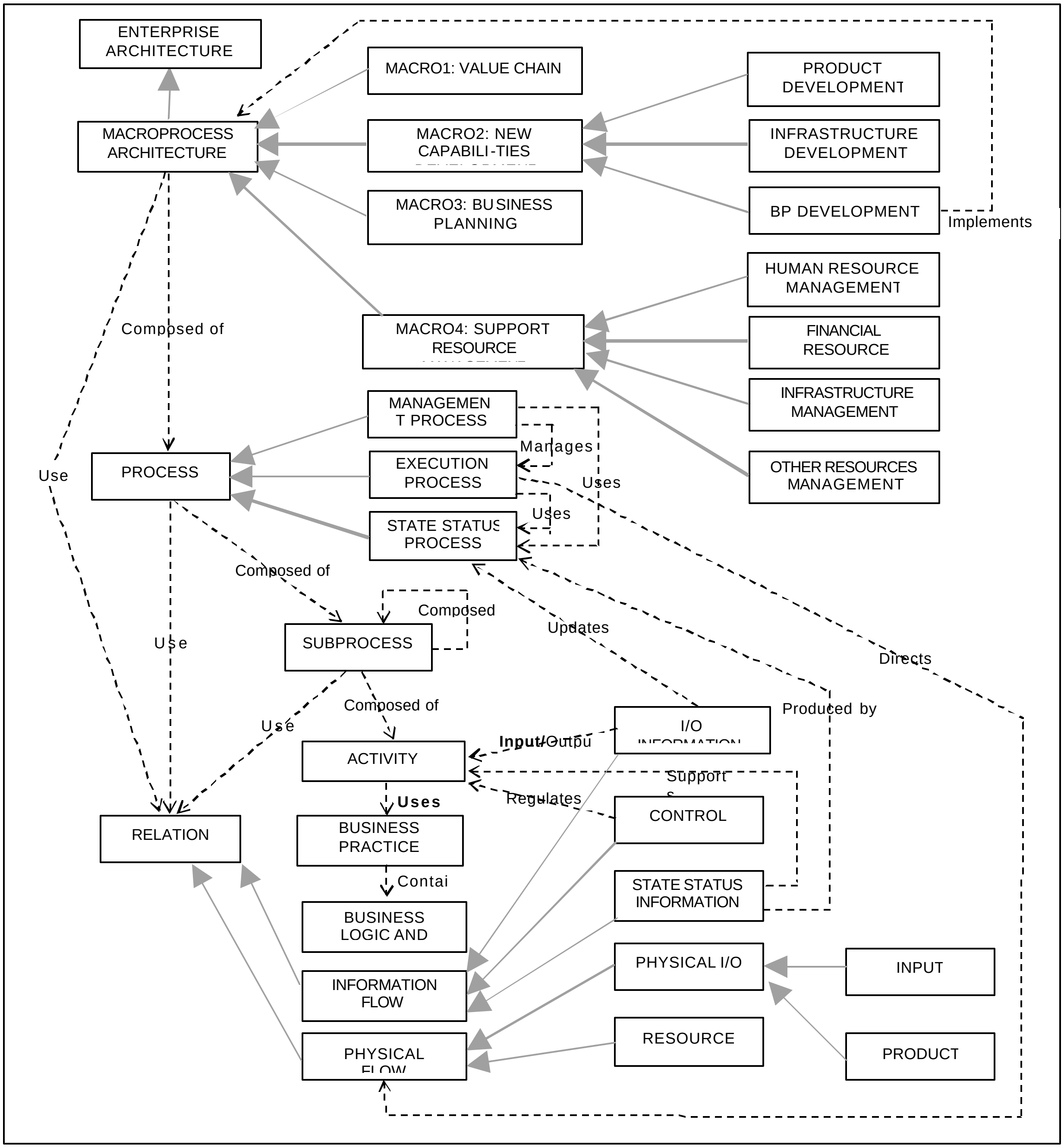

Figure 1. Business Processes Ontology

Now each macroprocess has an internal structure, also discovered by analyzing many real redesign projects and founded on regulation concepts [2,3,4], which is shown in Figure 1 by means of the types of processes it contains; they are:

- *Execution:* Set of subprocesses and activities that transform certain physical inputs, such as raw materials, documents, components, etc., into a "product". This can be a physical product, such as a cardboard product, which is generated from pulp and chemicals, or a service, like a loan which is generated form documents that specify subject and conditions for it.

- *Management:* Set of subprocesses and activities that gather customer's requirements and direct *Execution* –by means of objective setting, plans, programs, resource assignment and the like– to produce what is required.

- *State Status:* Set of IT subprocesses and activities that gather transactions occurring in *Execution* and *Management*, update the state of such processes and feed it back to them, in order that all the activities in a macroprocess always know its overall status.

This definition can also be represented by means of a flow diagram, shown in Figure 2, where we make explicit the relationships specified in the Ontology in Figure 1. The application of the model in such figure is obvious in physical production of goods and services oriented to final customers, such as manufactured goods or health and education services. So we will give an example of an internal customer service, which is the case of the generation of a business plan. Execution in this case is the "production" of such plan having as physical inputs various documents, such as market studies, government regulations, intelligence information and the like. Management includes to act by request of a top level executive on the assignment of people to a team that will develop the plan, the generation of a work program and the follow up that assures its completion. State Status facilitates the digital storage and management of all the documents involved and the updating and reporting of the status of the work program.

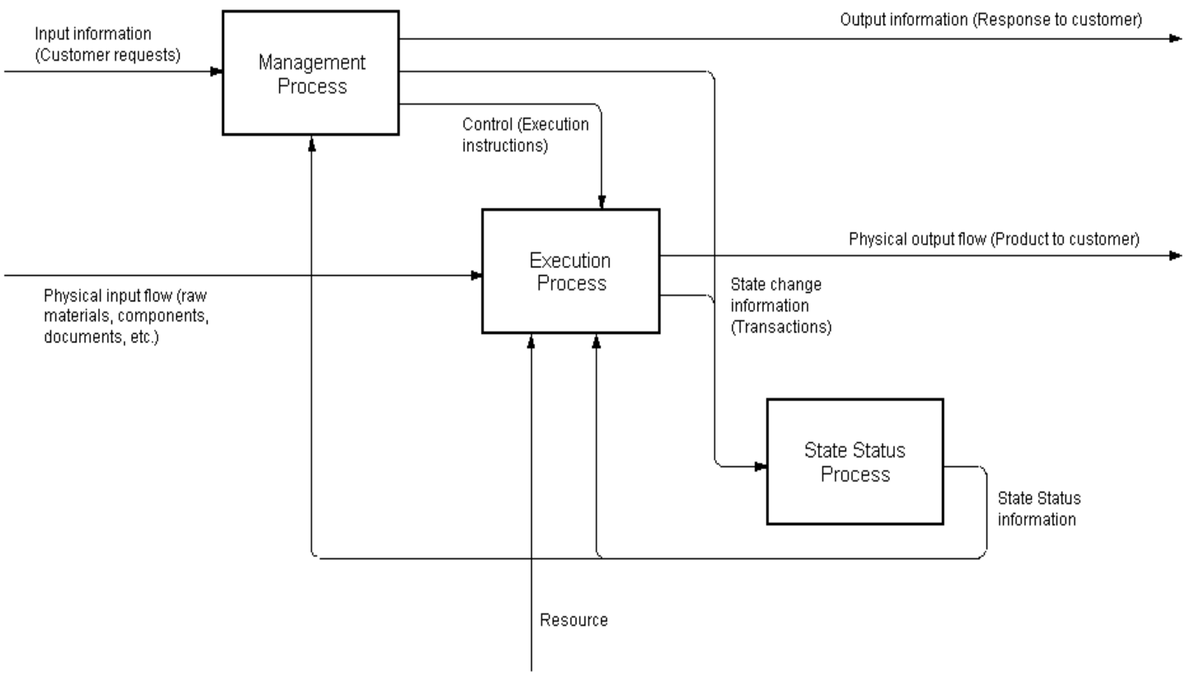

Figure 2. Types of processes in a macroprocess and their relationships

Now coming back to the Ontology, Processes are composed of Subprocesses and these of Activities.

Subprocesses are sets of activities of a process that produce a well defined result that is required within it. For example, in the process of Execution that develops a new product, we need a subprocess for the generation of a prototype or model to scale. Activities are the most disaggregated elements of the macroprocesses and they execute Business Practices that contain Business Logic and Rules. Business logic is defined as complex computer run algorithms or human performed procedures that specify the way a business is run; for example a complex algorithm for risk assessment based on mathematical modeling or a complex medical procedure (protocol) to treat a certain illness. Business logic and rules may contain formal rules, which are specific decision criteria for a well defined situation; for example, do not give a loan to somebody who has issued bad checks. Macroprocesses, Processes, and Activities, use several instances of a Relation to perform their duties. A Relation can be an Information Flow or a Physical Flow. The latter are the Physical I/O –Input or Product– or a Resource that are needed for Execution: raw materials, components, documents, machinery, computers and the like. An Information Flow exists to convey what is needed to communicate with external parties and to coordinate processes or activities in a macroprocess: requirements from customers, specifications of products or services, sales forecasts, production or operation plans, materials requirements, delivery schedules, etc. In Figure 2, there are several examples of these flows and of how they allow coordination. An Information Flow can be an I/O Information, a Control or a State Status Information*. I/O Information is the one that is consumed in the execution of the internal business logic of an activity and is also the product of such logic. Control are the policies, regulations and instructions that guide the behavior of the activity. And State Status Information is the set of data coming from the State Status Process, also needed to execute the business logic. Examples of all these type of flows are given in Figure 3.

Our Ontology has some features in common with the OMG´s Business Motivation Model [19], but our proposal is more specific in terms of business process structure.

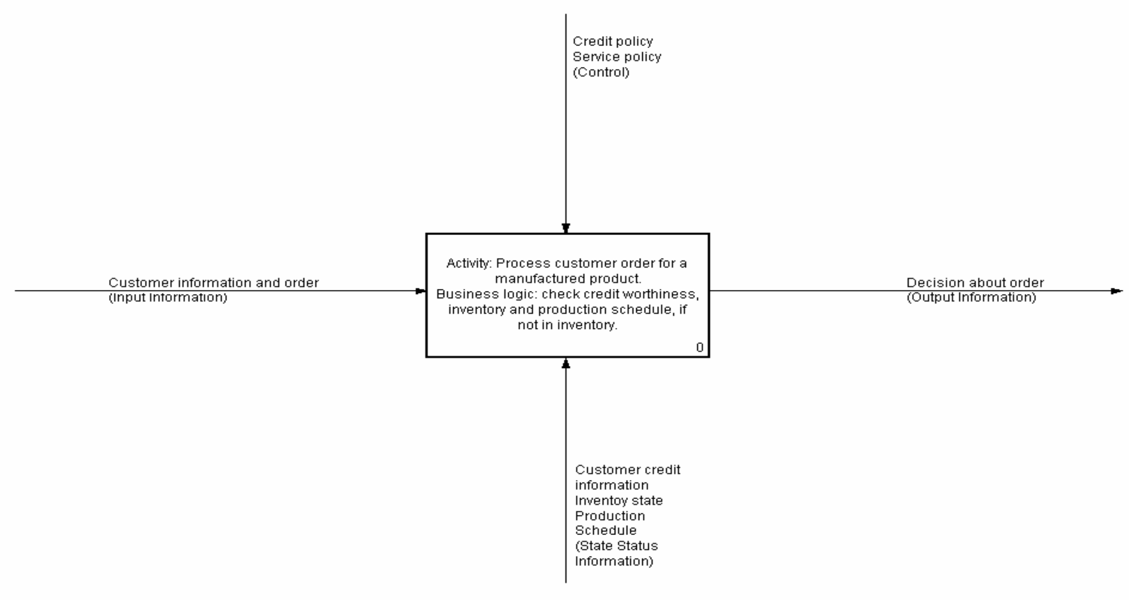

Figure 3. Examples of Information Flows

* This definition is consistent with the IDEF0 notation supported by tools like BPWin

2.2. The BP Architecture

Based on the BP Ontology of the previous section, we define a general architecture by first establishing the information flow relationships there should be among Macroprocesses in order for them to perform in a coordinated way. Such relationships are shown in Figure 4, where we follow the conventions established in the Ontology for the different types of flows. They could have been included in the Ontology but we decided not to do so in order to simplify its presentation.

Relationships are generic and not exhaustive; the idea is only to provide a guide to identify specific flows in particular cases, by specialization.

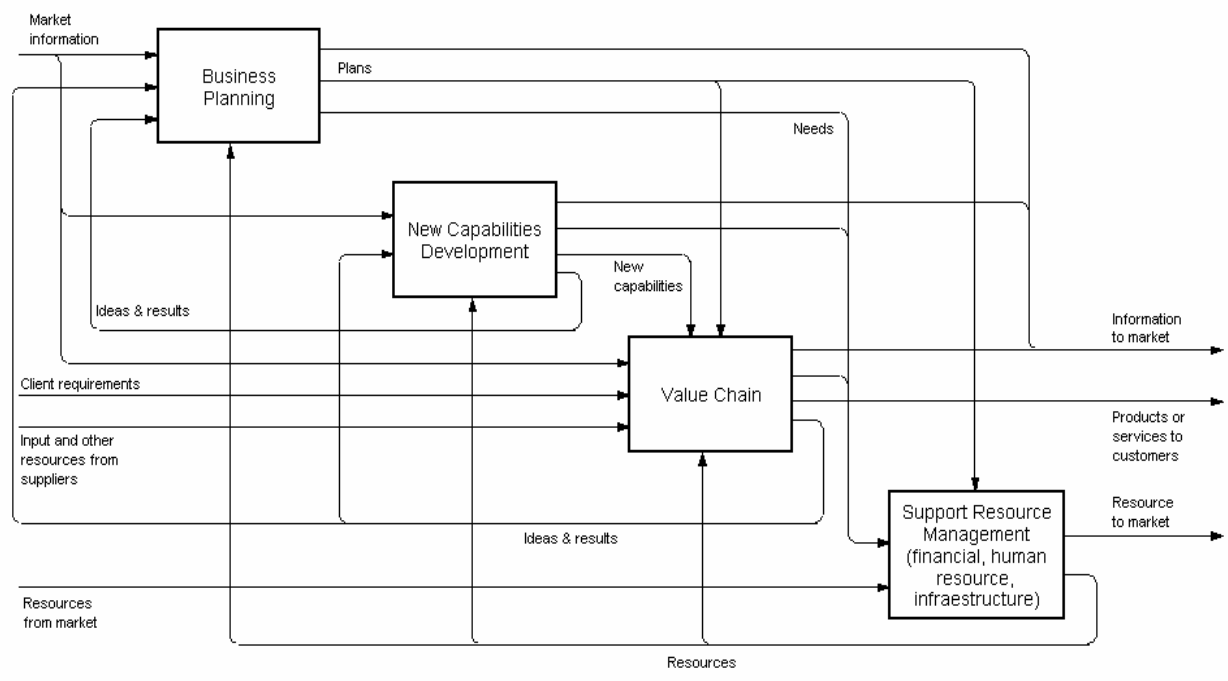

Figura 4. BP General Architecture

This architecture can be compared wih the ones proposed by HP and APQC [1], which have the same purpose. These proposals are shown in Figures 5 and 6 together with the equivalences, mentioned in the Introduction, with our macroprocesses. As it was stated before, ours is a development independent from HP and APQC, it is more general and has more details than such proposals.

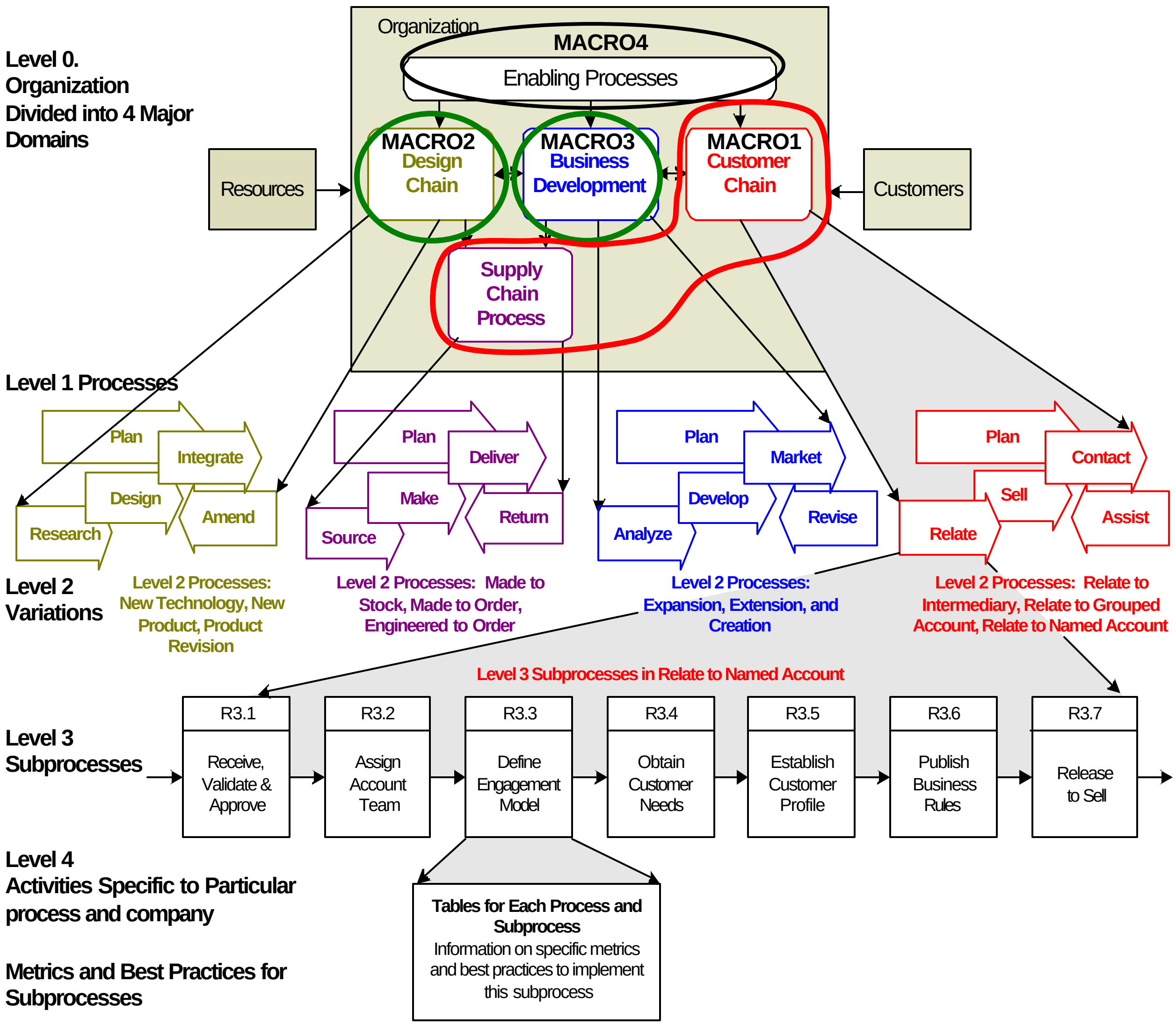

Figure 5. HP Macroprocesses*

* Taken from a presentation by P. Harmon at the University of Chile BPM Workshop, Santiago, Chile, 2005

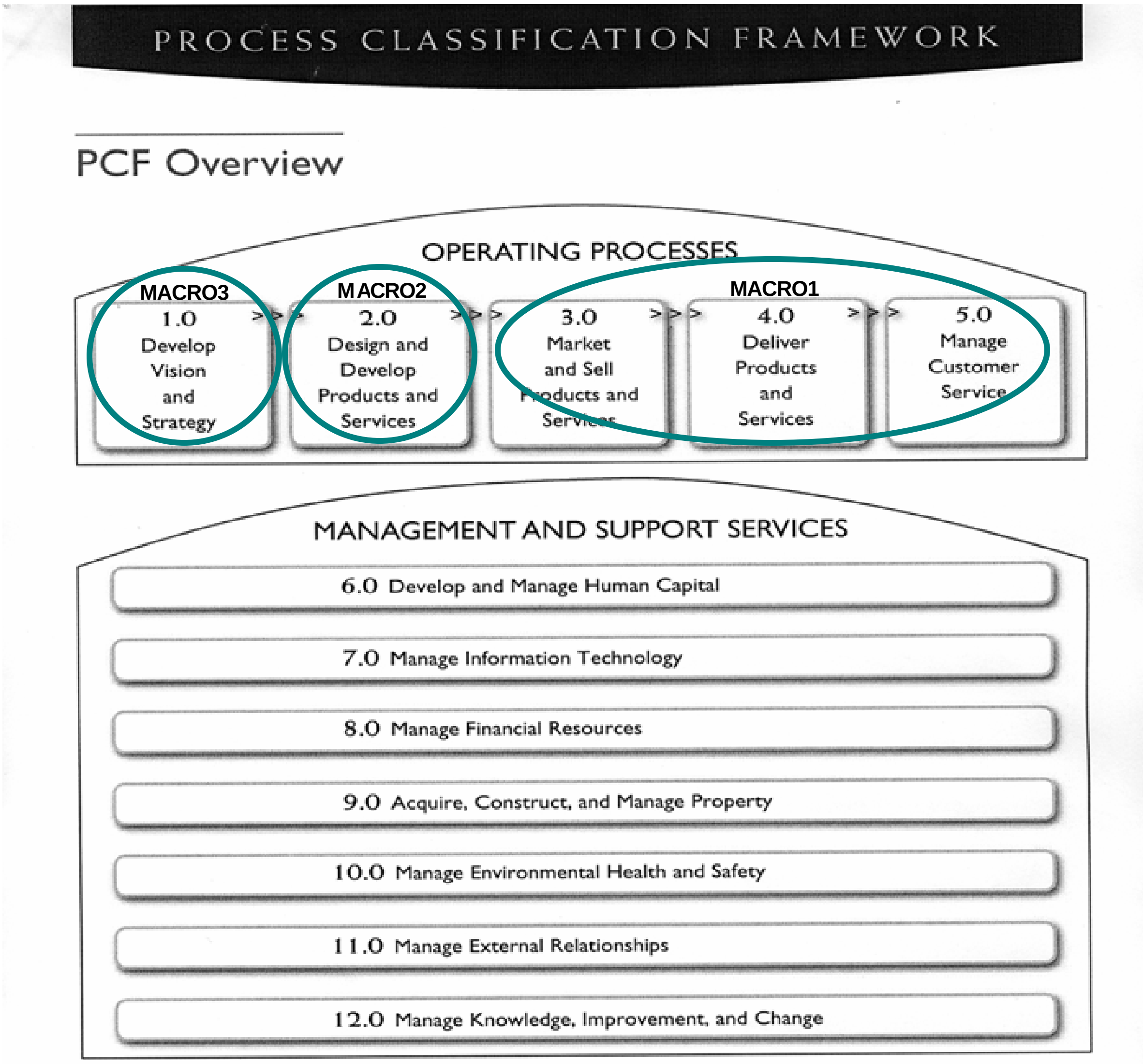

Figure 6. APQC macroprocesses

We illustrate the use of the BP Architecture with examples taken from real cases, where we also show how the architecture is used to guide design. We present cases where the scope of the problem implies that only some of the macroprocesses of the architecture are relevant. Of course, the general problem is to identify all the macroprocesse an enterprise needs, but to show how this is done is beyond the possibilities of this paper.

First case is strategic planning for an IT services firm*. In principle, then, the relevant macroprocess is *Business Planning*, but the general architecture of Figure 4 shows that there is a relationship by means of *Plans* and *Ideas & results* with *Value Chain* and *New Capabilities Development*. So we have to determine the relevance of these macroprocesses by looking at

* This is based on a project developed by M. Donoso at the Master in Business Engineering (MBE) of the University of Chile

the purpose the enterprise has in doing strategic planning. In this case the objective is to assure that strategic ends, measured by specific KPI's, are met by the *Value Chain* and, if this is not possible, to improve such macroprocess to make it happen. This means that the *Value Chain* is involved and also *New Capabilities Development*, since to improve the former, its redesign should be carried out by the macroprocess *BP Development*. So the situation can be summarized as in Figure 7. This figure shows an additional relationship among *Value Chain* and *Strategic Planning*, which is that the actual values of the KPI's are calculated with information generated in the former and fed back to the latter. The main idea here is that plans should be monitored by means of calculated KPI's and from this, ideas for process improvement may appear, which makes necessary *BP Development*.

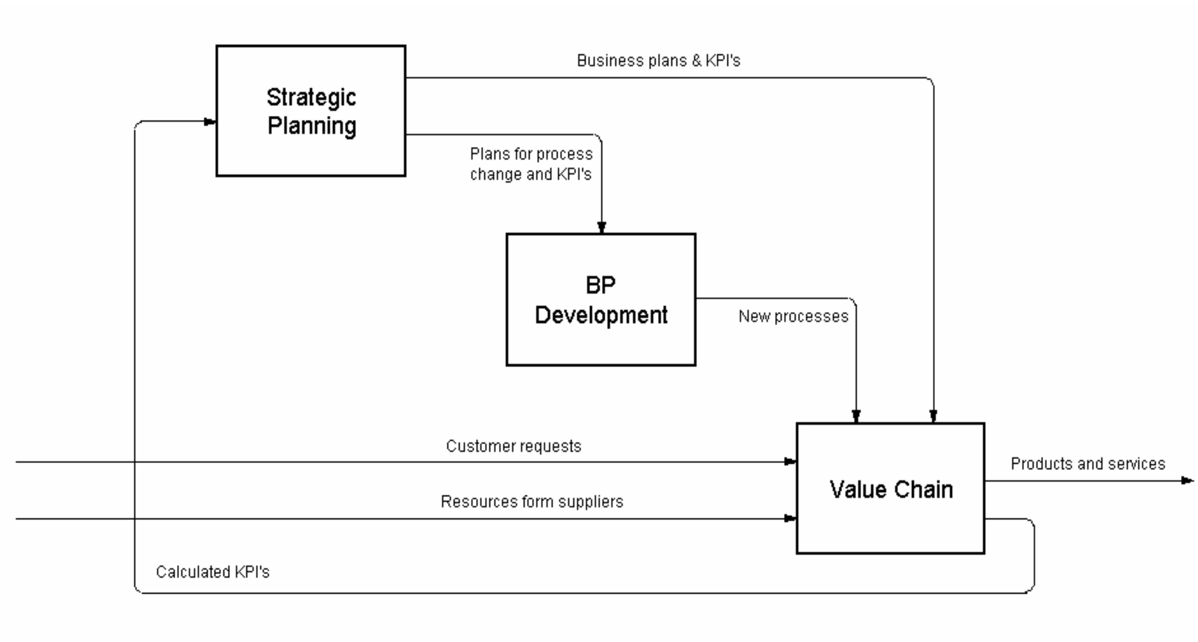

Figure 7. Macroprocess architecture for strategic planning

Another case is operational risk management in a bank[**]. This risk appears in the execution of the *Value Chain*, where risk events, such as errors and thefts, occur that produce economic loss for the enterprise. Then *Value Chain* is relevant, but since these events depend on the quality of the process, *BP Development* should also participate to analyze data about risk events and determine necessary process improvements to reduce risk. Also *Financial Resource Management* should be involved, since the final impact of risk events is in the financial statements of the enterprise. All this can be summarized as shown in Figure 8.

[**] This is based on a real project developed by H. Mora at the Master in Business Engineering (MBE) of the University of Chile

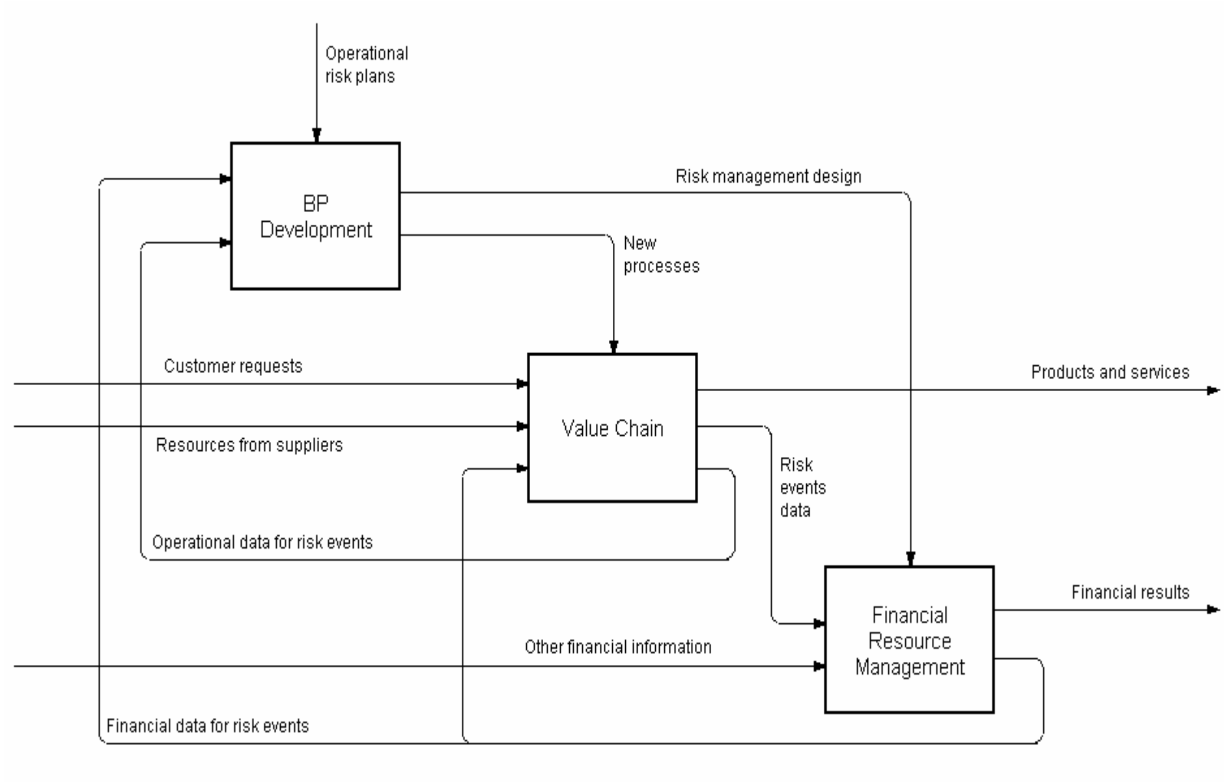

Figure 8. Macroprocess architecture for operational risk management

The third and last case is development and marketing of new products in a telecommunications company*. The main idea in this case is to be able to do a precise costing of the new products in order to provide a good basis for marketing decisions. Since costing depends on the use of resources in the *Value Chain*, the only possibility for precise estimation is to simulate this macroprocess. For this we need an executable model of the *Value Chain* and hence the macroprocess *BP Development* should be involved. Then costing based on such models would allow marketing people in the *Value Chain* to decide whether to introduce the product in the market and if yes, at what price. This situation is modeled in Figure 9. Notice that in this case we have two instances of *New Capability Development*.

* This is based on a project developed by M. Awad y A. Caprile at the Master in Business Engineering (MBE) of the University of Chile.

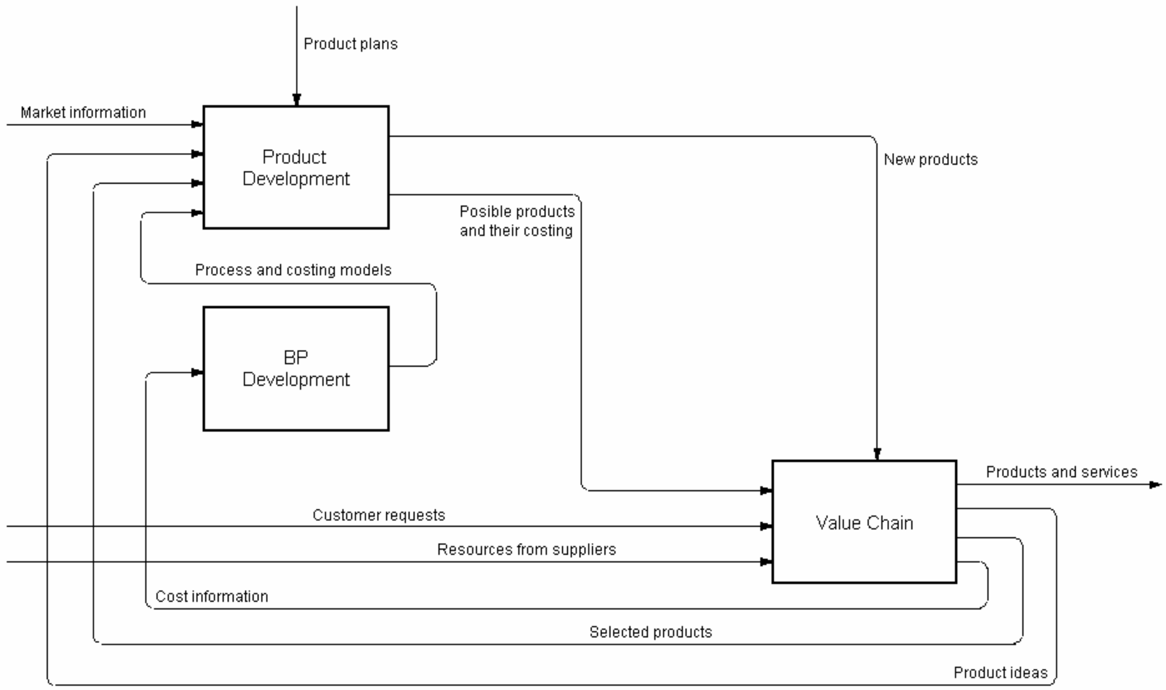

Figure 9. Architecture for telecommunications product development

3.- BPP for the BP Architecture

The BP Architecture previously presented can be detailed by giving, besides the general structure presented in Figure 2, the specific general processes that conform each macroprocesses. We have done this by means of Business Process Patterns (BPP), also proposed in 1998 [4], for each of the macroprocesses. Each macroprocess include best business practices reported in the literature [11,12,14,15] and validated by our experience. We summarize such BPP in what follows.

3.1. Value Chain Macroprocess

This structure, which is a model of the *Value Chain* or Macro1, shown in Figure 10, includes the processes of *Customer relationship management*, *Supplier relationship management*, *Production and delivery management*, *Production and delivery product or service* and *State Status*. It also shows the necessary relationships among such processes by means of information and physical flows, such as supplies and products.

Customer relationship management includes the analysis and marketing activities needed to induce and guide sales; the actual sales and service contact with customers; and the processing of orders, including the decisions about the feasibility and convenience of accepting them.

Supplier relationship management has to do with determining supply requirements; finding adequate suppliers for each of them; planning and scheduling delivery of supplies, including inventory management; and controlling that requirements are rightly satisfied.

Production and delivery management performs the required planning and scheduling of the production and delivery of goods or services, including demand analysis, capacity planning and logistic decisions.

Production and delivery of products or services implements the plans and schedules produced by *Production and delivery management*.

The structure of this BPP is clearly the one specified in Figure 2, where *Production & delivery product or service* is an *Execution Process*; *Production & delivery management, Supplier relationship management* and *Customer relationship management* are instances of a *Management Process*; and *State Status* is obviously a *State Status Process*.

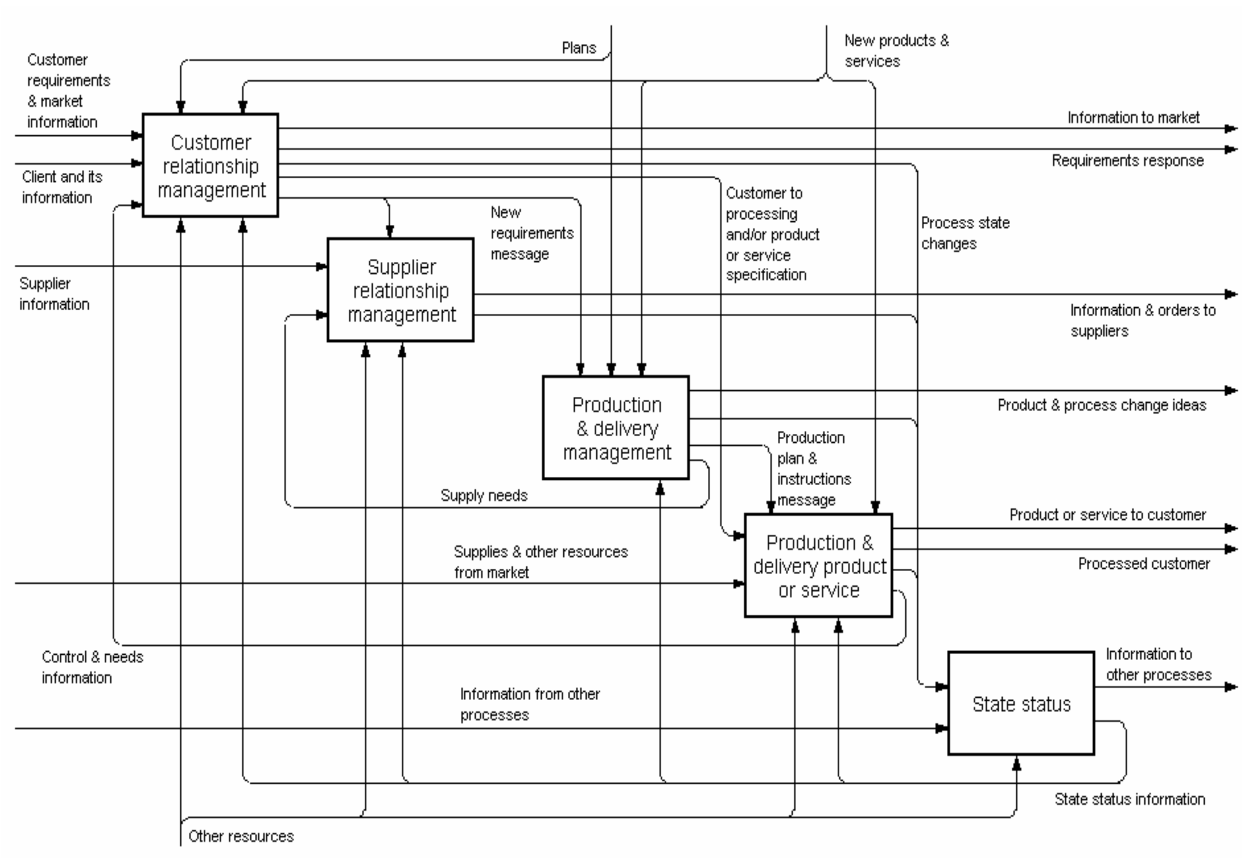

Figure 10. Business Process Pattern Macro1

We detail a BP pattern by partitioning each of its processes, as it is shown in Figure 11 for *Customer relationship management*[*]. We give further details by partitioning the subprocess *Marketing* and *customer analysis* of Figure 11, which is shown in Figure 11(b).

In Figure 11(b) we concentrate on *Customer and sales behavior analysis*. For such a subprocess, which is further decomposed in Figure 11(c), we can specify a best practice business logic, which would involve the use of Business Intelligence, e.g Data Mining, over a Datamart with the required information. Business logic, which guides the action in an activity,

[*] These process decompositions are supported by old modeling tools such as BPWin, based on IDEF0, and new ones as those based on BPMN [18].

determines the exact information flows that are required and that are produced, including the updating of the process changes in *State Status* of Figure 11 and the state information this generates, shown below each activity, which is necessary for its performance.

The pattern includes decomposition for all the activities in Figure 11. To further illustrate such task, we decompose *Production and delivery management*, which is shown in Figure 12.

Now a key and unique feature of our approach is to make explicit how the different activities of a pattern interact to produce coordinated actions. This is done by means of the information flows that activities interchange and the business logic that each of them executes to process such flows. For example, in the case of applying the previous pattern to production to stock, such type of relationship is the one between *Forecast model development* of Figure 11(c), *Sales Planning* of Figure 11(b), *Scheduling* of Figure 12(b) and *Supplier relationship management* of Figure 10. Clearly, forecast models produced by the first activity will be used to generate a sales forecast and sales plan, in the second, which will then trigger production lots that will be sequenced by *Scheduling*. The production schedule will, in turn, be used by the last activity to generate orders to suppliers. We present this coordination chain as a sub pattern in Figure 13, where we show a "horizontal" process view mixing activities from several "vertical" hierarchical decomposition views, including the explicit role of *State status*[*]. In such chain each activity executes a business logic that is designed to generate the required performance: to produce what is needed according to the forecast, assuring the required supplies and minimizing production costs.

[*] This view is given to facilitate the understanding of the coordination issues; experienced modelers can gather the same information from the "vertical" views in Figures 10, 11 and 12. Of course, there are many other sub patterns that can be derived from such views.

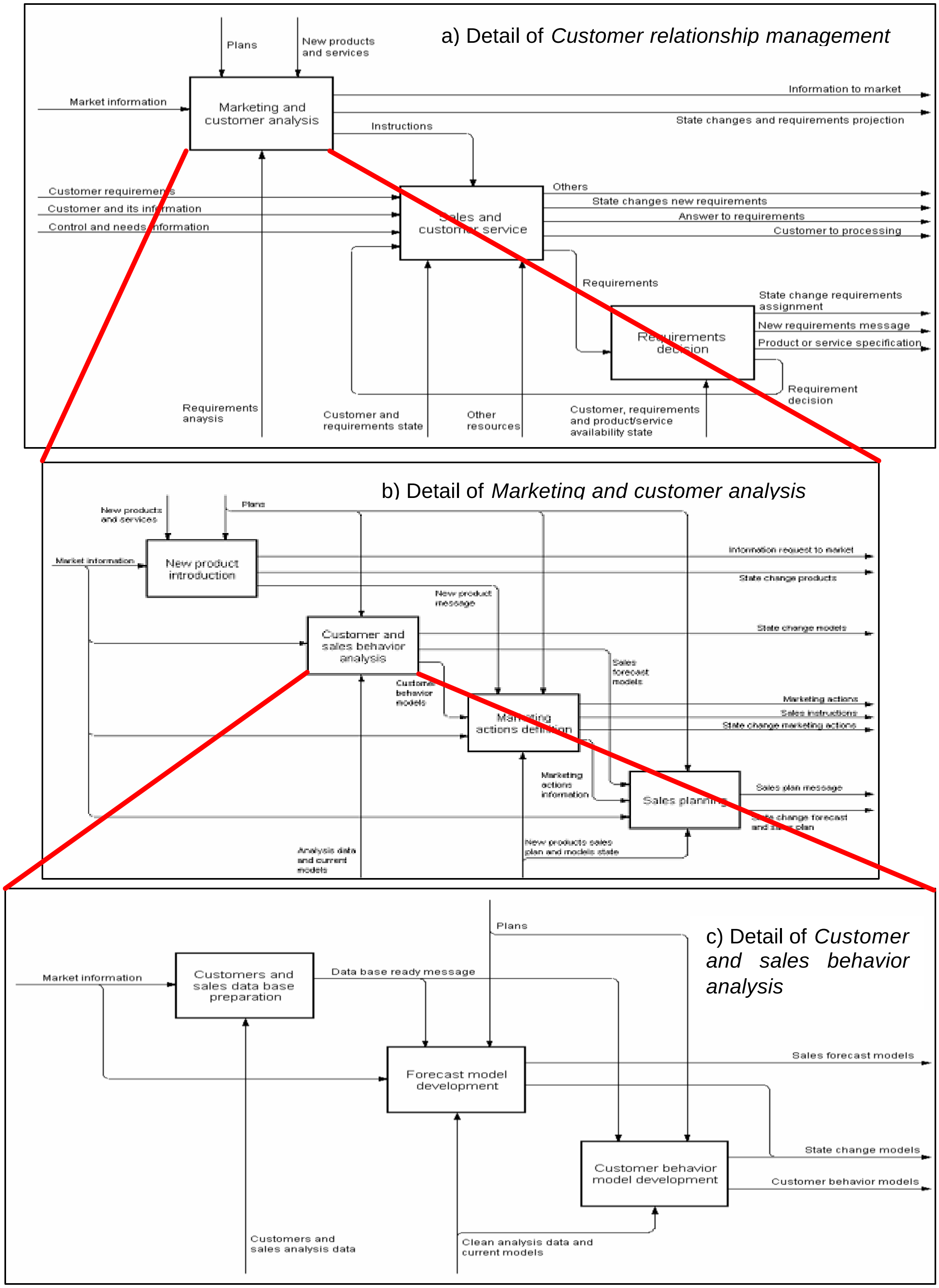

Figure 11. Decomposition of *Customer relationship management*

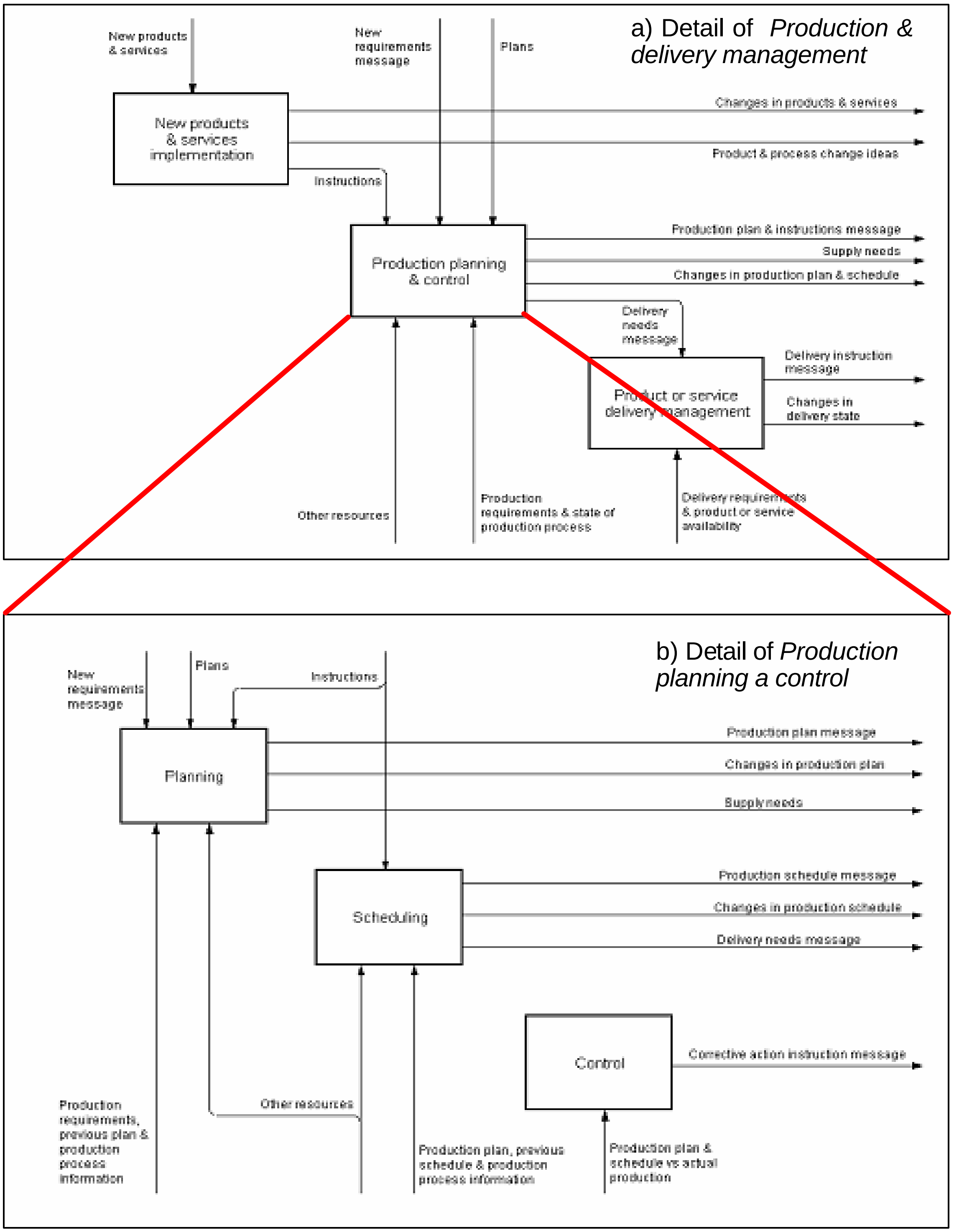

Figure 12. Decomposition of *Production and delivery management*

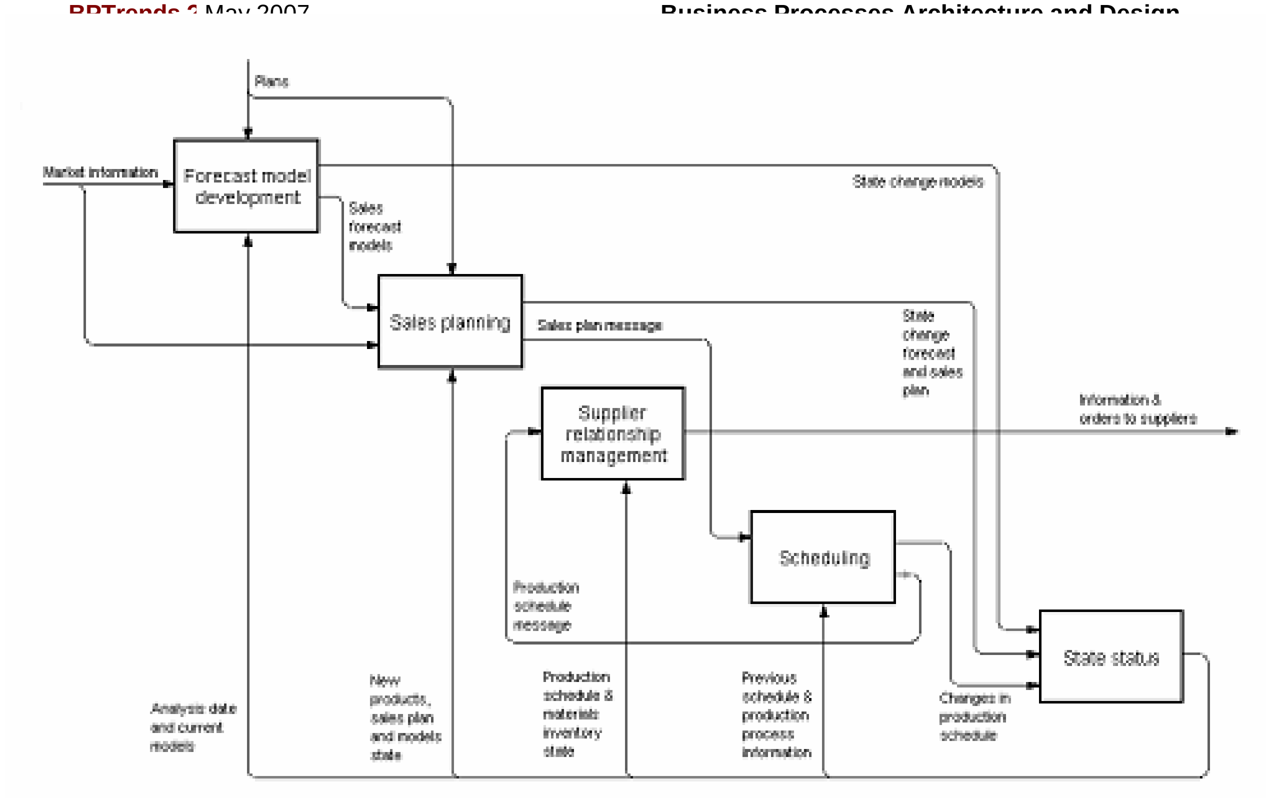

Figure 13. Coordination sub pattern

We have illustrated the concept of BPP with just one process pattern for a very general domain. Other BPP have been developed for particular cases or specializations of the general domain, such as situations in which there is not production and sale of products and services is made from stock bought from others, manufacturers that sells their own products, and hospital or financial services [5,6,7,8,9].

3.2. Support Resource Management Macroprocess

Following the same general structure of Figure 2, we present Macro4 in Figure 14, where the processes *Resource input, application and transfer* is an *Execution Process; Obtain resource, Decide resource application and Decide resource transfer* are instances of a *Management Process*; and *State Status* is *an State Status Process*.

Macro4 applies to any resource and a different instance for each of them can be developed; we give examples of these instances and explain the macroprocess below.

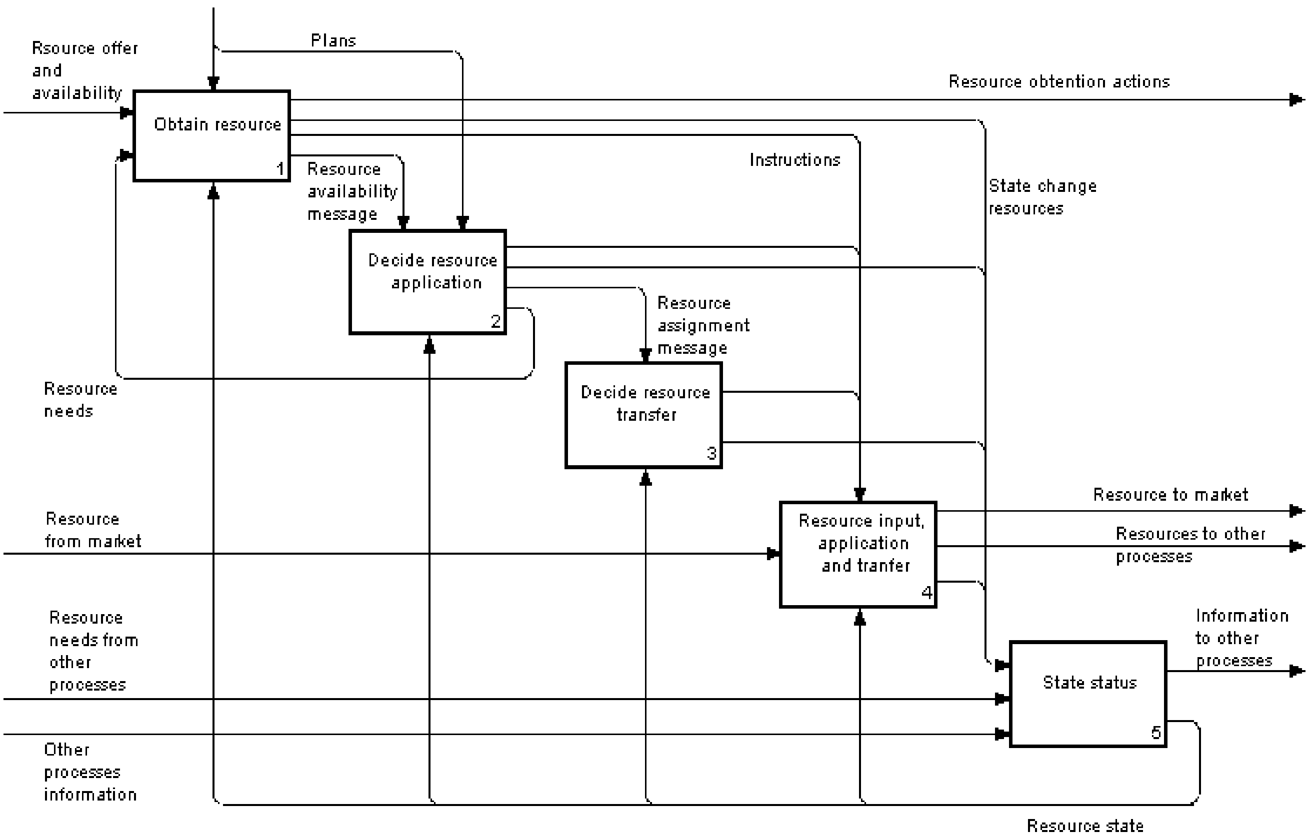

Figure 14. Support Resource Management Macroprocess

Obtain resource has to do with determining needs and executing actions to obtain resources such as people, machines, money, spare parts, office supplies etc.; so its purpose is to assure that any need the enterprise has for such resources is provided by deciding, for example, to hire people, to request loans, to buy new equipment and to outsource office supplies.

Decide resource application is the process that assigns available resources to requirements coming from other macroprocesses, such as new recruits to business units; computers to people who need them; office space to new business; and budget to business units. It also includes deciding about actions on resources that improve their capabilities, such as people training, equipment maintenance, money investment, etc.

Decide resource transfer determines what to do with the resources that should be sent to other enterprises or markets, such as obsolete equipment, money to be paid to suppliers, money invested, fired employees, surplus supplies, etc.

Resources input, application and transfer executes the physical manipulation of resources, such as inputting them to the enterprise by, for example, hiring people, receiving equipment and supplies and warehousing them, and receiving money from customers; applying the resources to different uses by, for example, putting people to work in a business unit, train people, maintain an equipment, invest money and give computers assigned to people; and transferring resources outside the business by, for example, selling surplus and obsolete equipment, paying suppliers, investing money and firing people.

Macro4 has several more levels of detail that show the subprocesses and activities that conform the processes and their relationship; such details are given in [5].

We remark again that what makes our BPP special is the specification of the relationships that should exist among processes. In the case of Macro4 it is clear that the control flows *Resource availability message*, *Resource assignment message* and *Instructions* provide the necessary coordination among processes. This is further supported by the *Resources state change* that updates resources in *State status*, which in turn feeds back the state of resources to each process. It is also clear that there are flows that coordinate Macro4 with other processes, such as *Resource needs from other processes* and *Plans* and *Resources to other processes.*

3.3. New Capability Development Macroprocess

The structure of Macro2, which is shown in Figure 15, follows the same pattern of Figure2, where *Design and build new capability* is an *Execution Process*; *New capability need evaluation* and *Manage new capability design and built* are instances of a *Management Process*; and *State status* is a *State Status Process*.

Since new capability development is done through projects, Macro2 has the typical processes needed for project management and execution plus the support of *State status* to update and communicate the situation of the activities in the project.

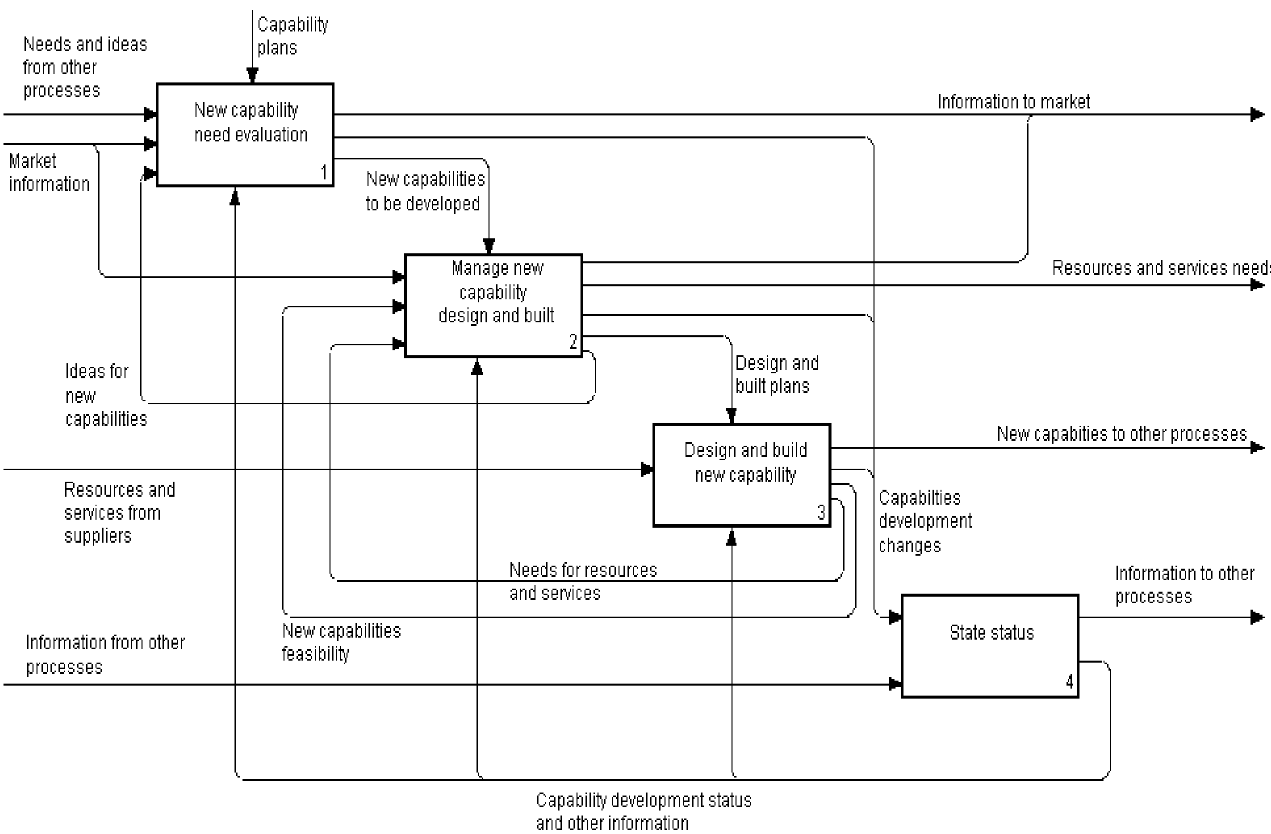

Figure 15. New Capability Development Macroprocess

Hence, *New capability need evaluation* is basically analysis of information that motivate and support the project and its formal economic evaluation to decide its implementation. For example, perform a market study and calculate a rate of return on the investment needed for a new product; analyze performance indicators of the *Value Chain* processes to determine necessary redesign and calculate economic indicators that justify such redesign; and evaluate proposals for new infrastructure to determine its operational and economic feasibility.

Manage new capability design and built performs the subprocesses and activities necessary to determine the resources needed by the project, obtain and assign such resources and produce a plan for it. For example, to determine that, for the development of a new product, a prototype should be built and assign people with the required abilities to a team to do it, together with a timetable; and determine required professionals and assign them to do a process redesign plus a schedule for it.

Design and build new capability executes the assignments and plans of the management process by carrying out the necessary activities. For example, actually design and built a prototype of a new product according to plan; do the redesign of a process according a given timetable, and design and built new infrastructure according to plan.

The processes of Macro2 can also be decomposed as explained for Macro1, going down to a level of detail where best practices can be recommended for the last level activities; for example, project evaluation, planning and scheduling practices.

3.4. Business Planning Macroprocess

Macro3 or *Business Planning* is decomposed in Figure 16. It also follows the pattern in Figure 2, where *Strategy development* is an *Execution* process; *Manage strategy development* and *Define business concept and vision* are instances of a *Management Process*; and State Status is a *State Status Process*.

Define business concept and vision is the process that, based on information about political issues, economic trends, technological developments, regulation factors, and the like, defines the vision for the enterprise, set goals and objectives (desired results) and develops an evaluation model to measure such results with suitable metrics.

Manage strategy development has two main sub processes: one which produces *Strategy development plans* and another that evaluates *Strategy proposals* produced by *Strategy development* and actual performance of strategies that have been implemented. *Strategy development plans* include the assignment of human, financial and other resources needed for strategy development or adjustment; and schedules for the completion of the job. Evaluation of *Strategy Proposals* has as a purpose to assure that such proposals are aligned with the enterprise vision and that adequate metrics are defined to measure their performance. Actual performance of strategies is measured by calculating the current values of the performance metrics and comparing them with goals. Of course these evaluations may result in improved strategy development plans to guide the work of *Strategy development*.

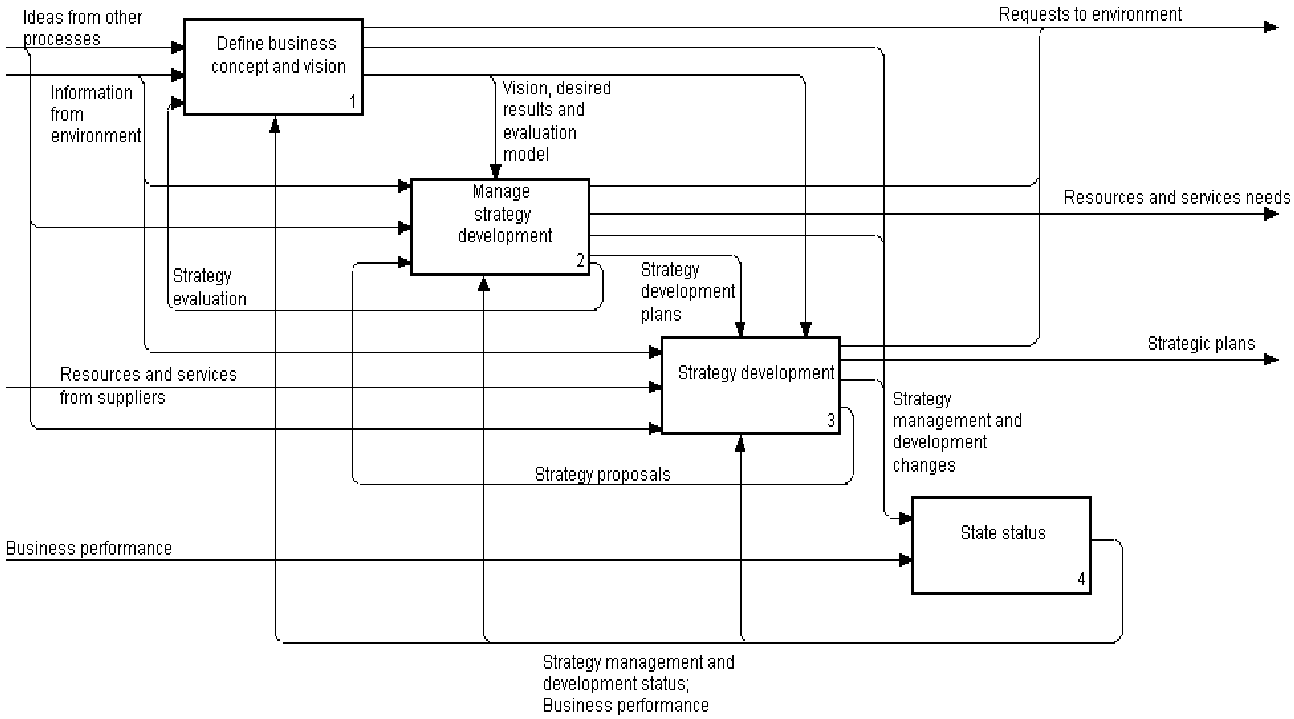

Figure 16. Business Planning macroprocess

Strategy development has, among other tasks, to define the enterprise mission that makes operative the vision; to generate and evaluate strategic options for new and current businesses; to define organizational structure, needs for new or redesigned processes, and the introduction of new technology; to transform strategies and other courses of action into detailed plans, including budgets, schedules and performance metrics, to be executed by other macroprocesses; and adjust strategies under *Manage strategy development* guidance. One of the most important tasks in this list is the generation and evaluation of strategic options, since it is here where an enterprise can produce competitive advantage. Ideas such as Porter's competitive strategy [20] can be of value when implementing this task.

The coordination among processes of Macro3 is clearly executed with the flows in Figure 16, as we have exemplified in the explanation of such processes. There are also flows for coordination with other macroprocesses. One is *Strategic Plans,* which is the one that makes strategies operative in order to be executed by Macro1, Macro2 and Macro4; another is *Business performance* that feeds *State Status* with the information that allows to calculate strategy performance metrics; and also we have *Ideas from other processes* coming from other macroprocesses.

Macro3 can also be decomposed into sub processes and activities as it was outlined in the presentation of this macroprocess.

4.- Architecture and BP Design

We emphasize that the final objective of the general BP architecture and BPP presented in the previous section is to guide design. Hence we aim for a methodology on how to do architecture and BP designs. In what follows, we outline such a methodology and give real life cases of its use.

4.1. Architecture Design

As it was outlined in Section 2.2., the starting point for BP architecture design is the general architecture of Figure 4. Such architecture tells us the types of macroprocesses that should be present in any design. Then, according to the scope of the design project, one should select the specific macroprocesses that need to be present in the architecture. The largest scope is to build an architecture for the whole of an enterprise. In such a case, the approach is basically to instantiate each of the type of macroprocess, determing all the grouping of processes that are relevant in the case at hand. For example, several instances of Macro1 could exist if the enterprise has several value chains that function in an independent way, such as a retail business that has the regular logistic chain for the products it sells but also a service chain for its own credit cards, which are used for customer purchases. Of course these different value chains interact and their relationships are part of the architecture. In some cases the relationships are so intense that the architecture design problem includes the trade off among integrating value chains in just one macroprocess or keeping them separate but with common parts which means close relationships among the value chains. This is the case of banks where several value chains for different products, such us bank accounts, loans, credit cards and the like, share common parts of the chain, such as customer sales and back office operations. An interesting architecture design problem here is to determine what is more cost effective: full independence or share of processes by means of relationships. This is a particular case of the more general problem of compartmentalization of enterprises, for which there are economic analysis that can be made [16].

The more common case of scope one finds in practice is to design the architecture of a part of an enterprise, such as one particular value chain, or a group of macroprocesses that are relevant to accomplish a given purpose. As an example of this situation consider the telecommunication case we presented in Figure 9. This case was simplified in Section 2.2., since the true purpose of the required BP architecture was to support a new business model and not just allow costing of products. The new model considers that the physical production of telecommunication services will perform as a “factory”, from which the business units will demand services, paying for them. So the factory will be a profit center and not just a cost center. So, in this case, the costing of products and services is the basis for the factory to bid and charge for products. This new situation is represented in Figure 17.

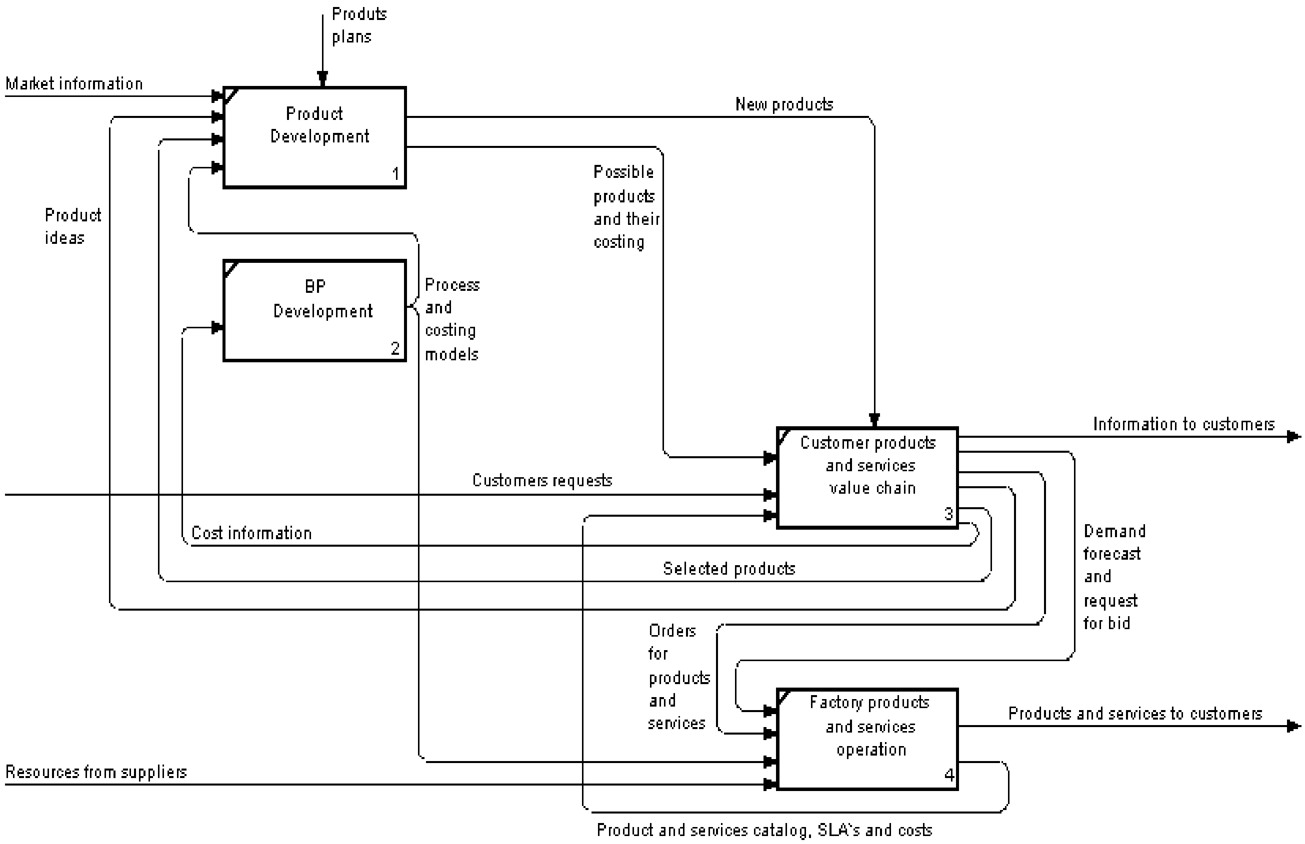

Figure 17. Telecommunications case architecture

In Figure 17 there are relationships for different purposes that take place in different timeframes. First, we have the relationships for new product development, which was presented in Figure 9 and explained in Section 2.2., which occurs occasionally. Secondly, these are yearly planning relationships where *Customer products and services chain* provides a *Demand forecast and request for bid* in order for *Factory products and service operation* to plan its production and calculate and update the *Products and services catalog*, *SLA's and costs*, using the *Process and costing models,* which is the basis for eventual negotiations of SLA's and particularly of costs, between the two macroprocesses, in order to provide competitive pricing to customers. Finally, we have a day to day relationship where *Orders for products and services* are requested to the factory, which, based on the accorded SLA's, delivers the actual *Products and services to customers*.

Now we present another real case, which is close to considering the full architecture of an enterprise. It deals with a major TV Channel, which produces an important part of its programming content*. So the *Value chain* or Macro1 covers, in this case, from the selling of the channel programming, with estimated ratings, to the actual production, where the canned products are bought and shown, and the local products are developed and transmitted alive or given in prerecorded format. But for Macro1 to perform well we need at least two other macroprocesses: one of the Macro2 type that defines all the new programming, either by

* This is based on a project developed by C. Salvatore at the Master in Business Engineering (MBE) of the University of Chile

studying the market of canned products or doing market research to define the types of programs that should be produced locally; and another of the Macro4 type to obtain the talents or faces the new programs need to be successful. These relationships can be modeled as shown in Figure 18. The dynamics of such relationships in this case is very intense, since, due to the characteristics of the business, *New programming development* has a high level of activity and it is constantly interacting with the *Value chain* to adapt the programming to the competition, considering its actual rating. The same is true for *Talent management* that should respond quickly to *Value chain* frequent and changing demands and also *New program development* needs for information about talents.

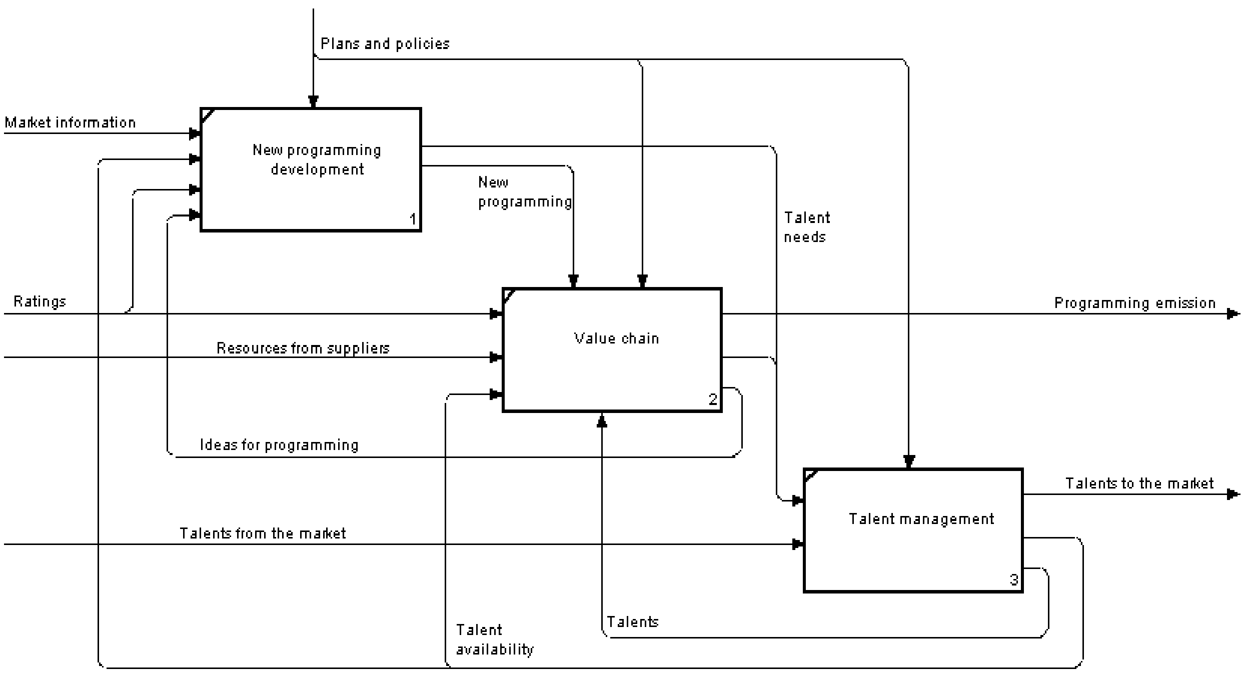

Figure 18. TV Channel case architecture

We remark that the architecture design cases presented clearly show how a particular way of structuring business activities works. They include many design options in terms of activities and processes grouping, interactions and coordination by means of relationships, and requirements for the detail design of each of the macroprocesses. In the next section we will show how such requirements are converted into a design with the help of the BPP.

4.2. BP Design

The basic methodology for BP design is to start with the requirements established in the BP architecture for a given macroprocess and use the corresponding BPP to derive a design. This is done, in the more usual case where there is a current process, by comparing the "as is" situation with what the BPP states it should be. Then the design decision is how close to the "should be" to move and what specific practices, including the business logic, to implement for each activity in the processes of the macroprocess under study. In the case where these is no current situation, the decision is similar in terms of determining how much of the BPP recommendations to follow.

In deciding how close to move to BPP recommendations, there is always an economic trade off that depends on the particular business for which processes are being designed. This is basically that improved processes generate quantifiable benefits, but they also need an investment in the design effort and associated implementation, including IT investments, and additional recurring operational costs. Of course, the balance of benefits and costs, measured by an appropriate economic indicator, should be positive for the design to be justified. There are many economic ideas that can be used in this analysis, which are presented in [5].

In what follows we present two cases of application of above methodology, which use different BPP.

The first case is operational risk management, presented in Section 2.2., for which we will design the *BP Development* macroprocess of Figure 8. For this we will use the *Business Capability Development* BPP of Figure 15.

From Figure 9, the basic requirement for *BP Development* is to generate *New processes* and *Risk management design* based on *Financial data for risk events* and *Operations data for risk events*. The first process involved is *New capability need evaluation*, which, in this case, specializes to *New process need evaluation*. In this process, the requirement is to determine which current processes operating in the *Value chain* of Figure 8, should be redesigned. This implies two design decisions: what data about *Value chain* operation should be collected and what analysis to do with it. Here we should consider what data is currently available and what new data should be collected. We will give below the decision about this design issue, which involves mainly a formalization of data collection and performing new statistical analysis to discover the opportunities of process improvement.

Once opportunities for redesign are discovered, redesign projects should be organized and plans for their development made. This is done by the process *Manage redesign and implementation project,* which is an specialization *of Manage new capability design and built* of Figure 15.

Then another process should carry out the redesign and implementation project, which is *Redesign and implement new value chain process*, an specialization of *Design and build new capability* of Figure 15.

Finally we have the typical *State Status* process, which keeps the situation of the different processes up to date, such as operational risk data, operational risk analysis results, redesign projects under development, and project plans and performance.

The processes above, together with the relationship flows, form the first redesign model, which is shown in Figure 19, where we have also specialized the flows in Figure 15.

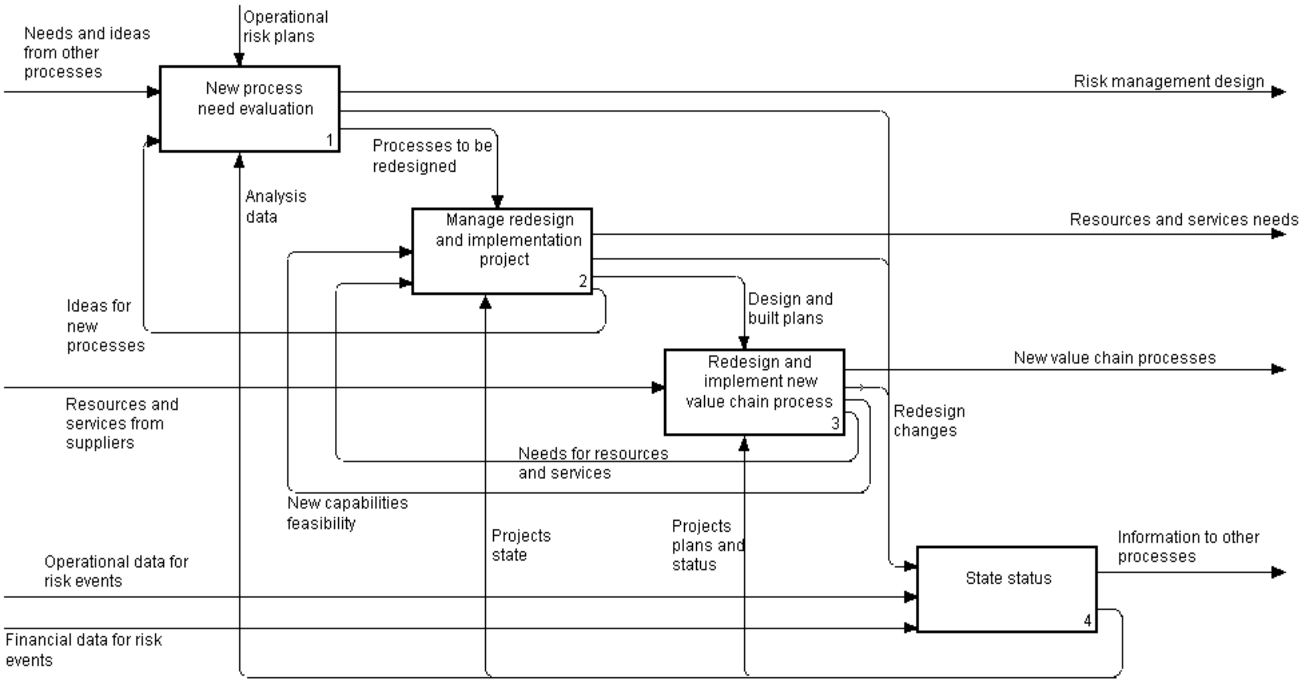

Figure 19. BP Development model for operational risk management

Now we will give more design details about *New process need evaluation*. Basically, as we said before, we need to specify the *Analysis data* and the internal logic that will manipulate such data to produce a recommendation for value chain process redesign. There are other procedures and design details that we avoid to simplify presentation. The *Analysis data* is the currently collected data for some value chain processes, which will be extended for all such processes. It consists of financial operation loss for particular risk events that occur in a value chain process. For example, loss due to the wrong closing of accounts in the checking accounts business process. The idea is to have data of this type for all the risk events that occur along each of the value chain processes.

Then, the analysis consists of determining the loss probability distribution for each of these events and the distribution of the yearly frequency of such events. Combining both distributions by means of a Monte Carlo simulation, an empirical distribution can be built to calculate the VAR, which is a yearly loss quantity that will not be exceeded with a given probability. For example a loss of US$ 3.5 million per year that will not be exceeded with a probability of 0.95.

Given these VAR's for each risk event of a value chain process, it is clear that the appropriate business logic is to rank them from high to low VAR for the same probability. Obviously, the largest VAR presents the best opportunity for redesign, since if we improve the corresponding process and reduce the VAR in a given percent, the reduction of loss would be larger. This makes possible to select good value chain processes candidates for redesign.

Now the other output of this process, *Risk management design*, is a direct consequence of the VAR analysis, since funds provisions to cover operational risks, which are required by bank regulations, can be calculated with precision: provision a quantity that covers risk with a given probability.

The second case of BP design we will present is the one related to the TV Channel architecture of Figure 18. Here we will consider the value chain macroprocess, which is the one that performs the actual emission of the TV Channel programs. Hence the BPP that applies is Macro1, shown in Figures 10 to 12. We start by specializing the first level model of Figure 10, for which it is relatively direct the mapping of the processes of the TV Channel onto it. Such mapping is shown in Figure 20, where the model in it is the general design that comes directly out of Macro1. We give a brief explanation of its more relevant ideas.

Programming production and logistics is the process where, following *Production and logistics plans*, the content of the programming is developed and emitted. This includes the production and recording of the local series, using the available *Talents*, the production of live programs and its emission and also of the bought canned programs

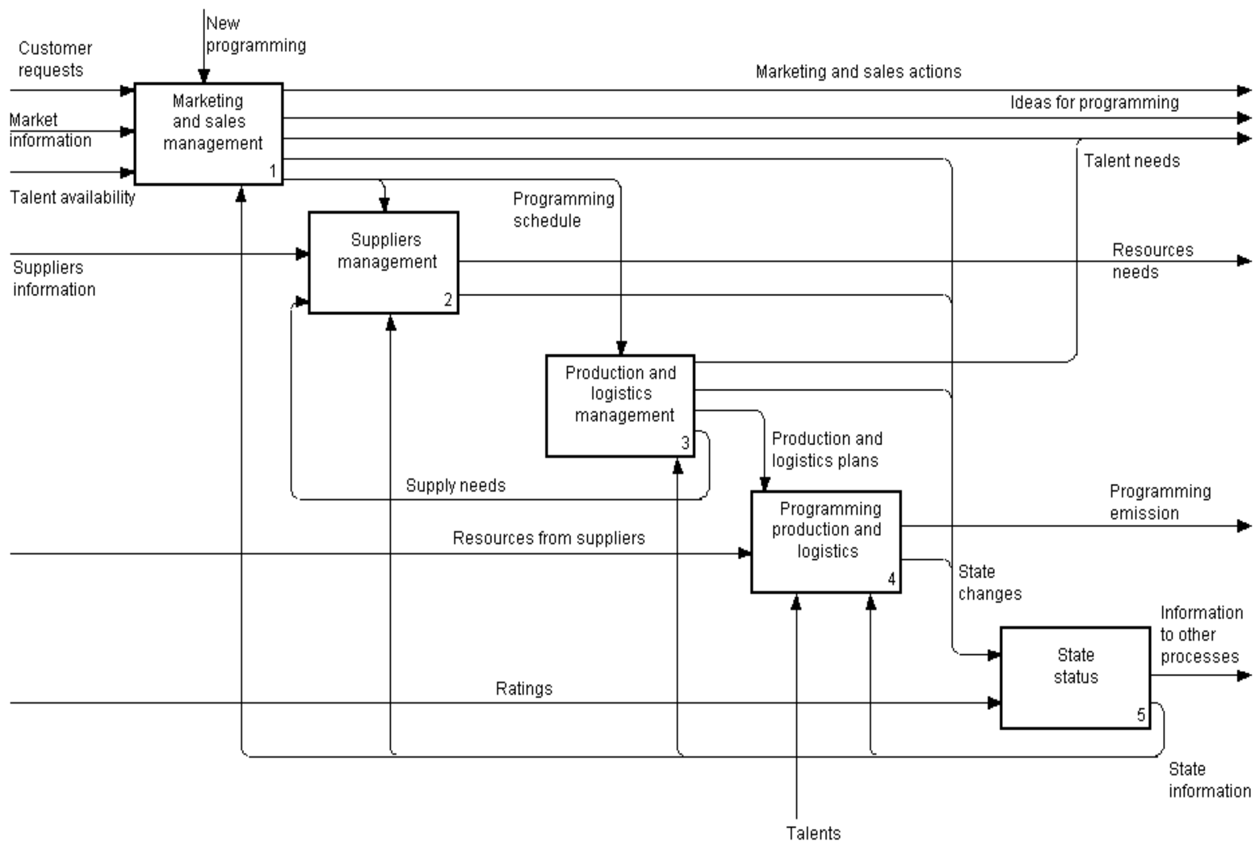

Figure 20. TV Channel value chain model

Production and logistics management is the process that assigns resources, schedule activities and, in general, make sure that *Programming schedule*, which includes all the programs to be emitted with dates and hours, is implemented with the adequate quality and at a minimum cost.

Marketing and sales management has as a main purpose to produce and sell a *Programming schedule* that maximizes the value for the channel in terms of rating and advertising income.

Suppliers management is the process that makes sure that all the resources —except for *Talents*— needed for implementing the *Programming schedule* are available.

Finally *State status* keeps up to date and provides all the information that processes need to perform their tasks, such as ratings, customer requests, schedule, resource availability and analysis results.

We remark that the coordination flows among processes assure that the complete macroprocess operates in a systemic way.

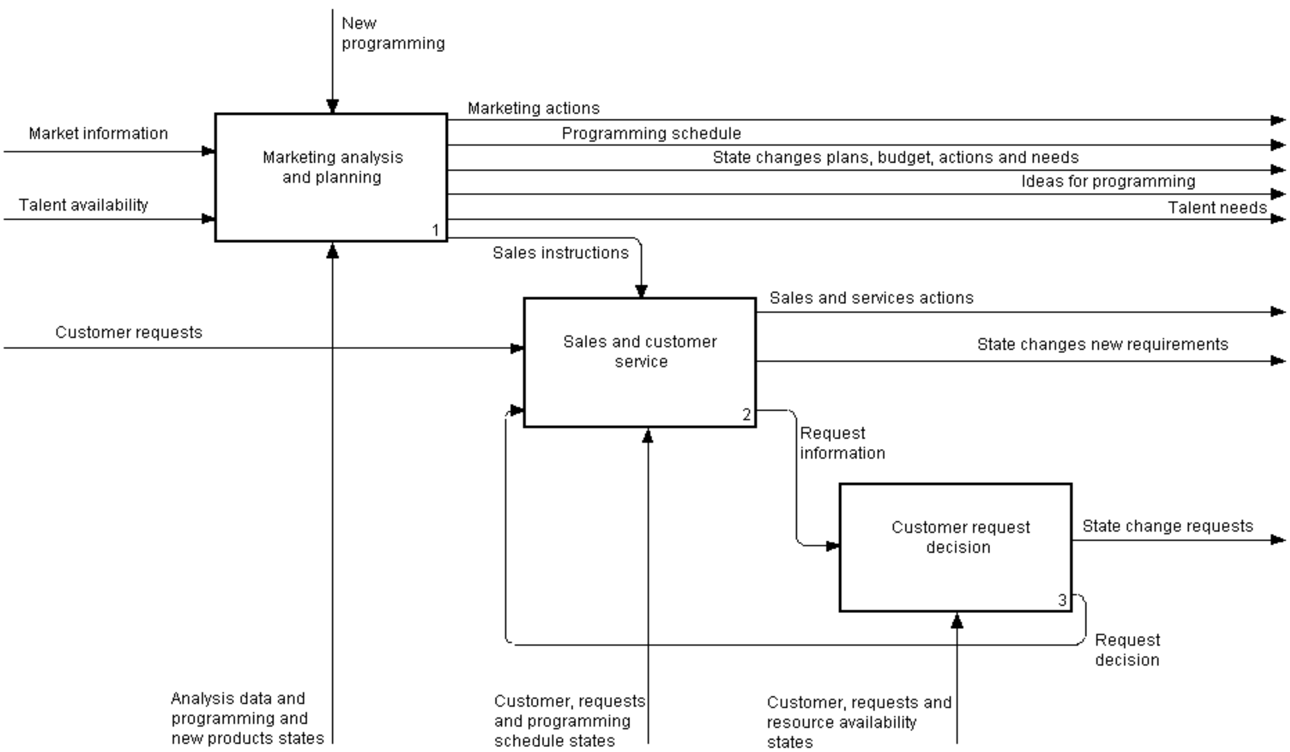

Figure 21. Marketing and sales management model

Now we give more design details of *Marketing and sales management*, by using the corresponding BPP in Figure 11a. Mapping of the TV Channel situation onto the pattern is also straightforward and it is shown in Figure 21. In this figure we will concentrate on *Market analysis and planning*, for which we can also apply the pattern in Figure 11b, resulting in the model in Figure 22. Here we will detail the design of *Customer and sales behavior analysis*, which produces an important result that determines the *Programming schedule*, which is the basis for the whole macroprocess. This activity has a purpose to produce a *Rating and sales forecast* for a given mix of TV programs (schedule) based on historical rating data, advertising and sales data and other information on TV audience characteristics. Such forecast estimates the value for the channel of a given *Programming schedule* and it is the main support in trying to define a programming that maximizes such value.

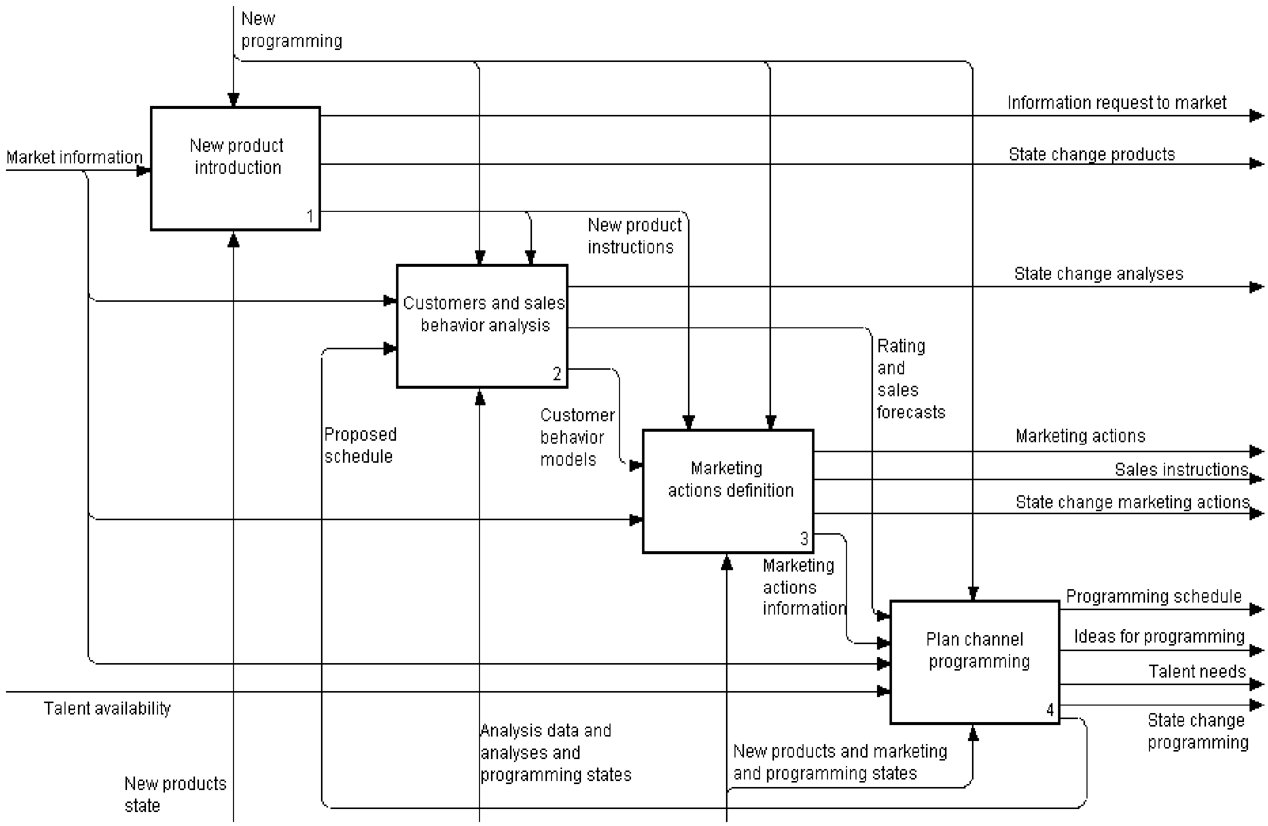

Figure 22. Marketing analysis and planning model

In generating the forecast above, we need a predictive model that is able to forecast the number of TV sets that will be turned on at a given time, and the share a given program will have at such time in different segments of the viewing population. This is complex mathematical problem and it is beyond the scope of this paper to explain its solution. But we can report that, in the actual case where this design was implemented, it was possible to develop a predictive model that forecasted ratings for programs with an accuracy of more than 90% and, in some cases, close a 100%.

In the cases above, we have presented the integration of architecture and process design. In particular, we have used the same types of models at different abstraction levels to represent architecture and process details. Decomposition of macroprocesses of the architecture and then of their component processes has allowed us to show design details in a controlled way and avoid too complex representations. In the last levels of design details we have presented business logic in an informal way but, following the same idea of decomposition, procedural models of the BPMN type [18] can be used to formalize such logic. As an example of formal business logic we give, in Figure 23, the BPMN model that presents the logic that allows simulating the value chain for the costing of a particular product in the telecommunications case of Figure 17.

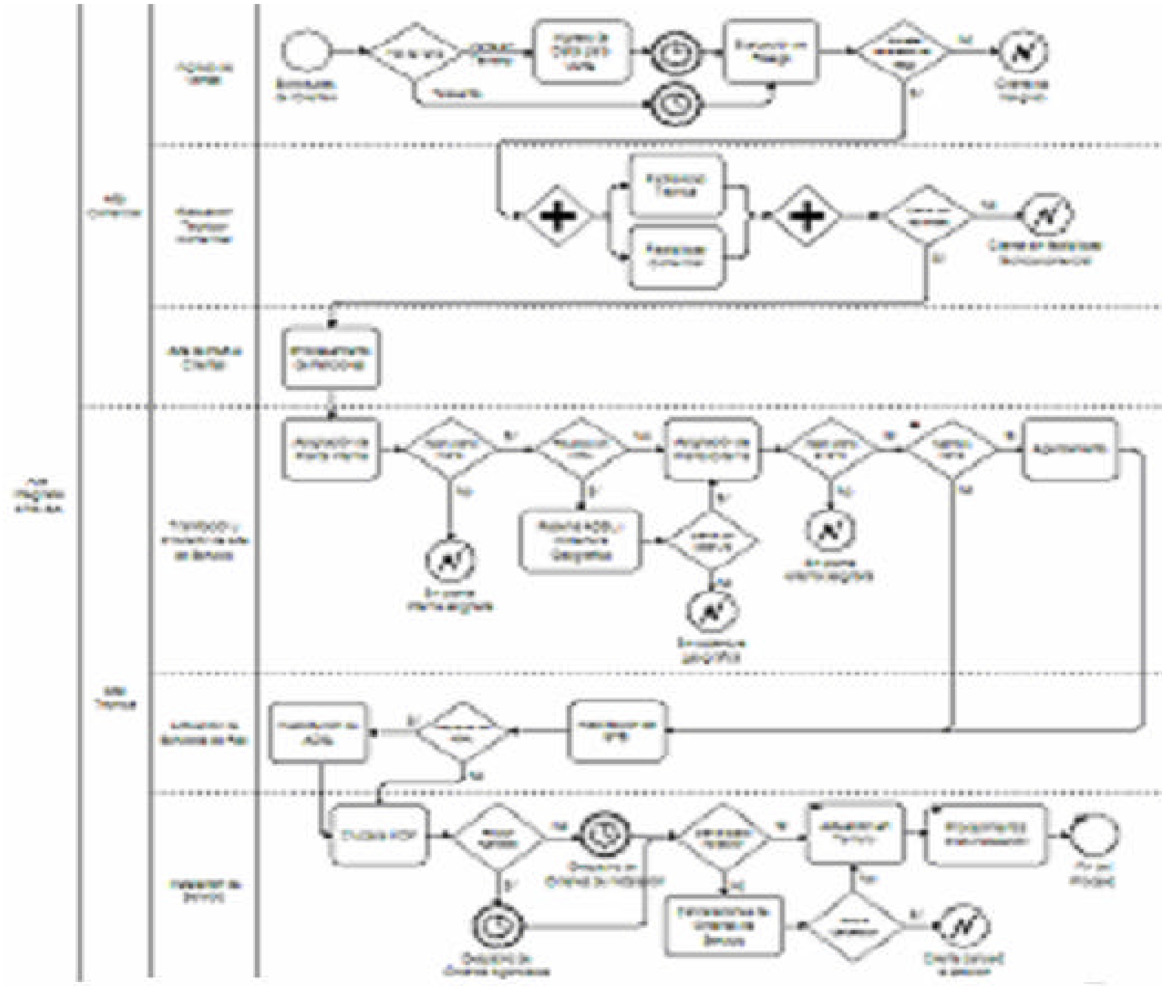

Figure 23. BPMN model for the telecommunications case

All this shows that it is possible to integrate in the same representation the different levels of design one finds in BPM: from architecture to business logic. This is an advantage in connection to current methods used by leading companies to represent different levels of design, where various approaches are used to model at such levels. For example, in a recent BPM seminar*, British Telecom, Intel and Bank of America reported using different types of models for architecture, general process design and detail process design. Typically an executive level Zachman type [25] representation is used for architecture, an informal but more detailed representation oriented to users is selected for general process design and a formal, usually a proprietary representation associated to a BP process modeling tool, is used for detail process design. This methodology has as a disadvantage the need of mapping one representation onto another, which is prone to omissions and mistakes and does not allow for traceability.

Our proposal, which allow appropriate representation at the different detail levels, does not need mapping and has full traceability.

* DCI/Shared Insight BPM Conference, Phoenix, Arizona, May 2006

5.- Extentions

The methodology we have presented allows integrated design from architecture to business logic but it is not yet formally integrated to BP support applications design. What we currently do is to derive requirements from the detail process models, where application support is explicitly modeled, and map such requirements onto UML models. From these UML models, applications are actually built.

But the ultimate integration would be to have executable BP detail design models, so that the mapping above could be avoided. This is the main extension of our ideas that we are currently working. What we are attempting to do is to formalize all the business logic we can in BPMN models at the last level of design, as exemplified in Figure 23. Then we convert these BPMN model to BPEL and execute them with appropriate software. The problem is that, due to current limitations of BPMN and BPEL, this is not possible for complex logic and for man-machine interaction within the process. The approach we are testing to solve this problem is to develop web services for the requirements that cannot be modeled adequately with BPMN/BPEL and insert them in the orchestration one can do a with the BPEL representation.

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