1 DELIVERING RESULTS: EVOLVING BPR FROM ART TO ENGINEERING

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Abstract

This chapter presents an approach to BPR that is focused on achieving results from the first stages to implementation. The engineering approach presented utilizes an integrated set of methods applied incrementally. This allows BPR practitioners to more realistically approach a project; assess its impact, duration, and required budget; and mitigate the risks of failure. We present the approach as a phased BPR methodology along with methods, proven strategies, and tools

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we have worked with successfully at each phase. We present motivations for initiating a BPR effort that have been shown to result in successful cases for action. We present rationale for justifying change and a method for building a business case that includes the use of cost benefit analysis in formulating the justification rationale. An approach to planning for a BPR effort is presented that uses the same methods normally applied in the BPR process itself. We cover the issues associated with setting up a BPR project including: forming cross-functional teams, and selecting method and tool technology for the BPR project. A methodology is presented for base-lining the current business situation, identifying the current value delivery system and the processes that support that system along with problem-cause analysis. We describe eight general principles of business process design and conclude with an object-centered technique for new process design. Finally this chapter addresses key issues in the implementation process starting with transition planning activities, model driven information system development, and initiation of a learning system that will carry the results forward in a continuous improvement manner.

Introduction

Business Process Reengineering (BPR) efforts are reported to be failing to meet their goals at a rate of 70% [Champy 95]. The salient observation about this statistic is that an enterprise or organization would have to be facing critical business issues or have considerable problems to attempt a high-risk, highly visible BPR project, given these significant chances of failing. However, a closer examination of this failure statistic must be warranted to provide meaning into how to reduce this statistic. We contend that there are three primary reasons attributed to failing BPR efforts. The first reason is the lack of an adequate *business case* resulting in unclear, unreasonable, or unjustifiable expectations for what is wanted or expected to result from a BPR effort. A second reason can be the absence of *robust and reliable technology and methodologies* for performing BPR so that there is a failing in executing BPR efforts. A third reason is an *incomplete or inadequate implementation*. Re-orienting a traditional organization from a function to a process focus requires a major cultural change in the organization. It also requires major change to the information systems that support the organization. The organization does not know what to expect and is often surprised, angered, or threatened by the change proposed. If the project does not correctly manage the expectations of the organization it will not be allowed to finish what was started. Finally, we contend that inadequate carry forward of “lessons-learned” and “how-to” knowledge from project to project significantly increases the chance of failure.

The authors present an approach to BPR that is focused on achieving results from the first stages of a BPR project to implementation. This approach utilizes an integrated set of methods applied incrementally. This allows BPR practitioners to more realistically approach a project; assess its impact, duration, and required budget; and mitigate the risks of failure. We present the approach as a phased BPR methodology along with the methods, strategies, and tools we have worked with successfully at each phase. We distinguish *methodology*, *methods*, and *tools* thus: A BPR *Methodology* gives us a structured framework which provides a step-by-step roadmap ensuring consistent and correct results. Methodologies are built from capturing strategies, techniques, methods, and tools into this framework. *Methods* are encapsulated best practice focusing on a specific structured approach (i.e., process-modeling methods, data modeling methods, cost modeling methods). *Tools* are software packages that automate a method or methodology, enable the correct use of a method, and aid the user in faster application of the method. A BPR practitioner cannot expect software tools to be effective without effective methodologies and methods as their basis.

This chapter is organized into seven major sections. In the first section, we present motivations for initiating a BPR effort that have been shown to result in successful cases for action. The second section addresses the problem of justifying change in terms of a business case. This section includes a description of the role of cost benefit analysis in formulating the justification rationale. The third section presents an approach to planning for a BPR effort. The fourth section covers the issues associated with setting up a BPR project. This includes forming cross-functional teams, and selecting method and tool technology for the BPR project. The fifth section describes the process for base-lining the current business situation. This includes identifying the current value delivery system and the processes that support that system. In addition methods for problem-cause analysis are presented in this section. The sixth section describes the method for new process design. In this section we present the general principles of business process design and conclude with an object centered technique for re-engineering. The seventh section addresses key issues in the BPR implementation process starting with transition planning activities, model driven information system development, and initiation of a learning system that will carry the results forward in a continuous improvement manner.

Section 1: Motivating Reengineering: Getting Started on the Right Foot

Published case studies and our own experience identify the following common features of successful BPR efforts:

1. A team-based effort guided by a proven, structured methodology that is aided by a powerful set of methods and supporting tools.
2. A focus on business processes rather than functions.
3. Cross-organizational process restructuring.
4. Challenges established assumptions.
5. CPI activity enabling both incremental and paradigm shift change.
6. A "Think Globally, Act Locally" approach.
7. A well planned effort with clear goals, defined business metrics, and measurable results throughout the effort.
8. Technology that can support the change.

Similarly, common features of failed BPR attempts include:

1. Multiple, uncoordinated initiatives.
2. Lack of commitment to establishing an in-house (organic) capability.
3. Insufficient or inadequate methodology, methods, and tools.
4. Attempt to outsource key decision-making.
5. Failure to concurrently address business, information system, and organizational change together with process change.
6. Inability to leverage information technologies and realign information systems quickly enough to make a smooth transition.
7. Inability to align process-intent with enterprise vision and goals, organizational structure, and job performer management.
8. Lack of top level commitment and understanding.

As can be seen from these lists, many of the features that define success or failure of the effort are defined early in a BPR effort. In fact, the decisions made from the initial commitment to the project through its actual justification and planning (usually the first 10% of the real project life-cycle) determine 90% of these features and hence the likelihood of success or failure of the project. The first section describes best practices for these critical initial steps.

1.1 For All the Right Reasons

Why attempt BPR efforts within an enterprise? As we all know, change is inherently difficult to implement, and BPR entails radical change. What can you expect to get out of it? It is recognized that serious BPR efforts are complex and resource consuming for an enterprise. There is a common saying, "If you don't know where you are going, any road will get you there." In considering a BPR initiative, the first and possibly the most important success criteria is to make sure that the rationale for initiating the project is sufficient for justifying the effort and expense of the project. In this section we identify the types of rationale that typically justify successful BPR initiatives.

As we look toward the twenty-first century, world class enterprises are learning the value of building flexible, dynamic business processes into their corporate structures to give them the agility to respond to a changing environment. Instant access via the World Wide Web and international trade initiatives (e.g., GATT and NAFTA) have broken down physical, economical, geographical, and political trade barriers that used to protect individual nations' manufacturers from their international competition. Because this paradigm shift has occurred simultaneously with a revolution in technology (during what is often called the Information Age [Tofler 80]), the demand for highly skilled and educated workers has replaced the factory paradigm of omniscient managers and assembly-line automatons [CIM 94]. Knowledge used quickly and effectively has truly become the power fueling profitable and effective enterprises.

Indeed, the manner in which an enterprise is defined has fundamentally changed: enterprises no longer rely on a hierarchical, vertical structure to develop their products or sell their services. Instead, enterprises are focusing on core expertise processes by applying resources and skills to perform what it is that they do best and leveraging partnerships (often with former competitors) to complement their own core expertise. High-profile corporate breakups, such as AT&T, and newly accepted business practices, such as out-sourcing, are manifestations of this emphasis on core processes. Like the breakdown of trade barriers, the practice of out-sourcing, for example, has led quite naturally to the formation of strategic corporate alliances. These corporate alliances, sometimes described as comprising a *virtual enterprise*, help each member of the alliance to better serve its customer base by leveraging each company's strengths within a virtual team with each member an expert in its field. Thus, by building higher-quality products and better serving consumer needs quickly and at less cost, an enterprise can recruit and retain a stable customer base in an era of global competition, where customer satisfaction is the key to the survival of the enterprise. With this context for change in mind, we can identify several specific principles (or rationales) that often provide the impetus for initiating a successful BPR effort.

1.1.1 Rationale 1: Fear of Failure. There needs to be sufficient motivation for the enterprise to make significant changes for improvement. In the business environment, this motivation is often driven by actual or perceived failures in performance. This actual or perceived failure can apply to how the enterprise measures up against the competition in terms of production, distribution, customer service, price, etc. The failure can also be in how competitive the enterprise's products are in the global marketplace. All issues such as these impact the choices an enterprise makes, from whether to enter new markets and/or develop new products, to what policies, procedures, and processes to establish that will, ostensibly, advance the overall benefit of the enterprise itself. The Critical Assumption Analysis (CAA) technique is one such approach for establishing specific rational in this category. Under CAA, stakeholders in the enterprise identify the assumptions under which their business is conducted. They then attempt to isolate those assumptions, which, if violated, would cause the enterprise to cease to exist as it is today (e.g., the assumption that "quality watches must be precision machines" or that "the cold war will always be with us," etc). All assumptions, but particularly the ones in the critical category, are candidates around which to build a case for action.

1.1.2 Rationale 2: Need for Structural Evolution. A second commonly used rationale is the need for structural changes in the organization. As previously mentioned the corporate structure of enterprises has been vertical since the Industrial Revolution. That is, a top-to-bottom management structure—with decision-makers at the top and assembly line workers at the bottom—has characterized the typical enterprise. This generally has meant that strategic planning for the enterprise occurs at a high level and is delegated down to divisions, departments, and individual job performers in the form of policies, procedures, and directives. In response, performance appraisals—which can take the form of periodic formal performance reviews or weekly status reports, sales figures, etc.—are reported back up the chain of command. This paradigm operates in a strict up-and-down the chain of command communication manner.

The emerging paradigm, however, has enterprises relying more on concurrent, *cross-functional* teams (i.e., teams that cross organization boundaries) composed of *knowledge workers* organized in a horizontal fashion. The goal of these cross-functional teams is to produce the enterprise's products most effectively by focusing on the product processes, not the organization of the enterprise itself. Customer success, as shown in Figure 1, relies on these cross-functional business processes to build and support the product. Under this paradigm, in fact, the quality of a product consists of both that product and its associated processes in designing, building, and maintaining it over its useful product life.

Structural organization evolution, however, does not come easy to an enterprise. While processes can be changed overnight, people and organizations typically cannot. Therefore, part of this structural evolution is not only an increasing corporate awareness but also a *change management* plan that plans for the orderly, evolving transition of the organization and the job performers within that organization from a vertical, structure to one that is more horizontal. This change management plan must include processes for facilitating information flow and communication across organizational boundaries.

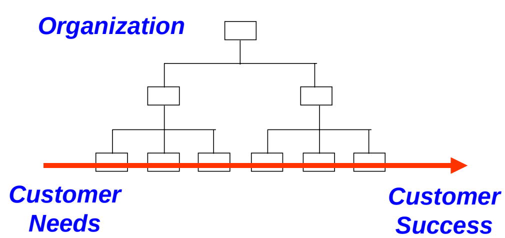

Figure 1: Processes *Cross* Classical Organization Boundaries

What occurs between management's setting strategic goals and workers on the line reporting their progress and all the layers in between? What occurs is a *business process*—a series of time-ordered individual activities performed as discrete events in a larger *scenario* that is guided by a strategic vision that must be implemented in stages, at the tactical level, to achieve the overall strategic objective. To use a literary analogy, one can think of the business process as a stage play: the play is written and directed (by management) to achieve an artistic (corporate) effect; the actors (employees) play their roles to enable this achievement; each scene (discrete event) contributes to an overall plot (process) that unfolds sequentially, uniformly, and deliberately; and all is held together by the motifs and themes (policies and procedures) that manifest themselves as each scene unfolds.

With this business process paradigm, however, there are often communication breakdowns (or *disconnects)* between various groups and/or departments that inhibit process performance. Many enterprises recognize that such breakdowns pose significant challenges to BPR, as well as other process improvement initiatives. In fact, the success of a BPR effort largely depends upon discovering and analyzing these disconnects.

1.1.3 Rationale 3: Need for Agility. A third principle or rationale is the need to align an enterprise's strategic goals with the objectives of its departments and employees, as well as with the tactical processes that are intended to achieve the overall strategic goals. It is generally recognized today that success in a rapidly changing environment is closely tied to how the enterprise proactively manages and evolves its business practices as part of an efficient implementation of its overall strategic plan; and how quickly and effectively the enterprise leverages new opportunities. We have, in fact, entered the age of *agility*.

Of concern to any enterprise today is the increasing rate of change in the socio-economic environment. This is one of the drivers behind BPR—it's a dynamic solution that we can implement today to meet current problems. The dynamic nature of the solution—that is, its ability to respond to changing trends in our enterprise, the market, etc.—is of paramount importance. Even if our enterprise is best poised today to leverage the opportunities of the global marketplace, some environmental, regulatory, or market change will occur that will change our reality and, thereby, require our enterprise to respond to that change. The rate at which we must adapt our enterprise to the "current" business environment is changing exponentially as information and computer technologies seem to change and improve on an almost daily basis.

Today's challenge is determining how to effectively respond to, and manage, change. Every manager—in fact, every job performer (or employee)—is faced with the fact that the current situation is, or will shortly become, unfavorable. And more importantly, radical change will often be required. Critical business issues intricately tied to change include affordability, responsiveness, quality assurance, resource scarcity, and assurance of total customer success.

Section 2: Justifying Reengineering

Wisdom, it is said, is not in just knowing the goal but also knowing the next best step to take to achieve that goal. A successful BPR effort conceived on one of the previously described rationale, and having all prerequisites met, begins with planning. Planning provides the context for developing a process vision, which is the fundamental driver of all improvement efforts. The more radical the improvement objective, the more important it is to associate process improvement efforts with strategic and business objectives and goals. Planning also determines the measures and critical success factors that will be used to evaluate the success of improvement projects.

There are two levels of planning: strategic and business (or annual) planning. Strategic planning looks outward to establish the context in which the organization or business unit will operate with respect to its defined mission, and to set the vision for a desired future state. Business planning looks inward to marshal available resources in pursuit of the vision. Both levels of planning rely on definitive objectives and quantitative measures of performance to guide and monitor progress.

There are five essential steps to a methodology for BPR planning:

1. Develop or validate the strategic plan.
2. Develop or validate the business systems plan.
3. Develop or validate the annual business plan.
4. Construct performance cells (performance measures) for processes.
5. Establish the process improvement project business case.

At the completion of the planning stage, a process improvement project is in place that is consistent with the strategic objectives of the enterprise, supported by sufficient resources, guided by a well-conceived process vision, and bounded by clearly defined objectives. The objectives are related to quantified goals that define the success factors for the project, and keyed to performance measures that monitor the attainment of project objectives.

The principal benefit of the planning stage is that improvement teams begin their work with a clear understanding of their mission and an idea of what successful performance will look like. Their efforts are properly focused on how they will achieve the process vision and performance objectives set in place by senior management, not wasted on trying to determine what their objectives should be.

An effective completion criteria for BPR planning is to ensure that the following questions are addressed:

1. Are the *project objectives* clearly driven from the enterprise's strategic goals and operational objectives?
2. Have the *core business processes* and *critical success factors* been identified?
3. Have the *critical business issue(s)* been identified as well as the core processes that have the greatest impact on critical business issue(s)?
4. Have the *current costs* been analyzed for the core processes?
5. Has a process improvement and management plan been developed?

2.1 Business Case Analysis

We include strategic planning, business issue identification, business opportunity identification, critical process identification, strategic goals, and top level cost performance analysis as critical to the formation of the business case for a successful BPR effort.

It is critically important for successful BPR efforts to have a clear understanding of the business case justification. This is not as difficult as people think. Most enterprises have some picture of their performance with regard to the marketplace and their competition, as well as some idea about how much they want or need to change or improve over a given timeframe. The difference between where they currently are and where they want/need to go is the driving motivation to a large extent to implement change with BPR. This difference must be translated into a set of goals, initiatives, and top-level initiatives that form the roadmap or strategic plan for improvement. This plan can then be used to further expand definitions of critical business issues or opportunities, as well as to identify the core (or critical) business processes that support those business issues.

By identifying critical business issues, processes, and goals, this process produces the primary inputs to the BPR effort. A business case based on these goals, initiatives, measures, and estimated costs needs to be developed to reassure management that the enterprise is headed in the desired direction and that the fundamental question of affordability (or return on investment for the effort) is identified early on. The specific benefits to be gained also need to be identified at this point. This initial business justification or forecast will be used to benchmark progress throughout the BPR effort when preliminary or intermediate results will be compared against the business case to ensure that the options being chosen or evaluated are consistent with the business case.

The business case should focus primarily on what it takes to help a customer to be totally successful. That is, the ultimate goals of a business from the customer's perspective (and, therefore, the business case itself) need to demonstrate how the business goals, such as revenue, profitability, improvements in other socio-eoconomic factors, growth of interest to the business, etc., are also supported.

2.2 Metrics for the Business Case

Generally speaking, the business case can be defined by considering five major factors, the **first** of which is *cycle time*. Cycle time can be measured as the how responsive an enterprise is to the customer's needs (i.e., the ability to get a product to the marketplace in a timely fashion). The term can also refer to the ability to increase or modify capacity to produce a product or service in response to market needs, as well as the ability to respond more quickly to changes in the marketplace or business environment. The business processes that will be reengineered will in fact have some relationship to the top-level parameter of cycle time.

The **second** major factor to consider when making the business case is *cost*. The business needs to have affordable systems or methods of productions for goods and services.

The **third** factor is quality. *Quality* does not simply refer to meeting product specifications (or standards of excellence), but also includes non-quantifiable attributes of business, such as whether customers are satisfied that the business is providing them with every means to achieve their own success. Quality is also measured in terms of the robustness and reliability of the systems provided. The *bottom line* of quality is that the customer feels that the system is always available to provide what the customer needs.

The **fourth** factor for consideration is *asset utilization*. In the case of manufacturing, asset utilization involves the availability of equipment and other assets to produce a product. In a larger sense, asset utilization is also about the ability of the enterprise to be creative, flexible, and adaptive. One of the issues the business community faces today is a critical shortage of skilled personnel resources. Ineffective business processes will quickly waste the few resources that are available.

The **fifth** factor for consideration is *revenue generated* (or the value of the output product). Clearly, revenue is not the only measure of output in, for example, a government organization where output may be the number of criminals captured and convicted—if that's the form of *currency*, or the measure of productivity, for the criminal justice system. In the U.S. Air Force, for example, the number of missions successfully flown would be the revenue for measuring productivity. Any parameter for measuring what an industry produces can, therefore, serve as its revenue. Revenue, then not only considers the costs associated with producing something, but also the benefits gained by the customer receiving the product. In the case of the criminal justice example above, the customer might be the general public.

2.3 Goal Prioritization

Critical business issues must be discovered and identified to drive the BPR project for the enterprise. One method for identifying critical business issues centers on Houshin planning. *Houshin* (sometimes spelled Hoshin) is the Japanese word for *strategy*. Yet, how this techniques works is very different from its Japanese meaning. That is, traditionally *houshin* has referred to the "down from the mountain" approach of communication goals to the organization. Instead, Houshin planning in the BPR context refers to prioritization of goals by identifying key process drivers. This assists a BPR effort in knowing which process to tackle first—the one that drives the most others. One form of Houshin planning is known as interrelationship digraphs and is discussed in Section 5.1.

2.4 CBA: Numbers that Support Intuition and Common Sense

One of the frequent concerns expressed by re-engineering teams is the lack of hard numbers to justify the obvious changes that need to be made. It is certainly true that often re-engineering justification demands considerations outside of the scope of the cost/benefit accounting schemes established for ongoing process improvement justification. However, this fact does not imply that a “case for action” cannot or does not have a utilitarian aspect. The creativity and “out of the box” thinking required to construct the financial argument often leads the re-engineering team into the kinds of ideas that eventually result in changes that have lasting impact because they enable the business to succeed. Often the impediment to quantification is a lack of “hard data.” That is, the current cost accounting system may not (and often does not) provide the level of visibility into costs that could be used as a baseline. In these cases the tack to take is to create cost models both for estimation of the current baseline and for projection of the future. It is often overlooked that knowledge based cost estimation and activity based costing techniques are equally applicable to the As-Is as they are to the To-Be. Monte Carlo techniques and statistical techniques combined with experience based rules of thumb and simulations provide powerful tools for producing numbers to justify the intuitions of the re-engineering team. Keep in mind you are producing a model not an audit report. It is also important to understand the power of problem decomposition to cost modeling. That is, if at first you cannot produce the model, decompose the problem into smaller pieces and try again. For example, in Figure 2 we illustrate a cost benefit model for insertion of an automated decision aid into an enterprise’s planning function.

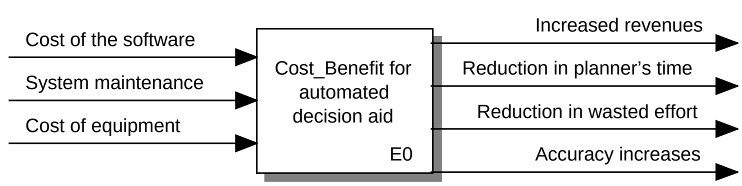

Figure 2: Cost Benefit Model for Insertion of an Automated into an Enterprise’s Planning Function

The benefits portion of the process change, when decomposed, actually turns into both a savings component and a revenue generation component (see Figure 3). Activity Based Cost Modeling (ABCM) when applied appropriately leverages this decomposition strategy with direct tie-in to the enterprise’s chart of accounts.

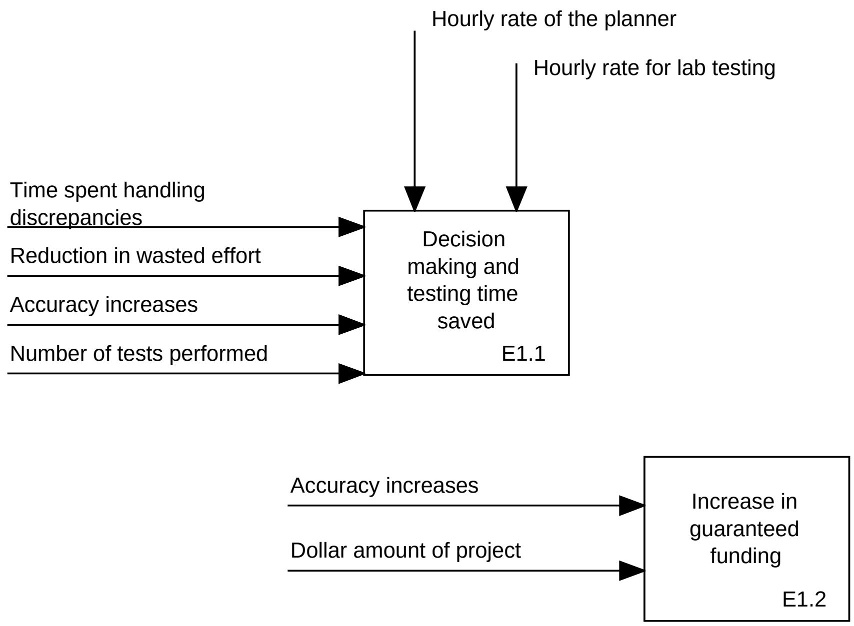

Figure 3: Cost Benefit Model Decomposition

Activity Based Costing (ABC) is a method that measures the cost and performance of process-related activities and objects (concepts). ABC is not strictly about costs, but also about resource use and consumption. By assigning costs to activities based on their use of resources (concepts) and assigning costs to resources (such as machines or employees) based on their consumption by activities, ABC allows for an accurate, cost-based description of your project, bringing costing information to bear on your process reengineering decisions. ABC communicates to people the rate at which activities consume resources as well as why the assigned resources are used. The key to using ABCM at this stage in the process is to keep the model simple and focused. BPR teams that confuse cost modeling with cost accounting get mired down and fail to produce the results they need. At this stage a good rule of thumb is that if your activity pool exceeds 60-70 activities you are too detailed for this stage. Using available desktop PC tools the project initiation team can easily construct activity models for the focus BPR area and generate rough cut ABC models. These models can be loaded with the latest annual operating expenses of the affected profit or loss centers and reasonable estimates made of the cost/benefit of a BPR effort within a few days time [Benjamin 97, AIØ WIN 96].

Section 3: Planning Reengineering Projects

If the BPR team has adopted a methodology, as suggested above, then the process of putting together a plan is greatly streamlined. Simply take the methodology (such as the one described in this paper) and,

1. Extract the activities that need to be performed,
2. Decide on which outputs of those activities are needed,
3. Decide on which relations between the activities will be enforced,
4. Decide on the process of execution,
5. Define your team,
6. Load and schedule your resources, and
7. Produce your schedule and budget.

Having a standard methodology also allows the organization to build on prior experiences in the choice of activities, relations, products, team composition, timing, and cost estimation. The following subsections detail such an approach.

3.1 Layout the Activities

The key to planning is understanding the needed project products, what you have to start with (inputs), the activities that need to be performed, who needs to perform them, and how one activity interacts with another. Experience provides this understanding and activity modeling (a la IDEFØ) is an excellent technique for applying that experience and passing on lessons learned to subsequent projects. The activity model results can be converted into a work breakdown structure (WBS) knowledge based cost estimation tool to capture experience based rules-of-thumb for setting rough time and cost budget figures. It is also possible to perform an activity-based cost estimate on the project itself to help determine which of the products of the project are going to cost the most and determine the priorities of activities based upon their contributions to key products. An example of an activity model of a BPR project is illustrated in Figure 4. Boxes indicate the activities. Arrows entering a box on the left indicate inputs to an activity. Two boxes linked by an arrow indicate a relationship of the receiving activity on a product from the source activity. At the level of the model displayed we have not exposed the specific resources (indicated by arrows entering the bottom of the activity box) required for each activity. The shadowed boxes indicate that there is further decomposition in the description of those activities.

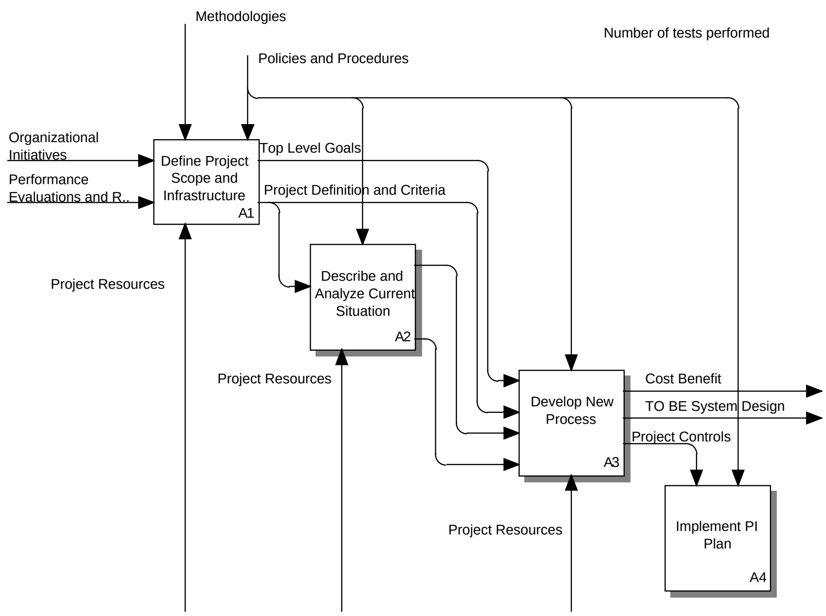

Figure 4: BPR Methodology Activity Model in IDEFØ Format

It should be noted that the breakdown for the purpose of cost estimation is slightly different than that for the project planning. This is a common occurrence since the project costing expert has developed rules of thumb will often integrate together multiple aspects of the BPR life-cycle activities, resources, and products into cost buckets for which he has specific estimation rules or data. An example of one such cost estimation breakdown is illustrated in Figure 5.

- E0: Generic Process Improvement
  - E1: Describe and Analyze Current Situation
    - E1.1: Identify Critical Business Issue
    - E1.2: Develop AS IS Process Map
    - E1.3: Identify and Prioritize AS IS Issues

E2: Develop New Process
E3: Develop PI Implementation and Mgmt Plan
E4: Implement PI Plan
E5: Deliverables and Documentation
E6: Hardware and Software
E7: Travel
E8: Consultants

Figure 5: Process Improvement Cost Model Cost Categories in WBS Format

For each of the cost categories in Figure 5 the BPR project estimation expert would identify the "cost drivers." Cost drivers are those aspects of a BPR project execution that impact the cost of preforming that project (see Figure 6). Associated with these drivers and the cost categories the domain expert records his rules for estimating the costs (as well as time and risk). Automated tools exist for such knowledge capture. Such tools also can directly generate a spreadsheet-based model [SMARTCOST 97]. The BPR project planner can then experiment with adjusting the factors that drive the cost, time, and risk of a project to guarantee affordable, achievable, and acceptable results.

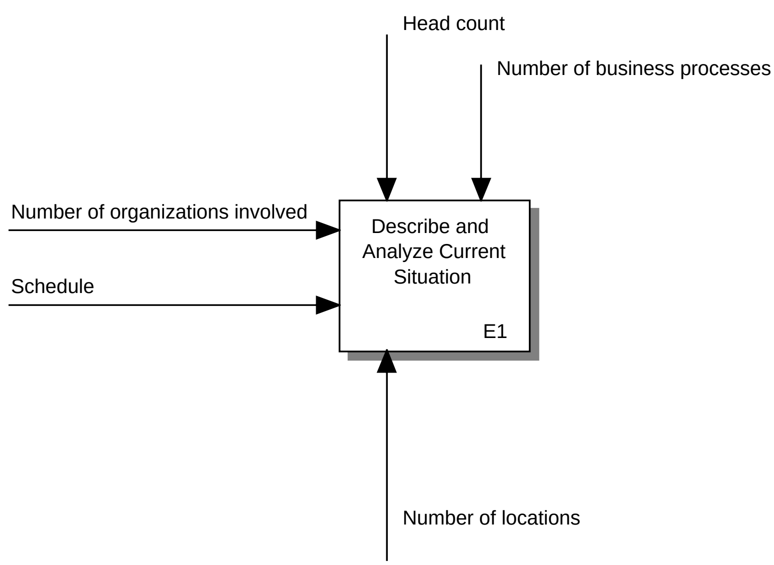

Figure 6: Example Cost Category in WBS Structured Knowledge Representation

3.2 Define the Execution Process

Once the products and activities are determined, the sequence the performance of those activities along with critical decision points or milestones in the execution must be planned. It is also important to identify contingency plans for high risk activities or products. Also you need to set the type of skills and amount needed for a particular course of action. You also need to set the budgets for each of the tasks. This is where the power of process modeling can be applied. It is also a good exercise for the project team because if you can't produce a model of the project-execution process, then how do you expect to be able to produce a model of your business process? Figure 7 illustrates part of such an execution process for a BPR project. Note the embedded decision point where the project team will either decide to develop a completely new process or simply make adjustments to the existing process.

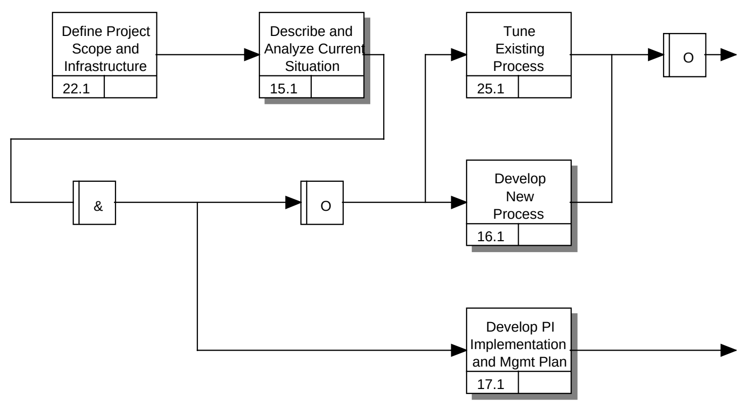

Figure 7: Process Model of Business Process Reengineering in IDEF3 Format

Before a project schedule and resource loading can be produced, an initial decision on the route through the execution process must be made. Once that decision is made the conversion of the project execution process into the project plan is fairly straightforward. In fact, tools exist that allow this step to be automated even to the level of resolving timing and resource contention problems [PROJECTLINK 97].

Section 4: Setting Up for Reengineering

Successful BPR initiatives depend on making the right choices for people and methodology and building the right effort infrastructure. We utilize metrics and yardsticks to gauge our adherence to the effort plan. This section discusses these key provisions of a successful BPR effort.

4.1 Cross Functional Teams with Organic Skills

For meaningful, long-lasting results to be achieved for the BPR effort, leadership, ownership, and participation by cross-functional teams is imperative. These teams can be successful only if their BPR efforts:

1. Have the approval and support at the highest level of an enterprise's management.
2. Involve those individuals who participate in, and manage, the process.
3. Are conducted within the context of the enterprise's culture and values.
4. Invest in the training, education, and tools to establish an in-house re-engineering and process improvement capability.

In successful BPR efforts all candidate team members should meet (or be capable of meeting) the following criteria [Isaacs 97]:

1. Possess a detailed understanding of the existing process.
2. Comprehend the Big Picture of how the process fits into activities of the enterprise.
3. Is not an unwavering advocate of the existing process.
4. Is able to understand, evaluate, or create alternatives.
5. Is a highly energetic individual.
6. Is a "team" player.
7. Has the time and is available to participate in the effort by attending team meetings and participate in description, analysis, design, or review tasks.
8. Perceives the team assignment as a reward and not as a burden.

Much has been written about the importance of the first three of these BPR success-criteria [Hammer 93], but in practice the remaining criteria are often overlooked. By analogy to the product definition process, there is certainly a point in the process where intuition, involvement of the end user domain, and inspiration play critical roles. Furthermore, to achieve a successful, enduring, and supportable world class product requires a disciplined approach and personnel knowledgeable of the appropriate engineering models, techniques, and tools. Successful re-engineering efforts invest in training of a core team in these basic skills and employ the services of experienced consultants and re-engineering specialists to accelerate the learning curve. Basic skills that should be established as organic capabilities within the re-engineering team include:

1. Business-process design life-cycle methodology particularly design tradeoff analysis techniques.
2. Project planning and management methodology.
3. Activity, process, information, and knowledge capture, analysis, and modeling.
4. Simulation, activity based costing, and cost benefit modeling techniques and tools.
5. Process integration and design techniques.
6. Basic principles of human factors and diversity management.
7. Collaboration and consensus building methods.
8. Process change implementation methodology.

The level of training and experience along with the investment in methods and tools discussed in the next section can be shown to directly correspond to the level of BPR capability in an enterprise. Our experiences with BPR initiatives indicate that there are five distinct levels of sophistication as illustrated in Figure 8. Enterprises, which have reached Level 5, can reasonably be expected to achieve their BPR goals. Risk of failure increases as the level of sophistication of the core BPR capabilities goes down unless that risk is mitigated through the use of supporting personnel.

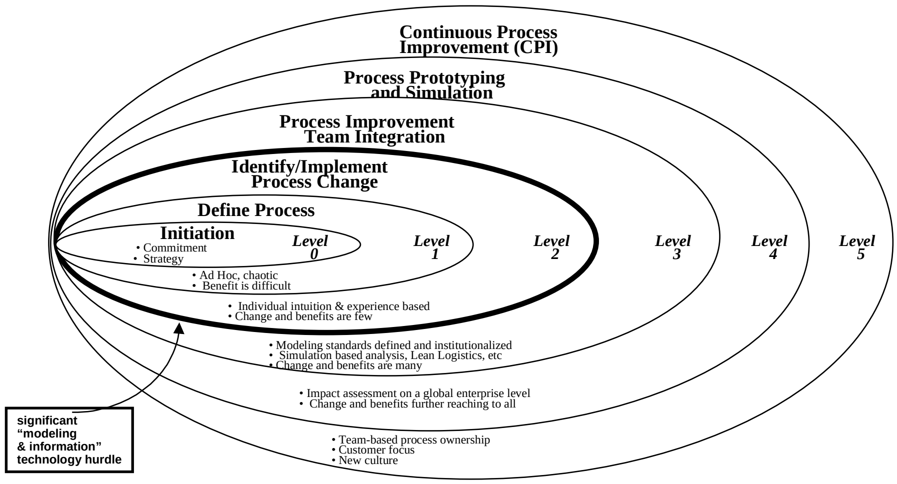

Figure 8: BPR Level of Capability Model

4.2 Methodology, Methods, and Tools

The Director of a $5B/year company that routinely executes highly successful BPR projects believes that successful re-engineering of an enterprise requires two necessary components: 1) the ability to assume the *process view* and 2) the technology adequate to support the proposed project through all of its phases [Isaacs 97]. Assuming the process view of an enterprise is a deceptively hard task. People tend to think hierarchically in top to bottom structures, but a *process* cuts across organizational boundaries and requires being able to construct multiple views (in an integrated and systematic manner) of the processes within the enterprise by which work is performed. We have found that being able to separate the key information into three separate views is crucial to piercing the complexity of the process challenge. One view is required for *enterprise activities* and the work objects that form relations between those activities. Another view it required for how tasks are arranged in a *logical or temporal order* based on an activation of the business process that produces a unit of goods or service. Another view is used for not only the categories of the business concepts, but how those categories relate together to form meaningful command, descriptions, and status messages. To allow the BPR practitioner to understand the complexity of the real world, the information in each view should be able to be organized hierarchically (for drilling down and abstraction), alphabetical order by object name, and optimally by some user-defined criteria (e.g., location, organization, creator, etc.) We have found that these three views are adequate for analysis and can be carried over (in technology specific forms) to the design and implementation phases of the BPR lifecycle.

Technologies that support the creation, analysis, and application of the above views are referred to as *methods*. The structured framework for application of these methods is a *methodology*. Individual specialized analysis or design practices are *techniques*. A variety of software exists to assist the BPR practitioner in the application of these methods and techniques and are called *tools*. The most powerful of these tools support integration of the information in the different methods, automatic drawing of the graphical display of a view, and support for generation of quantitative analysis results or process implementations directly from these methods. Software tools that facilitate BPR are those which reduce the cost and risk as well as provide a re-useable corporate knowledge base of the efforts of the team. Effective tools facilitate BPR by:

1. Enabling efficient and effective knowledge capture.
2. Ensuring increased knowledge integrity.
3. Using graphical representations for clarification of communication.
4. Maintaining a common, reusable repository.
5. Supporting team collaboration.
6. Enforcing the correct application of methodology and methods.
7. Maintaining a capability to export to other software tools.
8. Maintaining an “enter once, use often” approach in data collection.

Specific methods, techniques, and tools that contribute to the successful BPR initiative will be introduced in each of the following sections.

An important activity for BPR projects is to acquire descriptions of the concerned existing or proposed business systems.[1] Methods facilitate the acquisition and design of both *descriptions* and *models*. The differences

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[1]We use *system* in this chapter to refer to “... a group or set of objects united by some form or regular interaction or interdependence to perform a specified function” [Shannon 75]. This (generic) definition allows us to talk above the activities that an organization performs, the objects (such as agents and resources) that participate in these activities, and the constraints maintained by an organization performing these activities.

between descriptions and models are important, and each has distinct roles to play in the BPR process. Descriptions reflect the state of the world as known or believed to be true by an agent. Models built from structured, accurate descriptions are used by decision makers to reason logically from observations to conclusions (e.g., regarding cause and effect relations in our enterprise). Unfortunately, what we know about the world is often incomplete and, hence, descriptions are often partial. To fill in the gaps, we employ models (e.g., simulation, activity based costing) based upon idealizations. Idealizations are typically precise concepts that can be used to build models. Models built from these idealizations can be validated against a set of observations, but are not true or false. Models can be used in a valid context to predict characteristics that we cannot directly observe or easily measure. For example, while the concepts of points and lines from our grade-school geometry don't actually occur in the real world, we use them every day to compute a variety of useful data, from the amount of cloth in a shirt to the structural characteristics of a space craft. The ability to acquire and represent descriptions and idealizations are important for BPR. Descriptions provide factual evidence of what the enterprise does and how it performs its activities. Models are useful in predicting data (particularly economic and performance data) that otherwise would be expensive or even impossible to acquire. Together, descriptions and models provide the business engineer with the information needed to determine 1) what to change, 2) how to change, and 3) what will be the result of the change.

Successful BPR initiatives recognize that the methods, tools, and methodologies they choose must fit together into a cohesive framework to be productive. *Framework* has been defined in several different ways. In general a framework can be defined as a basic structure, arrangement, or system. In this sense, it refers to a structure that serves to hold the parts of something together. From an information system development viewpoint, a framework is "an organization of characterized situation types that are known to occur commonly during a system lifecycle" [Mayer et. al. 92]. In essence a framework is an organizing structure for a system. Frameworks provide for expressions of the characteristics of the conceptual parts of a system and the interrelationship between these parts. We define a *BPR Framework* (see Figure 9) as a characterization of BPR in terms of:

1. a set of guiding principles for BPR,
2. the BPR process consisting of a set of phases and time-phased activities, clear milestones, and phase products, and

3. a set of methods, strategies, and tools for BPR, an understanding of the role of these methods, strategies, and tools in supporting the BPR process, and proven mechanisms and techniques for achieving the phase products.

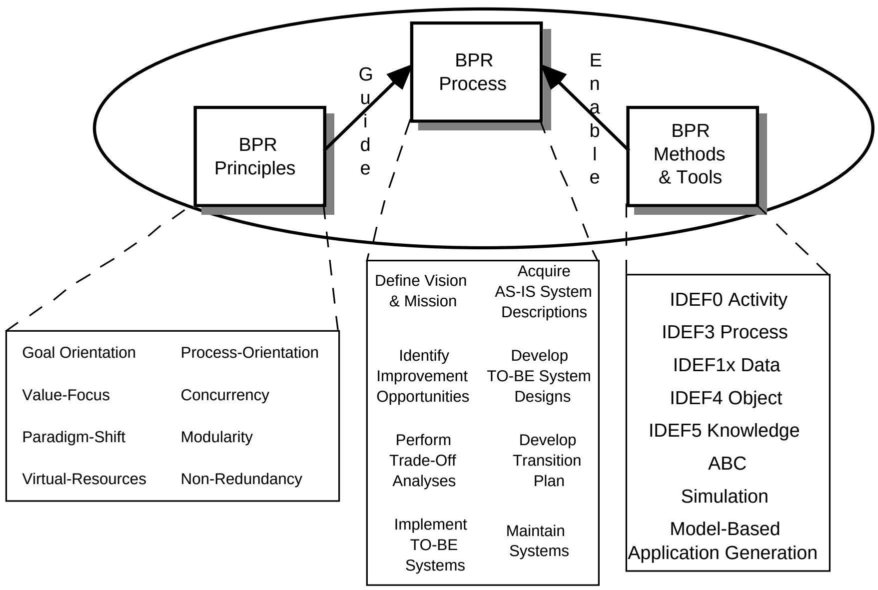

Figure 9: BPR Principles, Methods, and Tools

4.3 Metrics and Yardsticks

An important—and often overlooked—component of an effective BPR framework is the *yardsticks* to use to measure and gauge progress and performance. If the team BPR knows from the outset their goals and targets in a measurable form, the probability of success is greatly increased. There needs to be meaningful *metrics*, and the *means* to measure for those metrics, established for the four perspectives of an enterprise, job performer, departments, and the process itself. As a minimum for each perspective, there need to be metrics and methods of measurement of Performance, Quality, and Cost. These metrics are necessary throughout the BPR project life-cycle to:

1. Understand and baseline where each of these perspectives are in terms of their performance.

2. Understand how each perspective relates to and impacts the other perspectives.
3. Provide a quantified radar-screen of possible areas of improvement or change.
4. Provide a framework for tradeoff analysis of alternative change proposals.
5. Judge the success of the final results.

Section 5: As-Is Description and Analysis

With the goals defined, the plan and resources in place, the heart of the BPR effort can be initiated. This As-Is Analysis phase of BPR is aimed specifically at identifying disconnects within existing business processes and their specified intent. By d*isconnects*, we mean anything that prevents the process from achieving desired results (e.g., inconsistency between the functions of a process that cause failings of the existing process to achieve its intent.) In essence we are identifying symptoms of shortfalls and then trying to isolate root causes. What is involved in this phase is the documentation and description of the existing business processes using methodologies which will highlight the relationships between the various functions or activities within the enterprise. These functions or activities are essentially those essential pieces that are needed to perform the business process. The relationships between them include the relationship between inputs and outputs among those activities as well as between controlling mechanisms and resources. This relationship description or map describes many of the interactions between the various performers, departments, etc. within the enterprise. This description is essential to being able to identify disconnects within those relationships such as missing inputs or outputs, or non-value-added inputs or outputs, etc. The steps taken to describe the As-Is process also include a documentation of the sequence in which activities are performed. The sequence can include:

1. A causal relationship (e.g., *activity 1 must precede activity* 2).
2. A time relationships (e.g., *earlier than*).
3. A logical relationships (e.g., alternative paths, decision making events, etc.).

The third aspect of the As-Is description is to identify the amount of time that each activity requires to be performed, as well as the cost that each activity requires in terms of resources. Both of these factors can be included in additional models using simulation [PROSIM 97] or critical path analysis [PROJECTLINK 97] to identify the time it takes to perform the entire business process. These factors can also be used in activity based cost models to analyze both the direct and the indirect costs associated with a given activity [AIØ WIN 96].

In the examination and analysis of the As-Is process, it is easiest to focus on those factors that cause long cycle time. That is, activities, or relationships between activities, that tend to cause longer cycle times, produce higher direct costs, or associated higher indirect costs. However, related factors, which cause quality problems, should also be identified. In examining an As-Is process for disconnects, obvious factors that drive quality problems include: missing inputs or outputs, illogical sequences, non-value added tasks, or redundant tasks. Using simulation to detect timing problems, as well as bottlenecks in the system, causes that drive longer cycle time can be identified. From these causes, factors that result in higher costs and lower quality can be discovered. The following outputs should be the results of a completed As-Is analysis:

1. A functional relationship description of the current situation, including the relationship between functions and activities, showing inputs, outputs, controls, and resources.
2. The time or causal sequence of events within those activities.
3. A measure of the performance and cost.
4. A list of disconnects which are symptoms of root causes and some understanding and definition of the problems associated with the current situation.

The critical outputs of this phase are going to be the identification of the disconnects and the analysis of the root causes. These outputs are considered critical because they largely define—along with the goals from the business case—the inputs to the To-Be process-design.

5.1 Functional and Business Relationships

Key to the analysis of a new opportunity or a problem is nailing down what functions are performed and the relationships between those functions.

Similarly, the identification of the business units involved and the relationships between those units is required. We recommend the use of Interrelationship Digraphs and Activity Modeling techniques for these two tasks. In fact we typically see the IDEFØ method used for both purposes. Since we have already made use of the IDEFØ syntax in previous figures we will provide a brief description of its basics and application here. The IDEFØ Function Modeling method is designed to model the decisions, actions, and activities of an organization or system. IDEFØ is not only the most widely used, but also the most field proven function modeling method for analyzing and communicating the functional perspective of a system. Effective IDEFØ models assist in organizing system analysis and promoting effective communication between the analyst and the customer. Furthermore, the IDEFØ modeling method establishes the scope of analysis either for a particular functional analysis or for future analyses from another system perspective. As a communication tool, IDEFØ enhances domain expert involvement and consensus decision-making through simplified graphical devices. As an analysis tool, IDEFØ assists the modeler in identifying the functions performed and what is needed to perform them. Thus, IDEFØ models are widely created as one of the first tasks of a system development effort.

The basic activity element of an IDEFØ model diagram is represented by a simple syntax illustrated in Figure 10. A verb-based label placed in a box describes each activity. Inputs are shown as arrows entering the left side of the activity box while the outputs are shown as exiting arrows on the right side of the box. Controls are displayed as arrows entering the top of the box and mechanisms are displayed as arrows entering from the bottom of the box. Inputs, Controls, Outputs, and Mechanisms (ICOMs) are all referred to as concepts.

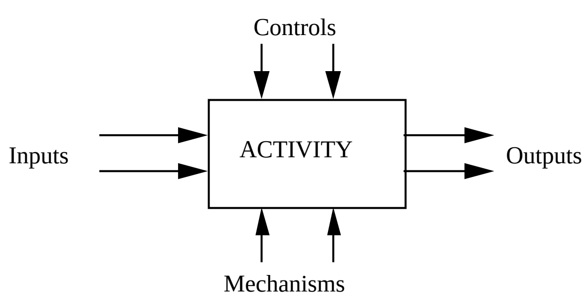

Figure 10: Basic IDEFØ Syntax

An IDEFØ model diagram is then composed of several activity boxes and related concepts to capture the overall activity. IDEFØ not only captures the individual activities but also reveals the relationships between and among activities through the activities' related concepts. For example, the output of one activity may in turn become the input, control, or even a mechanism of another activity within the same model as shown in Figure 11.

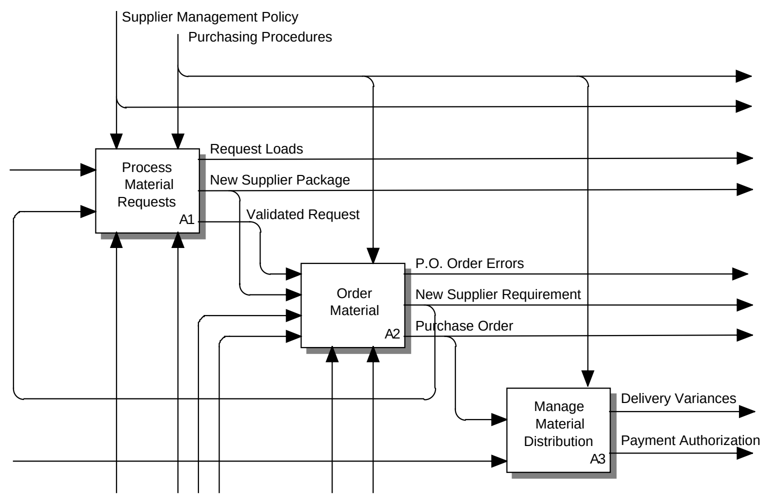

Figure 11: Basic Construction of an IDEFØ Model

IDEFØ includes both a procedure and a language for constructing a model of the decisions, actions, and activities in an organization. Applying the IDEFØ method results in an organized representation in a non-temporal, non-departmentalized fashion of the activities and important relations between them. IDEFØ is designed to allow the user to "tell the story" of what an enterprise does; however, it does not support the specification of a recipe or process and hence is not effective as a process modeling method. Such detailed descriptions of the specific logic or the timing associated with the activities require the IDEF3 Process Description Capture Method.

A strategy for organizing the development of IDEFØ models is the notion of *hierarchical decomposition* of activities. A *box* in an IDEFØ model, after all, represents the boundaries drawn around some activity. Inside that box is the breakdown of that activity into smaller activities, which together comprise the box at the higher level. This hierarchical structure helps the practitioner keep the scope of the model within the boundaries represented by the decomposition of the activity. This organization strategy is also useful for hiding unnecessary complexity from view until a more in-depth understanding is required as shown in Figure 12.

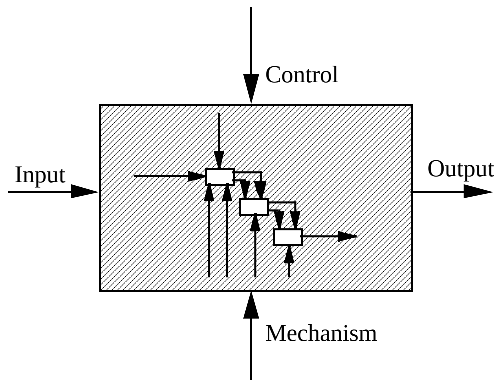

Figure 12: Looking Outside-In from an IDEFØ Perspective

IDEFØ captures "what" the organization does and thus, more specifically, is very effective in identifying the core activities and secondary functions of the enterprise. The actual act of identifying what the organization does will often result in answering the more important question of "why" the organization does what it does. This represents the first step of many BPR efforts focused on identifying candidate organizational areas for BPR. An activity for which one cannot answer the question of "why do we perform this activity?" is a definite target for BPR.

Interrelationship diagramming is performed with IDEFØ by placing the business functions inside the boxes and restricting the use of links to control and output only. The arrows take on a slightly different semantics, meaning that, a business unit/function *enables* another business unit/function when the output of one is the input of another. The interrelationship diagramming activity is completed when there is a one way flow of the influence relationships between the activities as indicated in Figure 13. The resulting digraph is often presented in the form of a circle as illustrated in Figure 14.

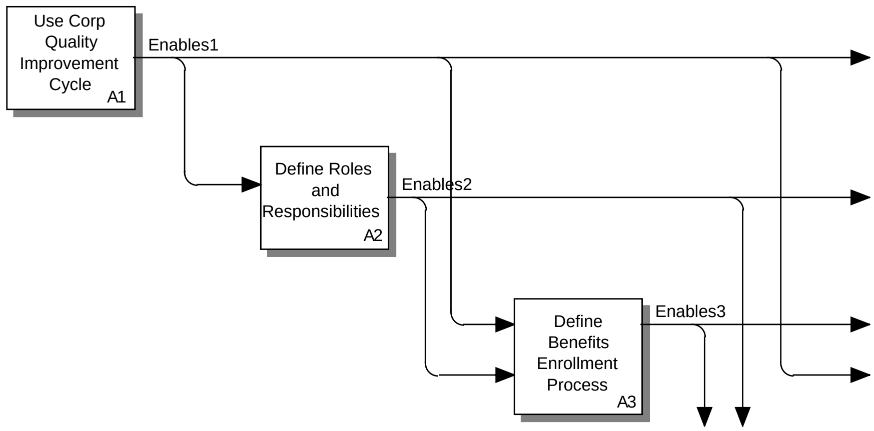

Figure 13: Inter-relationship digraph development with IDEFØ

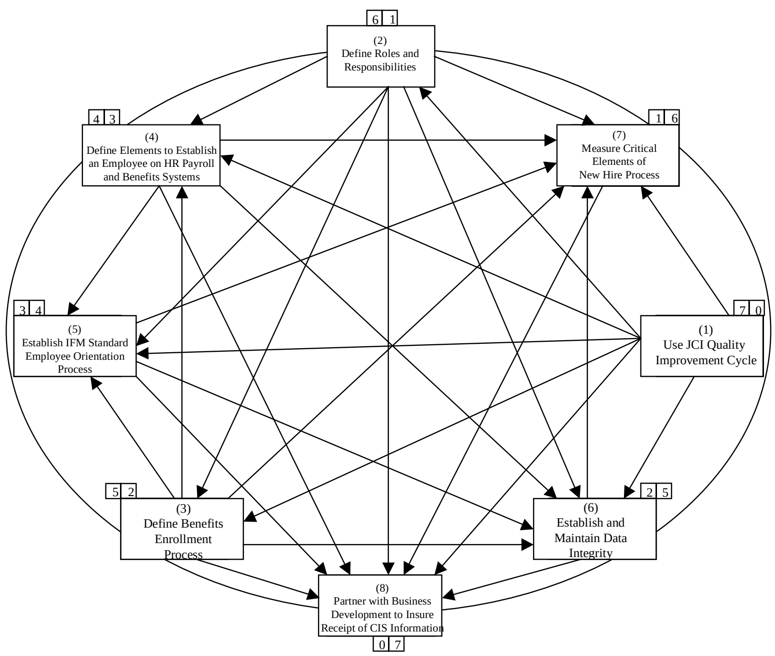

Figure 14: Inter-relationship digraph displayed in circular form

5.2 Process Mapping

The terms *process mapping, process description,* and *process modeling* are often used interchangeably. However, they identify three different, although similar, tasks. *Process mapping* is a method of gathering and displaying an intuitive (phenomenological) graphical display of the process situation. *Process description* is the gathering and structuring of the enterprise knowledge about the process. It is focused on documentation of the facts (or beliefs) which are known to the owners, operators, and customers of a process. *Process modeling* is a mechanism for constructing a simplified or *ideal view* of the process that is suitable for quantitative analysis (e.g., consistency completeness, simulation, and cost/benefit model analysis). Each has its place in BPR efforts. Normally we start with constructing a process-map. The results of the mapping exercise are used to structure the more in-depth process knowledge acquisition. Then, to answer questions, which require data that cannot be directly acquired, we design, build, and execute process models. There are a number of methods for each task. The IDEF3 method [Mayer 93] was designed primarily to support the process description capture task. However, it is often used successfully for the other two.

An IDEF3 process description consists of a structured knowledge base that is illustrated by a set of process diagrams and object diagrams. A simple description of a *process description* illustration is that it looks like a series of boxes that, collectively, loosely resemble a flow chart, with each box describing a step, or what modelers (systems analysts) call a *unit of behavior* or UOB. Consider a simple description of "patient chart access" in a hospital setting, noting that this example is oversimplified, but is attempting to demonstrate process models might appear. Below is a simple example of process steps for the Chart Availability process as represented in a process diagram.

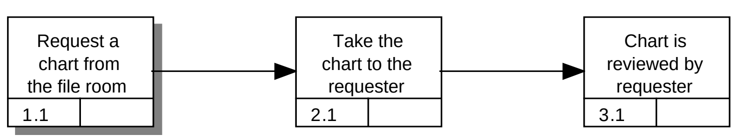

Figure 15: A Patient Chart Availability Process in IDEF3 Format

Note that in this diagram, the process is depicted at a very high level of detail possibly crossing a number of organizational boundaries. The process steps can be further broken down (*decomposed*) to a more detailed depiction of the process. In Figure 16, we present a simple decomposition of the "Request a chart from the file room" UOB from Figure 15. This decomposition represents what actually happens, in the file room, to accomplish the higher level step. The small boxes with the Xs inside are XOR (exclusive "or") junctions. These junctions mean that only one of the paths of step(s) is followed within the pair of X boxes. In this example, either the chart is pulled (probably since it is available in the file room) or the searcher looks somewhere else for the chart to be pulled (probably since it is not available in the file room). These steps would be further decomposed until the entire process is described.

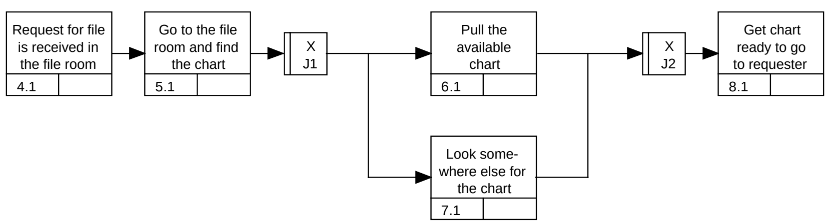

Figure 16: Process Model of Patient Chart Retrieval in IDEF3 Format

These two figures provide simple examples of what a process diagram looks like and helps to illustrate a few of the basic concepts of the IDEF3 process description capture method. However, there are a lot of additional pieces of information that are captured in the structured knowledge bases that are not displayed in the process "boxes." A process description capture tool also captures information such as:

1. The objects that participate at each step in the process
2. The roles that objects participate in (e.g., agents, resources, locations, artifacts, etc.),
3. The relations that objects stand in,
4. The state-changes that objects undergo in each step of the process,

5. The time it takes to perform a step (which can be represented in several ways from simple X minutes, straight line equations, or complex distributions),

6. The information that is required at each of the steps (for example, the data required at the “Request for chart is received in the file room” could be patient name, social security number (SSN), data of birth, etc.), and

7. Constraints on performing the step (e.g., starting conditions, terminating conditions, and completion conditions).

5.3 Information Analysis

Much of the effort in any organization today is directed at creating, managing, storing, or applying information. It is therefore crucial to the success of a BRP project to:

1. Identify what information is currently managed in the organization,
2. Identify which of the problems (or opportunities) identified during the business case analysis are caused by (or inhibited by) lack of management of appropriate information, and
3. Specify what information will be managed in the To-Be implementation.

We recommend a two-pass approach to this aspect of the business analysis. The first pass captures what information exists or should be managed about objects within the scope of the BPR project. The perspective of an information system in this first pass includes not only the automated system components (the IT or MIS view), but also non-automated objects such as peoples knowledge, filing cabinets, paper documents, etc. The BPR team must analyze and clearly state the information resource management needs and requirements. IDEF1 was designed as such a method. Rather than a database or software design method, IDEF1 is an analysis method used to identify the following:

1. The information collected, stored, and managed by the enterprise,
2. The rules governing the management of information
3. Logical relationships within the enterprise reflected in the information, and
4. Problems resulting from the lack of good information management.

The BPR team can use the results of information analysis to leverage these information assets and achieve the goals of the improved process. Their To-Be designs may include change to existing, or implementation of new, information systems, which can more efficiently take advantage of the information available to the enterprise. IDEF1 models provide the basis for those design decisions, furnishing managers with the insight and knowledge required to establish good information management policy.

Information models developed at this stage should distinguish between: 1) real-world objects, 2) physical or abstract associations maintained between real-world objects, 3) the information managed about a real-world object, and 4) the data structure used to represent that information for acquiring, applying, and managing that information. IDEF1 provides a set of rules and procedures for guiding the development of such information models. One IDEF1 goal is to provide a structured and disciplined process for analyzing information managed by an organization. This goal is accomplished by the evolutionary process defined in the method and by the measurable results and specific products required by the method. IDEF1 enforces a modularity that eliminates the incompleteness, imprecision, inconsistencies, and inaccuracies found in the modeling process.

There are two important realms for BRP analysts to consider in determining information requirements. The first realm is the real world as perceived by people in an organization. It is comprised of the physical and conceptual objects (e.g., people, places, things, ideas, etc.), the properties of those objects, and the relations associated with those objects. The second realm is the information realm. It includes information images of those objects found in the real-world. An information image is not the real-world object, but the information collected, stored, and managed about real-world objects. IDEF1 is designed to assist in discovering, organizing, and documenting this information image, and thus is restricted to the information realm.

5.4 Disconnect, Constraint, and Root Cause Analysis

As the activity models and process maps start to emerge from the team the designated process analyst examines them to identify points where there are disconnects, inconsistencies, or redundancies in the existing process. A simple example of how a disconnect could be spotted is if on the process diagram it is apparent that one of the legs of the process “ends abruptly.” Or, it is observed that there is not a logical way to go from one step to another step in the process.

Or, the same function is performed redundantly by different organizations. Discontinuities often take the form of inaccurate, untimely, inconsistent, or unavailable information. Finding these "disconnects, inconsistencies, or redundancies" is perhaps the greatest value of the As-Is analysis phase. It gives the members of the team the opportunity to look at the process from end to end, and better appreciate its complexity and where and why bottlenecks or problems occur. Our experience has shown us that members of a cross-functional team are often surprised at "how things get done" somewhere else in the enterprise. This type of analysis and information exchange also provides managers with the opportunity to identify another type of disconnect—specifically, situations where the process is being performed contrary to the business rules that are supposed to guide the process (i.e., *it is not being done the way they think it is*).

Constraint analysis in re-engineering has gained much attention in recent years through the work of the physicist, Eliyahu Goldratt [Goldratt 1985]. Goldratt's Theory of Constraints (TOC) is an approach to discovering the constraints that limit the accomplishment of the organizations' goals. The TOC philosophy seeks continuous improvement by systematically breaking the identified constraints. Goldratt defines a constraint as anything that limits a system from achieving higher performance versus its goal. We define a constraint as a relationship that is maintained as true in a given context. Analysis of constraints is key to understanding relationships between the different components of a system and the whole of which they are a part. Constraints encapsulate the assumptions, policies, and procedures of an organization. From a BPR perspective, three kinds of constraints are important: 1) constraints that improve an organization's throughput, 2) constraints that limit an organization's throughput, and 3) constraints that should be enforced to improve an organization's throughput. The knowledge structuring mechanisms provided by the IDEFØ, 1X, 3, and 5 methods along with the analysis mechanisms of IDEF9 facilitate the discovery and analysis of constraints [KBSI 1994b].

Causal Analysis is an important component of business system (and business process) analysis. The main goal of causal analysis in BPR is to identify cause and effect chains that link aspects of the system (usually the "controllable" system factors) to the performance goals of the system. An important step in causal analysis is to identify causal associations between system factors. Cause & Effect (or Fishbone) diagrams are commonly used at this stage to identify causal associations. Disconnects, as well as, problems and opportunities identified as goals for the BPR project are related in these fishbone diagrams to the activities, process sequences, or objects uncovered in the As-Is modeling activities. Often the number off problems, opportunities, and disconnects are so large that the BPR team looses focus. This is one of the situations that commonly cause BPR efforts to fail. However, use of traditional Pareto charts and Prioritization matrices can break these logjams.

Once the team has settled on the high priority issues and identified the causal associations, these associations must be characterized in enough detail so that the effect of the factor change on the association can be accurately estimated. Influence diagrams [Richardson 81] and Ishikawa Diagrams [Gitlow et al. 89] are useful for characterizing qualitative causal relationships. An influence diagram showing the causal relationships between production rates and Work-In-Process (WIP) is shown in Figure 16. The '+' indicates direct proportionality and the '-' depicts inverse proportionality.

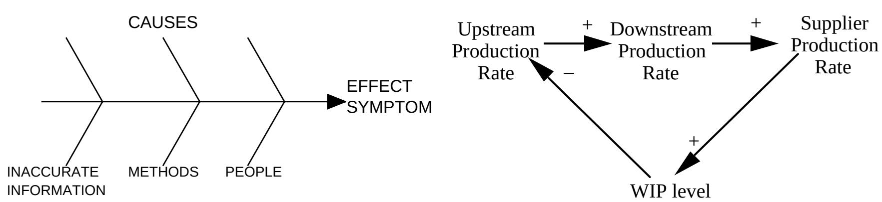

Figure 17: Influence Diagram

The result of these qualitative techniques must be validated either through direct observation and data collection or through analytic modeling (e.g., simulation). Once validated, the results for the basis for documenting the requirements for change. A common error in failed BPR efforts is to confuse having the models and analysis with having the change requirements. Substantiated change-requirements that have consensus support from the team and management are key to the success of the BPR effort. One of the challenges of producing such change requirements is the tendency to confuse requirements with designs. Change-requirements should specify "the conditions" that the system should be changed to satisfy. They should not specify how the change should be made. That is, they should not specify the solution, only the conditions that the solution must meet.

Section 6: To-Be Design and Validation

The goal of To-Be process design is to produce one or more alternatives to the current situation, which satisfy goals of the enterprise as stated in the business case analysis and which satisfy the change-requirements. At this point in time process design (or business re-engineering or balance sheet engineering or process improvement) is still more of an art than a true engineering discipline. There are few guidelines and no natural laws. We will therefore first present eight basic principles of process design we have observed that result in better process design. Then we will describe one of the approaches to applying these principles that provides consistently better results. The steps involved, in that approach to "To-Be Process Development", are focused on the objects or outcomes of the process. That is, initially the desired-outcomes of the business process are extracted from the change-requirements. These desired-outcomes are best stated in the form of "what are the objects?" either real world or conceptual, that are to be produced and "what are the characteristics (or structures) of those objects?" This "object (or outcome) centric" view may appear somewhat unconventional in comparison to the normal process view where the design would start with an attempt to identify and structure the steps in the To-Be process. However, it enables creative (out of the box) approaches to a design problem by focusing attention on the end first and the means secondarily.

6.1 Basic Principles of Process Design

The **first** principle of process design to keep in mind is that it is a design endeavor. That is, it is primarily inductive in nature. When faced with a design situation, the designer will generally start with a design that is already familiar and try to modify that design to address the new situation. To the BPR practitioner this implies the need to search for industry best practices and to augment the teams' knowledge base with exposure to the widest range of alternatives as possible. The **second** principle of process design is that it is not a process, rather it is a set of skills that are employed in an opportunistic fashion. To the BPR project manager, this principle implies that the progress of the process design portion of the project may not be realized in a linear fashion. There may be many false starts and there should be multiple alternatives that are subject to tradeoff analysis.

The **third** principle of process design is that "object design" plays a central role in the process design: processes produce some output and consume or are triggered by some input. One mode of thought for a process designer is the design of those input and output objects. The design of the structure of the input/output objects, their role relative to a process (supply versus control for inputs, measurement versus product for outputs), and their frequency/rate of arrival are all considered as part of the design process. One of the key aspects of process design is determining which of the specified input/output objects specified in the requirements for the process are modifiable and which are fixed, which are controllable and which are uncontrollable, and which are independent and which are dependent. An experienced process designer is always looking for ways to design the input or output objects to both streamline the resulting process and also to optimize the upstream and downstream interfacing processes.

The **fourth** principle of process design is decomposition and allocation. Processes must be specified to a level of sub processes that can be allocated to specific resources available in the execution environment. One of the reasons for process re-design is that the resources available and their capabilities change over time. Thus, a process that was once acceptable because there was a highly capable resource available, becomes no longer acceptable due to the loss of that resource, the unavailability of a replacement, or vice versa. Process design involves decomposition into sub processes (or objects into parts) until a level is reached in which the sub processes can be allocated to an available resource.

The **fifth** principle of process design is that physical and logical input/output contiguity must be maintained. Therefore, during the process decomposition, the input/output of each sub process must be specified and matched with the input available and the output required at the position of the sub process in the process flow. When there is not a match, additional processes may have to be added to make the interface or the sub process must be modified to perform the interface function itself. When neither occurs, another decomposition must be considered.

The **sixth** principle of process design is that there will always be failures that must be addressed. Therefore a process design must include processes for failure management: the possible failure modes, those considered expected or reasonable, of the resulting system must be identified. For each possible failure modes (and for possible combinations of failure modes) the effects of such a failure must be predicted. Then a design decision must be made to determine whether the sub processes will be added to detect and manage the effects of each possible failure mode.

The **seventh** principle of process design is that processes produce other than just the desired products. Therefore a process design must include the design of process steps for by-product (waste or scrap) management. During the execution of a process, products will be produced that are not useful as input to downstream processes or considered a part of the desired output of the overall process. These types of objects must be identified and sub processes put in place to collect and dispose of them properly.

The **eighth** principle of process design is the design of processes for coordination or management. A common example of such a coordination process is execution resource management. During the execution of a process there are normally multiple activations of the process being attempted simultaneously. In the normal situation there are limited resources available to perform the sub process instances. This naturally results in resource contention situations for which the process designer must add resource management subprocesses.

6.2 Object-State Transition Approach to Process Design

One approach to process design that implements the above-described principles focuses on the objects and their state changes. This approach helps to achieve a "change in view" of the domain experts. It is fairly clear that domain experts are most knowledgeable about the As-Is process and that knowledge and expertise is required to drive out symptoms and root causes. However, it can be an impediment to innovation to use the domain experts in the To-Be process design, especially if the domain experts are currently the owners of the As-Is processes. If individuals are too attached to an existing process, it is difficult for those same individuals to develop breakthrough ideas about a new process. More likely, such individuals will work toward small improvements rather than large improvements. For them, it is often simply too difficult to see how to make major improvements. By using an alternative approach in the To-Be design—specifically viewing the system from an object state in which one begins looking at the end of the process first—one can effectively shift the perspective of domain experts and allow them to think "out of the box." Another important element is to set the context of To-Be design in "green light mode." In other words, when the goal is to truly achieve massive improvement of business processes, one needs to be somewhat non-judgmental. A tone needs to be set for domain experts attempting process improvement—going for the gold means opening oneself to any idea that can in fact lead to substantial changes. This mindset is important to ensuring that the full creativity of the group can be explored, thereby maximizing the chances of achieving truly breakthrough results. This especially true since BPR efforts are complex and expensive.

Object centered process design intentionally starts with an attempt at a definition: what does success look like at the end of process? We form our definition in the context of an object—either real or virtual—produced by a process. We then work backward through the process and look at intermediate states of that object, and identify in those intermediate states the additional states and components that are collected about that object. In the end, we ask, "Have all objects and components been produced?" In the intermediate stages, some of information and components produced are included. In the beginning, an object is defined but there are no values for its attributes. For example, the designer's sketch of an automobile defines what needs to be there, but there are no components. Intermediate objects have subassemblies. By the end of the process, we have a complete and functional automobile object.

The next step involves filling in this map of transitions from one object state to another state, and identifying the process steps needed to go from one state to the next (see Figure 18). This now gives us a basic network that shows us the relationships between the objects producing and the processes needed to add the information—the fundamental architecture of the To-Be process. Now we need to begin to flesh this out with additional information. One major step is to examine the goals, the disconnects, and the root causes from As-Is analysis, and to compare the To-Be design with those. We want to ensure that we have identified some kind of process step or activity or some kind of piece of information that, in fact, satisfies those particular goals. Some of those goals may be performance goals such as desired cycle time (i.e., the time it will take each process step to be executed). Perhaps these goals will have types of information not easily captured in process models. For instance, if we have goals associated with costs, quality, etc. object state transition diagrams with associated processes need to have additional quantitative information identified that will show how those particular goals will be satisfied. For example, a quality goal to achieve certain yield might require adding a process step to address quality from the perspective of designing a procedure to assure quality control and that assurance steps and metrics are measured. Processes might include sampling, checking, or whatever is required to be most effective in achieving that quality performance goal.

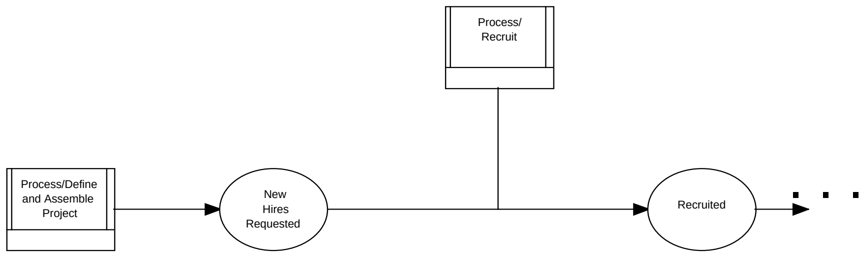

Figure 18: Object State Transition Network (OSTN) of New Hire Process

We now have the definition of the object we're producing from its final state to the initial state (working backward). We have identified process steps to effect each transition. Even in an object oriented design method process diagramming is used in order to ensure that the process steps, resulting from the object transition design, fit together into a logical pattern. In addition to the process logic, this step also generally includes the allocation of each process step to an organization unit. Such resource allocations must be verified as consistent with those manageable by the existing or envisioned management organization. This verification is normally accomplished via group review using a specialized diagram often referred to as "swim-lanes" as illustrated in Figure 19 [PROSIM 97].

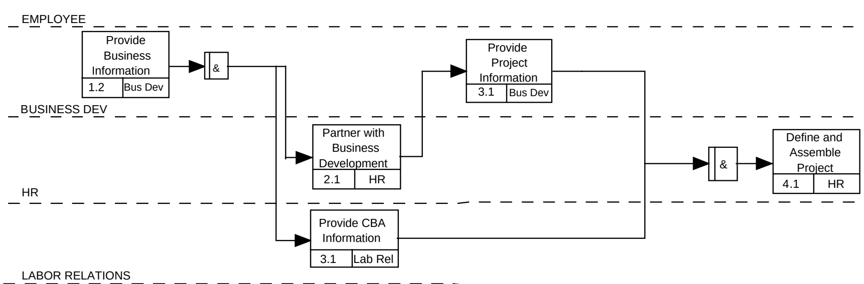

Figure 19: Model of New-Hire Process Showing *Swim Lanes* in IDEF3 Format

Once the To-Be process logic has been designed the next step is to design the information structure to support the new object transition and process flow. IDEF1X is typically used for this task. If an enterprise data model exists in the organization, this step involves sifting through that reference model, identifying the information elements that are required, and then requesting extensions to cover those information elements that must be added to enable the new process to work.

6.3 Process Metrics

To improve productivity and innovation, we must define and measure what we mean by improvement. We need to measure and report on productivity and innovation as often as we measure and report on profit and growth if we intend to increase the real wealth of the company. Each step of the process must have identified goals often referred to as the "process intent." These process intents must be compared with the overall improvement goals of the BPR project as well as the disconnects and root causes of problems in the existing process. Given that we have addressed each of the project goals, the next step is to complete the diagram with the metrics required to measure the performance of the processes once implemented. These metrics are, in fact, going to be largely customer-driven. That is, a process must address the *customers'* goals in addition to the enterprise or organization goals. Typically, the customer will ask, "Does the product/service satisfy functional needs? Was it on time? Is it affordable?" The enterprise's internal goals should focus on the same high level of quality: "What did the product/service cost the enterprise to produce? What was its capacity? What is its effectiveness? What is its productivity?"

6.4 Validation

An additional step in the To-Be design involves the validation of completeness and performance against the business case goals we developed in the beginning of the effort and the change-requirements. Simple checklist or matrix organized mappings can be used for the completeness analysis. Emerging tools that integrate both multiple methods with As-Is and To-Be views promise capabilities to track these mappings with automated change propagation [Tissot 97]. Typically, we use simulation, critical path analysis, or cycle time analysis to model performance of the To-Be design. The availability of simulation engines with powerful visualization interfaces allows the BPR team to visually inspect the operation of the To-Be proposed design [WITNESS 97]. The ability to generate such simulations directly from the process models brings this capability within the reach of virtually every BPR team [PROSIM 97]. Emerging tools will extend the visualization capabilities to virtual reality levels of immersion [Sun 97]. With these techniques, we can capture costs on the basis of their execution through simulation or ABC analysis and, given all that information, compare projected performance against our business case. That is, our business case will have within its goals our rationale for what resources we can reasonably expend for the new systems. If, in fact, our new systems don't meet our goals or are too costly or will take too much time to implement, we can choose at this point a different set of actions. Our investment has been only to this point and does not expend additional resources of manpower, time, and money on implementations that will remain incomplete, too costly, or not cost-effective.

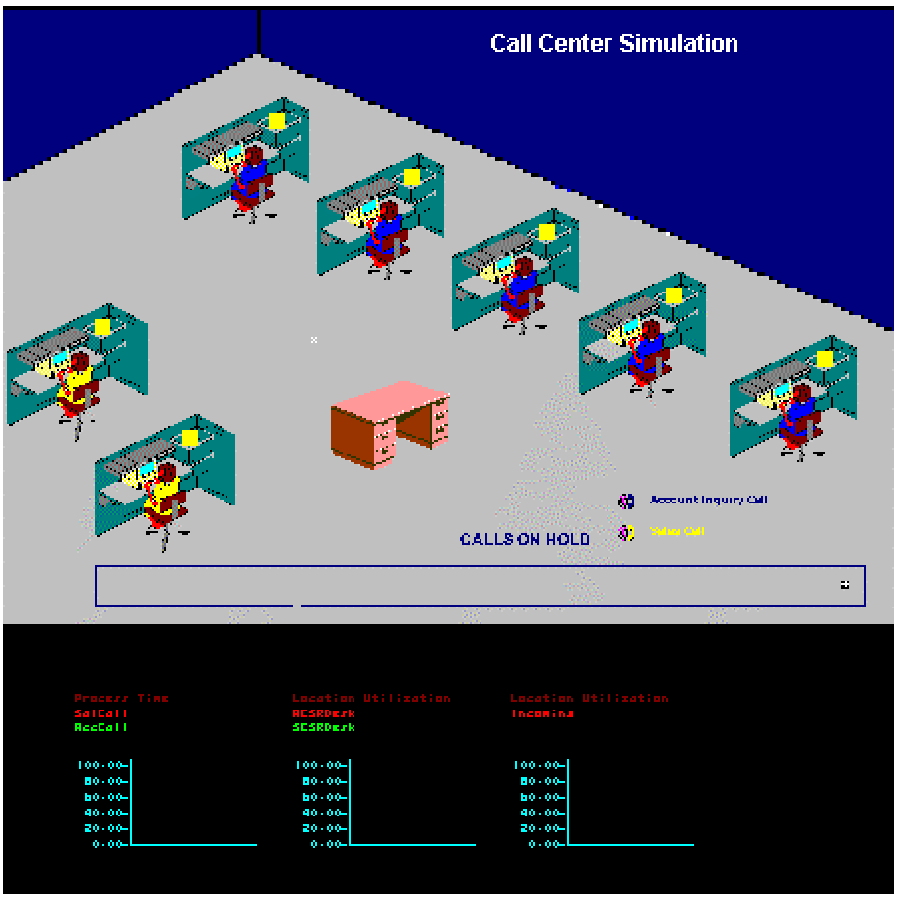

Figure 20: Simulation Visualization of a Reengineered Process

The true benefit of using modeling methods to perform BPR is that we can use the technologies now available to automate the BPR process. We can create a complete picture of our system from the earliest planning (at the strategic and business case levels), to the description of the As-Is and through the development of the To-Be design(s). And we can analyze these designs to determine whether or not they do in fact fall below, meet, or exceed our expectations defined in the business case.

Validation of our To-Be system involves two aspects: 1) *goal validation* to ensure that the new system meets the effort goals and 2) *performance validation* which simulates the To-Be design to ensure that the new system will not unintentionally cause detrimental impacts in its interface with other systems or functions. Goal validation is normally accomplished by peer review with the understanding that problems will be eliminated or the opportunities will be met. Many times, goal validation serves as an excellent mechanism for communication status of the effort as well. Performance validation can also be accomplished using some peer review, but is essentially very dependent on using automated tools for looking for unintended impacts.

6.5 Return on Investment Forecast

In the original business case development, goals, initiatives, and top-level measures were identified. Now the To-Be design can be used to 1) identify projected performance for the new design in terms of both capacity, output, cycle time, quality, and utilization, and 2) project the costs associated with implementing and operating the new design. These projections can be used to create a business case of the To-Be design for comparison with the original business case. From this comparison, we can refine the initial estimates of the benefits of the project to be gained by implementing the new design, as well as calculate the return on investment. Comparing To-Be design to the As-Is system is made possible by use of the model-based methodology described above. In the case of the As-Is system, we can establish metrics that allow us to determine the price of a good unit of service in the allotted timeframe, as well as our total capacity to produce a specified quantity in a certain amount of time. With the new process (and using the same parameters), we can show what the new performance will be. For example, in the new design perhaps we doubled our capacity and knew how much we had invested to implement the new process. We can quickly develop the difference between the As-Is and the To-Be and predict payback period. By doing this before implementation proceeds, we can validate the effectiveness of the To-Be design.

6.6 Perform Trade-off Analysis

The purpose of trade-off analysis is to evaluate the relative merit of *completing* alternative process/system design alternatives. Ideally, multiple system designs will be carried forward to a level of detail at which performance and ROI analysis is possible. Often, trade-off analysis and system design are done incrementally, and iteratively; that is, trade-off analyses is performed initially with a partial system design, the analysis results are used to refine the design, the analysis is invoked again, and so on. Depending on the goals of the BPR effort, the nature of the tradeoff analysis may vary from *Qualitative* (rough-cut, order of magnitude) to *Quantitative*. Trade-off analyses often focus on measures of system performance and include cost/benefit analyses. Trade-off analysis is difficult in practice because of the existence of multiple, competing criteria. Multiple-criteria decision support techniques such as decision charts, weighting factor score charts, and decision analysis charts may be applied to guide the analysis process [Hunger 95]. The IDEF methods can be used effectively in conjunction with analysis techniques such as ABC and simulation to perform trade-off analyses.

Of particular importance is the tradeoff between process streamlining and flexibility. Paradoxically, these two qualities are competing design goals. Greater efficiency, accomplished primarily through process streamlining, often results in less flexibility. Likewise, enhancement of flexibility levies constraints on attainable efficiency. The appropriate balance between these competing design goals is sought initially through accounting for known downstream concerns.

Section 7: Implementation

After the To-Be process/system design has been selected, the next step is to develop a plan to transition to the re-designed process from the As-Is process. The overall transition strategy must align the organizational structure, information systems, and business policies and procedures with the re-engineered processes/systems. The transition plan often includes 1) a system integration strategy, 2) a technology strategy, and 3) an information system strategy. The IDEFØ and IDEF3 methods have been shown to be effective tools for representing and communicating the transition plans.

BPR efforts will result in various forms of implementations depending on the nature of the change required. Some changes may involve only policy change, while others may require complete business and information system restructuring. Regardless of the extent of the implementation itself, success depends upon effective implementation planning. If done correctly, implementation planning will mitigate the two major risks of failure that inhibit implementations: 1) meeting initial expectations of time and expense, and 2) risk of change to an ongoing operation.

7.1 Transition Process Design

The foundation for the BPR implementation plan was laid in the initial business case. The BPR method and software tools available today allow us to capture the evolution of those business case concepts through the As-Is and on into the To-Be. Along with the various function, process, object, and information descriptions at each stage we can also identify the various dependencies among the views. This allows us to take the next critical step, which is to design a process for moving the organization from the As-Is into the To-Be, as well as the resources required enabling that transition.

Further, we can use this functional modeling framework as our initial business case to create a detailed architecture or project view of the changes we wish to make. As we analyze the existing system and define and describe the To-Be system, we can add additional relevant activities and begin to assign the time and resource allocations needed to perform the implementation.

7.1.1 Integration of Information Infrastructure and Functional/Business Views. Many enterprises today undertake Business Process Reengineering (BPR) *and* Information Infrastructure (II)[2] modernization efforts to drastically reduce costs and improve performance. While these efforts would appear to be complementary, they are rarely conducted jointly. That is, although it might make sense to conduct BPR and information infrastructure modernization efforts in a highly coordinated fashion, there has been little success to date in making the attempt. The importance of coordinating such efforts in the BPR transition plan is obvious when one considers the implications of making changes to the business process and/or the supporting network hardware and communications infrastructure. Making changes to the logic and structure of a business process

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[2] We use *information infrastructure* to refer to the network hardware, communications, and applications supporting enterprise-wide operations.

generally introduces new requirements on the supporting infrastructure. Likewise, making changes to the network hardware, communications, and application infrastructure can have dramatic impacts on the performance of business processes and the end user's ability to perform [Painter 96]. Most successful BPR efforts involve the II evolution as a part of the design process and all successful BPR efforts must involve IT in the implementation planning and execution.

7.1.2 Evolving the To-Do from the As-Is and To-Be. One of the most powerful and beneficial aspects of the methods and tools identified earlier in this chapter is that they make possible a systematic, traceable, and significantly automated transition planning process. The IDEF models that were created during the As-Is can be mapped to those created during the To-Be and an initial list of change requirements generated. Additional requirements for the construction of the To-Be components can be added and the result organized into a work breakdown structure (WBS).

Recent developments in BPR software technologies enable automatic migration of these WBS activity/relationships into a process modeling environment. The benefit here is that we can now define the causal and time sequential relationships between the activities that we have planned.

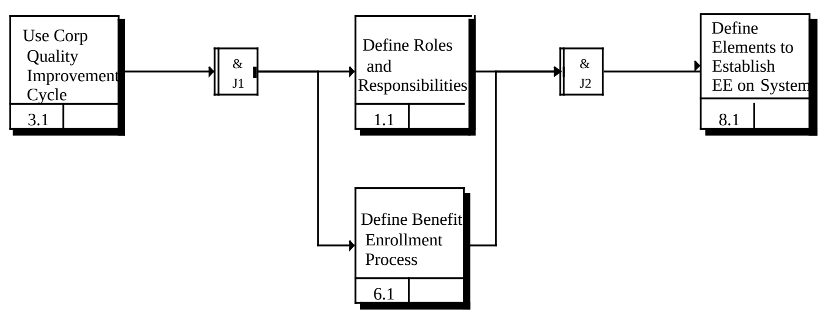

Figure 21: TO-DO Process Model in IDEF3 Format

The process model view also permits us to identify the time duration aspects of the activities. In two steps, we have taken the activities and initiatives needed to solve the root cause problems and generated all of the key functional, sequential, resource and time information to serve as the foundation of the To-Do Implementation Plan. Using the BPR methods and technologies plus the knowledge of the BPR team, an initial project plan is created automatically just as it was done early in the Project Definition. So the BPR team has available a "Strawman" transition plan that can evolve as the BPR implementation progresses. This permits the team to make, among other things, estimates of the implementation costs as the project progresses. Similarly, alternative strategies, which were identified during the Project Definition Phase, are easily incorporated into the To-Do Activity and Process models. Alternatives that were identified subsequent to the Project Definition Phase are also easily added. Alternatives are typically analyzed for impact on ROI and risk. Available BPR software technology permits the BPR analyst to evaluate the key performance measures (e.g., cycle time, cost, quality, utilization, revenue generation) through simulation and cost/benefit analysis. In addition, such factors as favorable customer impact and cultural impacts must be considered.

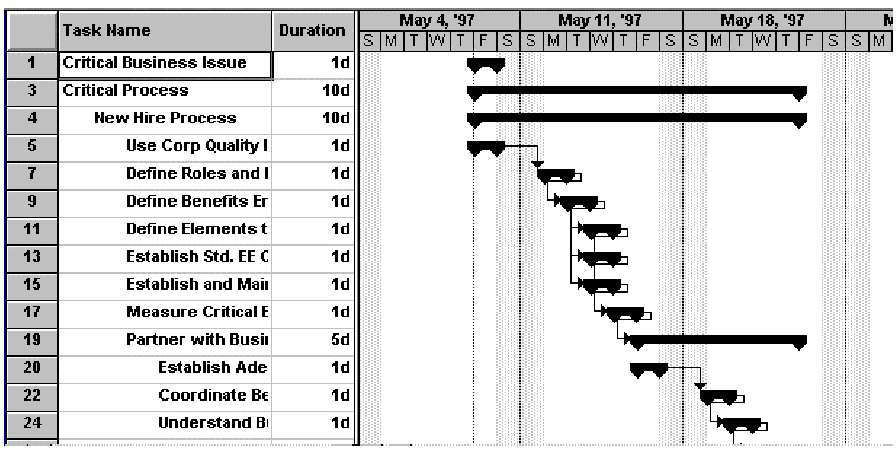

Figure 22: Transition Project Plan for Reengineered Process

7.2 Model Driven Information System Implementation

Rapid implementation of the information system that is required to support a re-engineered business process is critical to the success of the BPR project. An advantage of the methods and tools described in this chapter is that they enable automation of the information system change. Even though we have seen significant progress in software engineering during the last decade, software development remains an expensive and risky endeavor. Organizations must find ways to reduce the 'in-house' software development cost and time. One alternative is the use of commercial-off-the-shelf (COTS) software packages. The key issue facing this alternate solution is applicability: Can today's rapidly changing complex organizations effectively use COTS packages to support their activities? COTS software is designed considering the widest common market approach to the business requirements. They normally embody an implicit business process. This implicit process is generic, often hard coded, and hence requires considerable effort to customize. This requires the business to either change its operational processes to be supportable by the COTS or bear the cost and time involved in custom software development. Model based software development proposes to eliminate this "one-size-fits-all" software solution and reduce the cost and time of achieving custom systems [PROSYS 97].

The To-Be enterprise models can be used to characterize the needed application clients, the information services, and the workflow control requirements. These same models can then be extended with additional refinement from the support information system view. The functions that the system must perform and the constraining relations between functions, captured in an activity model (IDEFØ), can be used to automatically generate client software menu and dialog components. The process sequencing, timing, resource, and object information that are captures in process (IDEF3) models enable automatic generation of data input form presentation sequences, constraint (rule) enforcement strategies, and work-flow management elements business information applications. The information elements captured in the To-Be information models (IDEF1X) can be mapped to existing data resources enabling the automatic generation of three-tier data server systems and data warehouses. In this manner, the software system development can become a natural extension to the BPR effort.

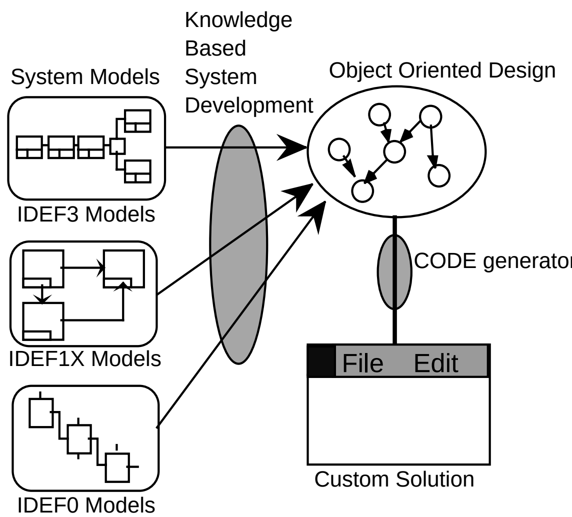

Figure 23: Model-Based System-Level Application Generation

Model generated software technology takes software reuse beyond the object and component levels to the system level by providing the power of reusable system templates. As an organization builds a library of IDEF models, these models can be used to generate systems that have a standard architecture, user interface, workflow approach, and data backbone. Then, by merely customizing the source *models* and re-generating the code, the system can be tailored to meet particular re-engineering needs. By taking control of the software development process all the way from the problem description stage, this model driven strategy, significantly reduces the time to implement the needed information systems. It also makes major inroads in bridging the gap between the process owners/operators and the software developers.

7.3 BPR Knowledge Asset Management

BPR is never really completed because the environment the enterprise operates within continues to change. For the enterprise to continue to survive and thrive, it must incorporate BPR as a corporate philosophy and tradition to adapt to the changing environment. BPR as an organic discipline must continue to grow as lessons are learned from its practice and information technology continues to evolve. For instance, change management or the practice of human factors in incorporating and enabling BPR changes most effectively has resulted from the lessons learned in early BPR exercises. Changed processes in automated systems can be implemented rather quickly. Organization structures can be redefined in corporate policies and communicated to an enterprise quickly. People, however, are less adaptive to change than automated systems and organization policies. As a result, change management continues to evolve. Information technology changes dramatically each year. Older implemented solutions of large-scale integrated heterogeneous databases, for example, have been replaced by solutions of data warehouses and intranets. As an enterprise continues to grow and evolve the systems that resulted from previous BPR efforts will become out of date and require re-engineering. The practice of BPR can be streamlined and become less risky if the organization makes use of the models and methods consistently between projects. This requires treating the models as a business knowledge asset.

8.0 Conclusions

Broad experiences in enterprise engineering have helped BPR professionals identify many problems and constraints that are common to their organizations: fragmented processes, duplicated effort, unnecessary tracking and rework, manual and paper intensive processes, inadequate software and systems training, lack of systems integration (barriers to information sharing and maintenance), inaccurate and untimely information, and so on. Delivery of the process redesign, organizational re-alignment, and integrated systems development and implementation solutions needed to effectively address these and future needs requires collaborative effort with process operations and management personnel to apply the methods, techniques, and technologies described in this chapter. Initially, BPR was practiced almost as a black art. In the past five years the methods and technologies presented in this chapter have emerged as the beginnings of an engineering discipline with both standard blueprinting conventions and powerful performance and cost prediction models.

A recognizable benefit of the approach described in this chapter is in its cost effectiveness, its holistic nature, and its focus on inserting an organic BPR capability within the organization. With a "Just-In-Time," in-context training strategy the approach can be successfully applied to assist projects in clearing the common hurdles that typically stagnate reengineering efforts. This assertion is based on the observation that institutionalizing reengineering is fundamentally a learning (and sometimes "unlearning") process. As such, we feel it is important that the participants have an understanding of, and appreciation for, the methods, tools, and techniques that will be used during the project and afterward to institute continuous process improvement (CPI). This strategy, when coupled with a step-by-step reengineering framework, can assist organizations in sustaining momentum through successful implementation and the establishment of a continuous improvement culture. The approach presented is holistic in the sense that we don't offer a "canned" solution: *"just change this process, downsize support staff, purchase this software."* Instead, we recommend use of the techniques necessary to analyze and understand the enterprise from organizational, process-oriented, and job performer perspectives. What distinguishes engineering from alchemy is a structured methodology, grounded in observations and facts, guided by sound models, and targeted toward realistic (though far reaching) goals.

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