METHODOLOGICAL FRAMEWORK FOR BUSINESS PROCESS RE–ENGINEERING FOR RAILWAY INFRASTRUCTURE MANAGERS

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Abstract

European Railways are in a transitional organizational process due to the implementation of the railways' European Directives. This necessitates a re-engineering of the railways infrastructure companies (termed Ims-Infrastructure Managers). It is for this topic, that the present paper provides a methodological framework for the business process re-engineering of Railway Infrastructure Managers' (IMs) processes and structure. The methodology is a generic and innovative Business Process Re-Engineering (BPR) that uses inputs based on the IMPROVERAIL research project of the European Commission and shares the most common characteristics of BPR methods. It concentrates on those processes that rest for their main part within the competencies of the infrastructure manager. Representative processes were chosen in each of the three key areas of the organisation: operational, commercial and managerial. With this, the IM should be able to understand and develop specific re-engineering measures based on his goals and needs. Process's improvement initiative should be measured against its stated aims and achievements through an analysis of performance improvement in re-engineered processes. Realising that different organisational and sectoral structures exist, this will assist the IM's to reach a decision about the most effective, efficient, and feasible structure for the railway company.

Keywords: Railways; Business process re-engineering; Infrastructure managers
Topic Area: H4 Strategic Changes in Transportation Organizations

1. Introduction

Recent years have witnessed an important effort in liberalizing the market of transport services in the European Union countries. In this context, the railway industry has followed a process of drastic changes. Starting in the 90s, with the adoption of the EU Directive 91/440, the business is under an important structural reform with the separation of infrastructure and operations to different legal entities. The aim of these changes is overall modernisation in order to provide an industry less dependent on subsidies for its financing. This is expected to produce improved flexibility and capacity to face complex environments and the ability to become more integrated in the overall transport and mobility system. One of the key players in this process is the Infrastructure Manager (IM). The IM is practically "any body undertaking responsibility for establishing and maintaining railway infrastructure"[1]. The main responsibilities of the Railways Infrastructure Manager (IM) are summarized below:

- planning and financing of infrastructure development projects

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[1] Directive 2001/12/EEC

- management, planning and financing of infrastructure maintenance and renewal
- train-paths allocation
- traffic management
- Charging

It is obvious that the traditional bureaucratic structure of the Railways Organizations is not able to cope with such great structural changes; therefore an organized methodology should be introduced in order to facilitate the process of organisational change. One of the methods, suggested in this paper, is Business Process Re-engineering (BPR). The aim of BPR is the improvement in performances either for the whole organisation or for parts of it. For implementing BPR, a computer software was created for the IMPROVERAIL[2] project *(IMPROVRAIL, 2003; bis)* called the "Toolbox". It is based on the proposed methodological framework and it is a self - assessment management tool that follows the generally accepted principles of Business Process Reengineering (BPR), in order to measure the achieved performance improvements related to costs, quality and service.

2. Methodological framework

The proposed methodological framework is a generic BPR methodology, which is easy to be applied and open for application for all IM structures. More specifically, the methodology provides a unifying "decision framework" which the IMs can use to guide them step-by-step through the processes of re-engineering of the railway Infrastructure Company. It also lays out an ordered set of decisions linked together logically as well as in their time order for consideration. For each decision the several phases articulate the principle options and alternatives, available to IMs and assess the expected consequences associated with each option based on recent European experience. In particular by applying the methodology IMs should be able:

- To place their company in the context of current and historic railway developments
- To understand the major trends shaping the challenges of the future.
- To gain an appreciation of how important is for successful re-engineering to realign the values and redefine the culture of the IM so that it manifests increased sensitivity to customer needs and expectations.
- To reach a decision about the most effective, efficient, and feasible structure of their company and how to go there, given the forthcoming consequences of EU directives and each country's unique legal, economic, political, and social environment.
- To gain a solid understanding of the processes, the activities they consist of and their relationship to re-engineering.
- To take steps to develop specific re-engineering measures based on the IM's goals and the needs of train operators and other recipients.
- To receive practical advice on how to take the many elements of IM re-engineering and put them into a procedurally logical and politically feasible sequence of steps that maximize the chances for success.
- To identify whether this change process has made their companies better off.

[2] IMPROVERAIL is an EU program that focuses on the infrastructure business part of the railway industry. In the context of current changes, IMPROVERAIL assesses the performance of infrastructure managers according to the guidelines for change provided by the European Directive 91/440 and other subsequent regulatory instruments. An innovative contribution of the project is that it brings quality management and reengineering approaches, to the sector, through the analysis of functional and managerial bottlenecks as well as inefficiencies in the sector.

The methodological framework consists of five phases (Figure 1) that are interrelated and they are somewhat the required logical steps that follow the pattern:

Understand the environment → Set the Objectives → Use tools to accomplish them → Produce outputs → Recommend activities / implementation

Some of it elements are based on previous work on Business Process Re-engineering *(Hammer et al, 2001; Hunt, 1996)* and Decision Support Tools *(Tsamboulas et al., 2001).*

2.1 Phase 1: The railway business and regulatory environment

It consists of two steps that are analysed below:

Step 1 – Reconnaissance **:** The reconnaissance step comprises the background analysis of where, in the current context of railway business and regulatory environment, the IM fits. The goal of this initial step is to place IMs in the right context of current practices. Thus, the IM should gain an appreciation of the following (analysed as sub-steps):

Sub-Step 1.1. Study of the competitive environment/landscape: A need arises to carry out a study, if not already available; to identify how exogenous forces will impact the railway companies. These forces are mainly the rivalry among modal competitors and bargaining power of railway users and train operators.

Sub-Step 1.2. The railway dynamics of today: After gaining an understanding of the competitive environment, the dynamics of the railway sector should be assessed from the viewpoint of a liberalized market "player". This will judge the IM's position in the current situation and will provide a first notion of the emerging opportunities in view of the forthcoming changes in the railway industry.

Sub-Step 1.3. The challenges and opportunities: Findings of the previous step will help identify the changes that present opportunities to IMs for new ways of doing business (particularly with private enterprises). This means that the issue of attractiveness to the private sector has to be addressed.

Sub-Step 1.4. The impacts of new regulation in the railway industry: The above will be scrutinised in view of the consequences that recent EU and national legislation and policies have on European railways (at national and/or international level). It will assess the impacts that general regulatory frameworks (transport deregulation, privatisation, etc.) and *changes in railways legislation (specific EU Directives, etc.) are expected to have on IMs.*

Step 2 –Assessment of IM position in the railway industry

This step entails a background search for defining where the IM stands in the full range of railway sectoral and organizational/institutional models. The aim of this step is to identify, if this is not already known, the current structure of the railway sector in which the IM operates and the organisational and/or business model of the IM.

Sub-Step 2.1. Definition of the sectoral structure: It identifies the key dimensions of the railway sector in which the IM operates. Thus, the profile of the "ideal" IM that operates in the current environment can be drawn. The key dimensions considered are:

- Level of Integration (vertical or horizontal)
- Ownership status
- Degree of change (or degree of adjusting to EU regulations) and
- Orientation, i.e. production, commercial and market oriented railway.

Sub-Step 2.2. Definition of the organisational structure: After the railway structure is determined, the organisational model of the IM should be assessed, to obtain a first estimate of its ability for change. Thus, the IM profile is drawn with respect to competence, goals, hierarchy and procedures.

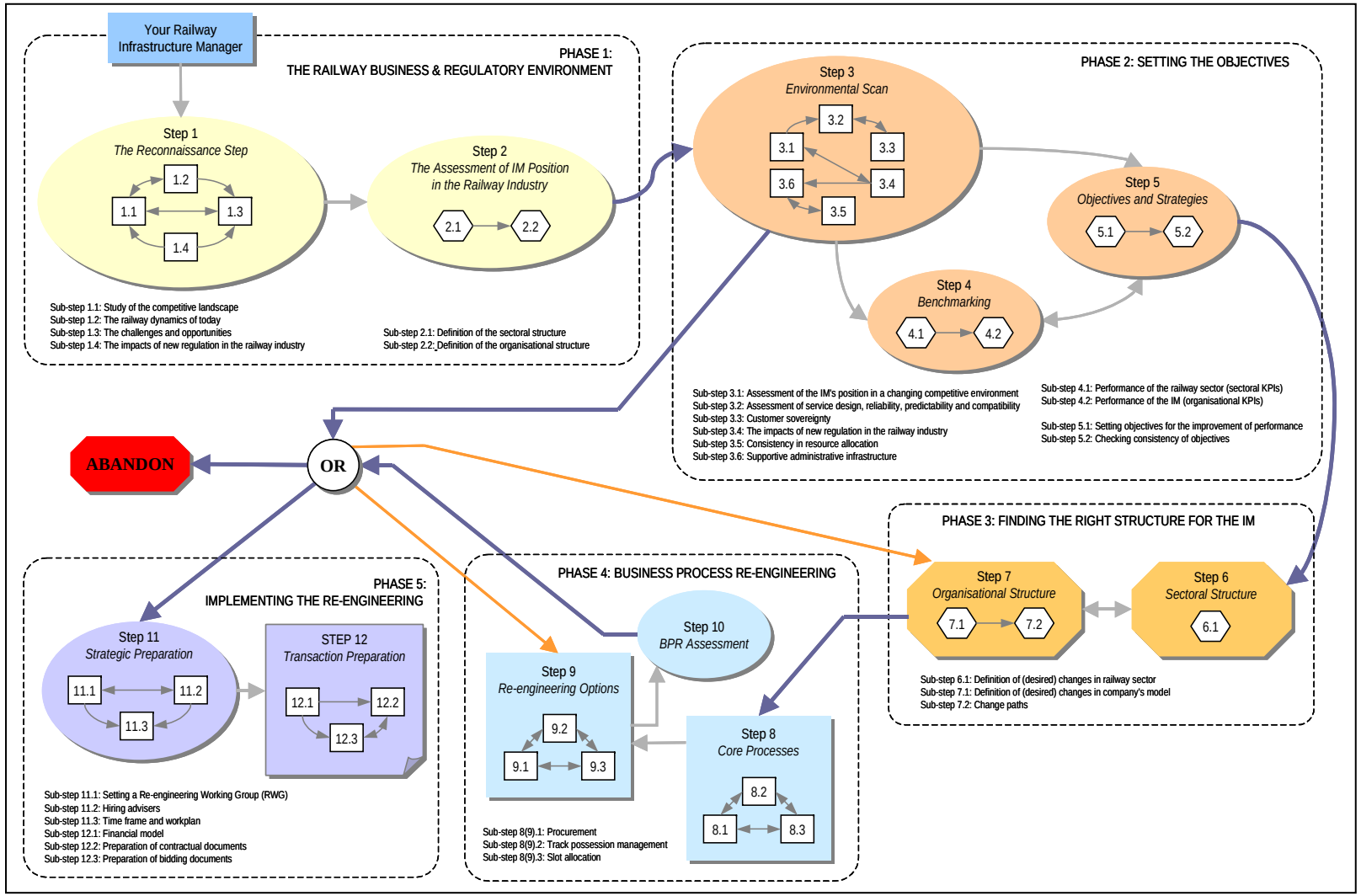

Figure 1 The BPR Methodology

2.2 Phase 2: Setting the objectives by IM

Phase 2 provides an overall description of the BPR objectives and the IM's strategies for the future, attracting its dynamic competitiveness and redirecting its competencies. It consists of three steps that are analysed below:

Step 3 – Scan for the Environment/area of business operations

Strategic refocusing entails a periodic environmental (related to the environment of operations) scan, which the top management team initiates and disseminates among all employees. The aim of this step is to assess the IM's business environment in order to define the scoreboard on which the IM's progress will be measured. The environmental scan and the subsequent action agenda would typically include the following components:

Sub-Step 3.1. Assessment of the IM's position in a changing competitive environment: IM can be categorised in three groups according their orientation towards: Production, Commercial aspects, Market. Also, it assesses the IM's position among these orientations.

Sub-Step 3.2. Assessment of service design, reliability, predictability and compatibility with customer needs: If re-engineering is done to meet the needs of the customers (mainly train operators), then inquiry into specific customer needs and requests is essential. This means surveying, interviewing, observing and measuring user requirements.

Sub-Step 3.3. Customer sovereignty: Recasting a traditional railway culture involves developing new customer supportive behaviour and adopting customer-oriented values.

Sub-Step 3.4. The impacts of the new legislation in the Railway Industry: Once the customer dimension in the BPR is taken into account, IMs must identify and assess the impacts of the new legislation in the Railway Industry. In doing so, they investigate whether there are resources and competencies available to cope with the new situation.

Sub-Step 3.5. Consistency in resource allocation: Once the IM has adopted a specific strategy to serve adequately a set of customers and to develop specific competencies, then resource allocation decisions are made. These should support the strategic development actions as planned by the IM.

Sub-Step 3.6. Supportive administrative infrastructure: The IM should be continuously reinvented to reinforce the primary mission, i.e. creating value for IM customers. In a market-focused IM organisation, it is crucial to set administrative infrastructures to support decision makers in responding to market needs and to improve internal-external relationships (amongst departments and with customers).

Step 4 – Benchmarking

Business processes (current and the ones resulted after the application of BPR) are benchmarked. Railway infrastructure companies must examine how strategy and re-engineering complement each other. Benchmarking tools provide reference points for defining ambitious, but achievable, performance goals and also support railway IMs in understanding the methods used by other IMs for improving their business processes.

Sub-Step 4.1. Performance of the railway sector (sectoral KPIs): To perform the benchmarking of the railway sector of interest to IM, the key process indicators (KPIs) that characterise the performance of the railway sector should be collected and analysed. The KPIs considered in the methodological framework are shown in Table 1 (measurement units are given in parentheses).

Sub-Step 4.2. Performance of the IM (organisational KPIs): In order to benchmark the railway organisation performance, the IMs must specify the Organizational Key Process Indicators (OKPIs) so as to reflect the anticipated changes of performance, after changes are implemented. The proposed OKPIs are shown in Table 1 (measurement units are given in parentheses):

Table 1 Sectoral and organisational KPIs

Sectoral KPIs	Organisational KPIs
Productivity (thousands of train km/total railway employees)	Quality (% trains on time)
Service Quality (% trains on time)	Productivity (train km/employee)
Network Coverage (km/head of population)	Profitability (% cost coverage)
Subsidy (% cost coverage)	Growth rate (% over 5 years)
Labour Cost (% cost/national average industrial rate)	Diversification (subsidiaries in road transport)
Operations Cost (€ per train km)	Passenger modal share (% total passenger traffic)
Payroll Cost (€ per train km)	Passenger fares (Euro per km)
Profit (% total cost coverage)	Non-transport revenue (% total revenue)
Asset Utilisation (thousands of train km/route km)	Payroll cost (Euro per train km)
Growth (% net asset value/gross asset cost)	Asset age (average years)
Learning days (training/employee)	Network utilization (train km/network km)

Step 5 – Objectives and Strategies

Business Process Re-engineering is only to be undertaken after a full and complete assessment of IM objectives. IM should check whether the KPI values set in the previous step indicate conflicting objectives or strategies. In order to define the objectives and strategies IM should exert the following aspects (analysed as sub –steps):

Sub-Step 5.1. Setting the objectives for the improvement of performance: A survey of objectives from the European IMs has been done. These results should be considered as a guide for setting up the objectives for BPR rather than as a rule.

Sub-Step 5.2. Checking consistency of the objectives by examining the underlying strategies: Finally, the IM should check whether the KPI values set in the previous step indicate conflicting objectives or strategies.

2.3 Phase 3: Finding the right structure for IM

There are several possible structures after the application of BPR. These may fall within the general structures envisaged for IMs by the European regulatory frameworks. Hence, an assessment of the organizational structure of European IMs is essential in order to gain a better view of the organizations' adaptability to change. This task is performed in phase 3 of the methodology and more specifically in steps 6 and 7 that follow.

Step 6 – Sectoral structure

The methodological framework identifies the territory of possible railway sector structures, using the scenarios approach. Thus, the IM should try to identify where in this range of possible structures it operates or will operate. The main sectoral structures considered are:

- *Regulated Structure:* railway is completely dominated by the State, which usually implies vertically integrated structures, state ownership, production oriented strategies and minimum adjustment to initiatives towards liberalization.
- *Limited-competition Structures***:** similar as above, but with some recognition of market competition forces. A typical, but not exclusive, example includes public ownership and in some cases private participation, commercial orientation and reactive behaviour towards liberalization initiatives.
- *Deregulated structure***:** the regulated functions are replaced by mechanisms, which are sensitive and responsive to market forces. The railway sector becomes responsive to the market and customer satisfaction turns out to be the primary objective.

Sub-Step 6.1. Definition of (desired) changes in railway sector: In addition to the analysis of railway's current structure, IMs need to define the desired structure of the railway sector, in which their companies would have better means to operate. There are two main drivers in this process, each one leading to a different direction: the Excessive government control and the complete absence of government involvement, which might lead to overexploitation and reduction of reliability.

Step 7 – Organisational structure

The next step in the methodological framework is the definition of the IM organizational structure. Concisely these structures are:

- *Bureaucratic Structure:* IM is driven completely by Government, sometimes as a branch of the civil service, with a very rigid line of command, objectives based on output statistics, major strategies and policies defined by Government and little freedom to operate outside these tight parameters.
- *Autocratic Structure:* similar, but with more emphasis in acquiring power and growth by acquisition (integration). Reduction of regulation is usually an objective, which sometimes is associated with incentives for top management.
- *Commercial Structure***:** is characterized by IM's recognition of the market introduced at the lower levels. Objectives incorporate business targets, within Government strategies and policies such as quality and consistency. The management will have some freedom on marketing activities.
- *Organic Structure:* the production functions are replaced by business sectors. Government objectives are based on financial and service delivery parameters and will be more closely related to business targets set within the railway organization.

Based on where the current IM's structure is, two steps are taken for further analysis:

Sub-Step 7.1. Definition of (desired) changes in company's model: It requires an assessment of the desired organizational structure of the IM, in order to identify appropriate change paths. To do so one needs to gain insight into the organization's resistance to change and understand the mechanisms that increase the change force. Resistance is proportional to how close an IM is to traditional command structures. Change force is reversibly proportional to how active or consistent the IM has been in progressively adopting more advanced organisational models.

Sub-Step 7.2. Change paths: Based on the above, the change path that is more likely to facilitate the process of organisational change is identified. The most common change paths are: Bottom Up experimentation, Top Down experiment, Radical Leadership, Goal cascading, Core Process Reengineering, Organisation Realignment, Rapid Adaptation, Autonomous restructuring, Downsizing and restructuring *(PRORATA, 1998).*

2.4 Phase 4: Business process re-engineering

IM should be able to improve the performance in many different ways. These are the change paths described above. One of the change paths is re-engineering of core business processes. Phase 4 consists of three steps:

Step 8 – Core Processes

In order to get the most benefit from BPR it is important to select appropriate processes for re-engineering and to decide in which order to re-engineer them. There are three main criteria used to help in the selection of the key processes for re-engineering:

- Where in the organisation are the most serious problems?
- Which are the most important processes to the successful running of the company?
- Which processes provide the best opportunities for successful redesign?

Three main categories of core processes are identified for a railway organisation a being: operational performance (i.e. day to day operation), managerial performance (i.e. role and effects of corporate organisation) and commercial performance (i.e. interactions with external organisations and bodies).

Based on these categories, the following business processes were considered as of utmost importance:

- Asset Management: mainly track maintenance, possession management etc.
- Charging: mainly allocation of slots to freight operators.
- Procurement.

In principle, the identification of Core Processes is industry-dependent. The selected processes are described in more detail in the following sub-steps:

Sub-Step 8.1. Procurement: the rail industry has rules and controls affecting procurement, and they are governed by specific safety and quality standards. Beyond this level, however, some IMs have restrictions as to where large, or even small, purchase orders can be placed. Notwithstanding the need for adherence to EU Directives concerning open tenders for government orders, some IMs operate under guidelines determining that orders must be placed in-house wherever possible (such as the "make or buy" culture found in many organisations). In such instances cross-departmental processes are vital to ensure that procurement meets and indeed anticipates the demand created across the IM, and that all internal resources are adequate to meet these needs.

Sub-Step 8.2. Track Possession Management: Naturally, also in commercially oriented and market oriented companies track possession management takes place. But since in more production oriented rail infrastructure managers other processes such as charging and procurement are less developed, track possession management has been chosen to be discussed in this respect. For a common understanding of the term, the definition of track possession management is phrased as:

The (set of) process(es) to obtain the slots, necessary to efficiently maintain, renew or expand the rail infrastructure.

They are the result of a certain predetermined maintenance or renewal need or of a specific investment program. Unplanned track possessions exist as well. They occur when corrective maintenance has to be carried out. Because of the unexpected character of this type of possession, they cannot be planned or managed in advance.

Sub-Step 8.3. Slot Allocation: The principles behind slot allocation are at the core modern infrastructure management. In order to provide a genuinely responsive and dynamic service, the IM needs to ensure that it provides non-discriminatory access to all current and potential freight operators that wish to use its network. However this access is subject to a number of considerations. A vital aspect of concern to IM's is the balance between passenger and freight traffic over the network. Traditionally (at least during the latter half of the 20th century) the emphasis has been on passenger services, not least in order to lessen the environmental impact of increased private car usage. IM's need to ensure that freight receives its due attention, and that the processes governing allocation of route slots are efficient enough to optimise this modal choice. Slot Allocation processes vary in complexity significantly, and the number of operators competing for bids determines most of the variation. Market-oriented IMs tend to have (or at least permit) multiple genuine freight train operators. Also, besides the social desirability of incumbency that ensures consistency of service, the IM attempts to liberalise access to slots. In operationally oriented IMs there is frequently a monopolistic – usually state-owned - freight train operator. The occasional specialist operator can function in this environment (where allowed), but otherwise the process of slot allocation is a traditional one rather than the "market place" envisioned by the Directives.

Step 9 – Re-engineering Options

Having analysed the selected core processes the next step is to identify the re-engineering options that can be used to improve the performance of the IMs.

Step 10 – BPR Assessment

The main purpose of this step is the development of an evaluation framework to assess the performance of a railway infrastructure manager, as well as the impacts on the IM performance from the chosen BPR strategy resulting from the implementation of the EU Directives.

The evaluation methodology includes four criteria for performance assessment: a) business performance improvement, b) organisational effectiveness, c) user acceptability, for several items, always subject to d) conformity with EU and country regulation. The main procedures in this step are:

- To measure the performance of IMs against the assessment criteria, before and after;
- To aggregate scores (performances) and to compute an overall index;
- To decide whether the anticipated changes justify the resources and effort spend

2.5 Phase 5: Implementing the IM re-engineering

For the implementation of IM re-engineering two main types of preparations should be made; they are presented in steps 11 and 12 respectively.

Step 11 – Strategic preparation

Because of the wide-ranging implications for the IM when BPR is applied, the decision to embark on the path to re-engineering must be an initiative fully supported at the highest levels of company's administration. Once the principle is agreed upon by the Administration, an effective way to overcome the traditional difficulties is to set up an Interdepartmental Working Group (IWG) under the chairmanship of a high level company official, and give it an explicit mandate.

Sub-Step 11.1. Setting a Re-engineering Working Group (RWG): The Interdepartmental Working Group will have to define the objectives of IM re-engineering, have them approved by the Management. In addition, he has to prepare a Mission Paper that will propose the new institutional framework within which the sector will develop.

Sub-Step 11.2. Hiring advisers: IMs often lack the full range of expertise to carry out complicate tasks for BPR in house. Hence they contract out such tasks to external advisers. Managing these advisers then becomes a primary task of the IM.

Sub-Step 11.3. Time frame and work plan: For the sake of efficiency, it is advisable to give explicit deadlines to the work of the IMs. The time frame for conceptualising and implementing re-engineering, however, must be realistic. A six-month period is likely to be the minimum time required to establish a company re-engineering strategy and secure agreement on it from various stakeholders. This phase may extend up to twelve months in more complex institutional and operational environments. Implementing the re-engineering itself -including transforming public IM authorities, setting up preparatory bodies as needed, preparing transactions and closing contracts- may require between one to two years, assuming no political disruptions occur. Altogether, a two to three-year time frame between the inception of the re-engineering process and the time when the new IM organization is up and running would seem a reasonable reference.

Step 12 – Transaction preparation

It results in the development of tendering processes, which are transparent, open and competitive. There are numerous details that must be attended to, as any IM re-engineering initiative moves into its final stages. Dozens of documents and analyses must be prepared and made available to the public and prospective investors and train operators, the key among them being described below.

Sub-Step 12.1. Financial model: Financial modelling should help the IMs to identify the transactions that will eventually prove attractive to private sector partners, while providing them with the revenue streams they need to meet their own financial obligations.

Sub-Step 12.2. Preparation of contractual documents: The IM should next draft the contractual documents defining the operational and financial relationships between and among the contracting authority, the regulatory authority and the private operators.

Sub-Step 12.3. Preparation of bidding documents: In addition to the proposed draft contract, the tendering documentation should include all documents pertaining to the organization and rules governing the bidding process.

3. Description of the toolbox

As already mentioned, the Toolbox is computer software that facilitates the implementation of BPR in IMs'. It can provide to its users with decision support tools, tested and proved institutional re-engineering tactics and guidelines which represent "best European practice". The main audience for the Toolbox is predominantly (but not exclusively) executives within IMs who are responsible for planning for the creation of value. The Toolbox will also be of interest to other government officials and to stakeholders within railway service companies, forwarders, railway consultants and transport businesses dependent on railway services. The Toolbox is made up of six modules. Each module corresponds to a separate phase of the methodology, except Module 1 which is only a means to provide a context for understanding the subsequent modules.

3.1 Main window

The Toolbox has been designed to eliminate complexity in identifying the best-suited re-engineering path to improve performance of IMs. This is achieved by offering a user-friendly Windows interface. Toolbox's Main window provides users with a platform to communicate with the system. On the main window users can find:

Menus	Provides Menus to activate commands
Toolbar	Provides Buttons to activate commands
Status bar	Displays Session information
Treeview	Displays the hierarchy of topics
Info area	Displays the contents of the selected Module
Pad	Provides an area for the user to take quick notes
Messager	Displays system messages

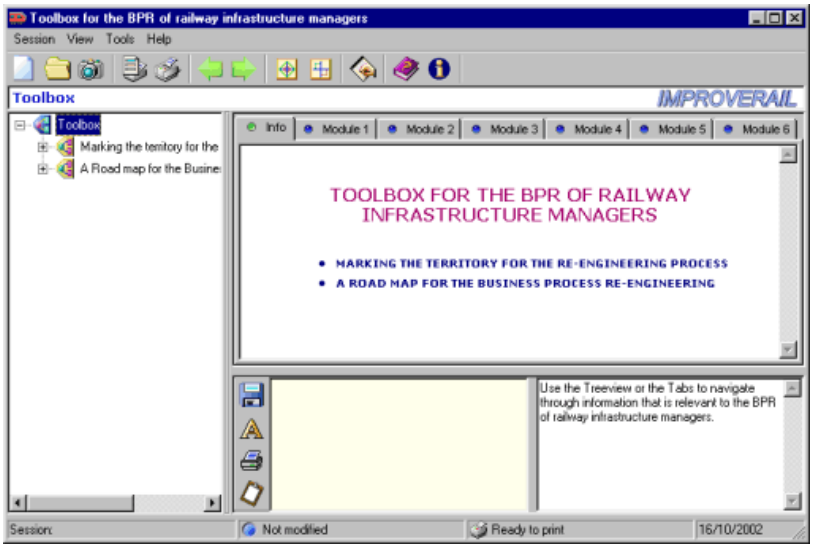

Figure 2 Toolbox's Main Window

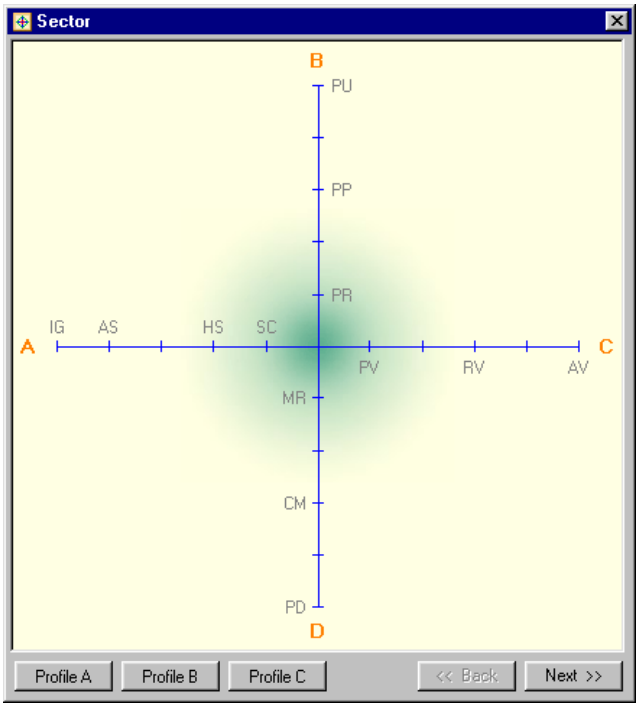

Figure 3 Sector Form

3.2 Forms

Sector form: The Toolbox's Sector form provides users with the ability: (a) to define the current structure of the railway sector in which the IM operates, (b) to identify possible drawbacks with respect to the sector's level of performance (KPIs) and (c) to specify desired changes on the four dimensions that are responsible for describing different Sector structures.

In the Sector window the user can deal with Axes and Profiles. There are four orthogonal axes representing different structural dimensions: Axis A represents "Level of Integration", B "Ownership", C "Degree of change" and D "Orientation". Each of the four axes is divided into five divisions (0 - 4, outer to inner).

The index position, caption and label of the divisions is shown (for each axis) below (Table 2):

Table 2 The structural Dimensions

A (Integration)	**B** (Ownership)	**C** (Degree of change)	**D** (Orientation)
0 - Integrated (IG)	0 - Public ownership (PU)	0 - Active (AV)	0 - Production (PD)
1 - Accounts Separation (AS)	2 - Public-Private (PP)	2 - Reactive (RV)	2 - Commercial (CM)
3 - Common holding with subsidiaries (HS)	4 - Private ownership (PR)	4 - Proactive (PV)	4 - Market (MR)
4 - Separate companies (SC)			

At the bottom - left side of the form, there are three Profile buttons. These represent stereotype (default) Railway Sector Structures (profiles) that apply to many existing practices. These are the Regulated (A), Limited competition (B) and Deregulated (C) profiles.

Current structure: In this view of the Sector form, the Current structure of the Railway Sector must be specified. To identify the Sector's structure on the diagram, move each of the

four green Handles onto the desired position. It is recommended that you first read the necessary background information of Module 2. The three Profile buttons, represent default Railway Sector Structures that may apply to the current structure of the Sector. A line passing from the following axes' positions as shown in table below represents each profile (Table 3):

Table 3 Sector Structures - Profiles positions

Axes	Position		
	Profile **A** (Regulated structure)	Profile **B** (Limited competition structure)	Profile **C** (Deregulated structure)
A	0	3	4
B	0	2	4
C	0	2	4
D	0	2	4

Current Structure **Desired Structure**

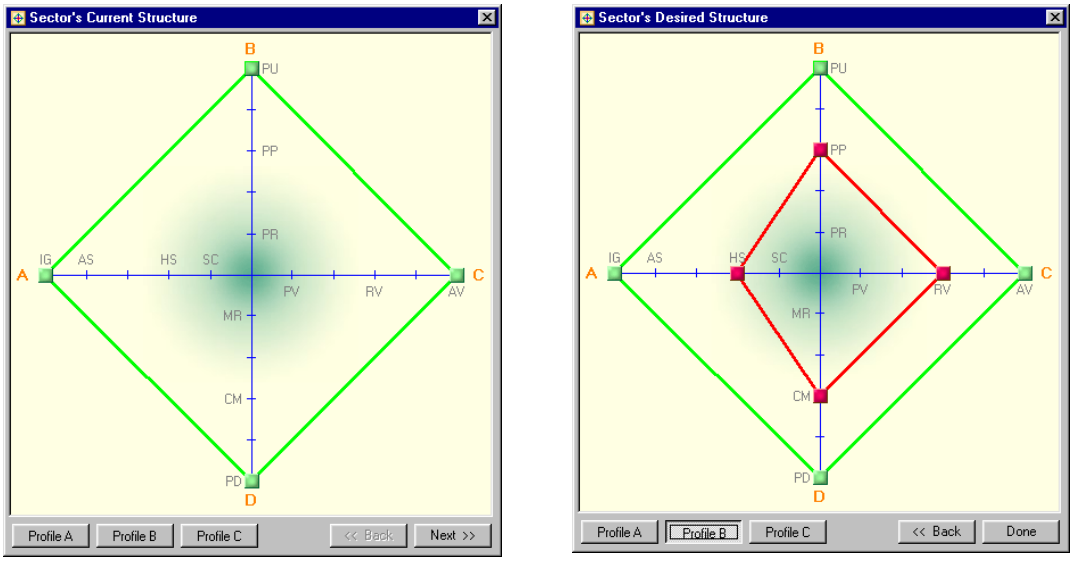

Figure 4 Current and Desired Sectoral Form

After the Sector's Current structure has been specified, the user can click on the Next button to view the Sector's Key Process Indicators (KPIs). The latter may help the user identify short-term operational objectives.

Key Process Indicators (Sector KPIs): In this view of the Sector form, the user must specify the Key Process Indicators so as to reflect the anticipated changes of performance of the railway sector in which the IM operates. It is important that the user has substantial knowledge of the Sector's current performance and a clear view of achievable (realistic) objectives. To set the anticipated value of a Key Process Indicator, the user can scroll the corresponding Scrollbar to the desired value or type the value directly into the textbox and press ENTER. In detail, the following Sector's KPIs (Table 4) are available.

The three Profile buttons represent default ranges of KPIs, which correspond mainly (but not exclusively) to average performances of the Regulated, Limited competition and Deregulated Sector structures. The values of KPIs (Table 5) for each profile are:

After the Sector's Key Process Indicators have been specified the user can click on the Next button to view the Sector's Desired structure. The software will:

(a) automatically measure similarities between the user-defined KPI vector and the three default Profiles and

(b) propose the Profile that is closer to the structure associated with the KPIs set by the user. Similarities are measured by means of the following equation:

$$\cos\vartheta_{ij} = \frac{\sum_{k=1}^{m}(X_{ik})(X_{jk})}{\sqrt{\sum_{k=1}^{m}(X_{ik})^2 \sum_{k=1}^{m}(X_{jk})^2}} \qquad (1)$$

where ***i*** is the user defined KPI vector, ***j*** a default profile and ***m*** the number of KPIs.

The $\cos\vartheta_{ij}$ is a well-established method for measuring similarities between vectors. It varies between 0-1; it is 1 when the two vectors coincide and 0 when they have nothing in common (orthogonal). It is highly recommended that the suggested structure is fine-tuned by the user (after it appears) by moving the red handles to the desired position.

Table 4 Values of sector KPIs

Name	**Range**	**Units**
Productivity	0 - 10000	thousands of train km/total railway employee
Service Quality	50 - 100	% trains on time
Network Coverage	0 - 1000	km/head of population
Subsidy	0 - 300	% cost coverage
Labor Cost	100 - 300	% cost/national ave industrial rate
Operations Cost	0 - 30	€ per train km
Payroll Cost	0 - 30	€ per train km
Profit	0 - 200	% total cost coverage
Asset Utilisation	0 - 50000	thousands of train km/route km
Growth	50 - 100	% net asset value/gross asset cost
Learning	0 - 10	days training/employee

Table 5 KPIs values for profiles

KPI	**Value**		
	Prof A	**Prof B**	**Prof C**
Productivity	3000	5000	7000
Service Quality	60	80	95
Network Coverage	900	500	300
Subsidy	80	10	0
Labor Cost	200	150	100
Operations Cost	20	15	12
Payroll Cost	15	12	9
Profit	0	20	60
Asset Utilisation	10000	20000	30000
Growth	50	60	80
Learning	1	3	8

Desired structure: In this view of the Sector form, the Desired structure of the Railway Sector must be specified.. The software will automatically propose the Profile that is closer to the structure associated with the KPIs set by the user in the previous step. Although this might

be a good approximation, it is highly recommended that the suggested structure is fine-tuned by the user, after it appears, by moving the red handles onto the desired position.

3.3 Organization form

Toolbox's Organisation window provides users with the ability: (a) to define the current organisational structure of the IM, (b) to specify the desired changes in the company's performance by means of the KPIs, (c) to identify overarching objectives and strategies, (d) to establish where this setup leads in terms of organisational structure and (e) to identify best-suited methods to implement the change process.

Key Process Indicators (Organizational KPIs): In this view of the Organisation form, the user must specify the Key Process Indicators so as to reflect the anticipated changes of performance of the IM. It is important that he/she has substantial knowledge of the IM's current performance and a clear view of achievable (realistic) objectives. (The screenshot of the Organisational KPIs is similar to this of sector KPIs)

Objectives and strategies: In this view of the Organisation form, the user can check whether the KPI values set in the previous step indicate conflicting Objectives or Strategies. He/she can also specify the time horizon of the Objectives and be flagged every time targets are set which cannot be supported by existing structures. To set an Objective's time horizon, the user can select the appropriate Node (objective) in the treeview and click the "Short" "Medium" or "Long" term option at the right or press 1 for "Short" 2 for "Medium" or 3 for "Long". The specified horizon will appear as an initial (S, M, L) at the left of the selected Node. After the Objectives have been set and checked for consistency against IM's strategies, the user can click on the Next button to view the company's Desired structure. The software will:

(a) measure similarities between the user-defined KPI vector and the three default Profiles and

(b) propose the Profile that is closer to the structure (organisational model) associated with the KPIs set by the user. Similarities are measured by means of equation 1.

3.4 Modules

Modules provide background information for the various steps of the railway re-engineering process. Users can navigate through the different modules by clicking the right tabs on the top of the Info Area or by selecting the corresponding Node on the TreeView part of the main window. As mentioned in the introduction the Toolbox consists of six modules:

1. Framework module: Sets the stage and links between the other modules that follow
2. Railways business and regulatory environment : Sets the roles and functions of IMs in today's business and regulatory environment
3. Setting the Objectives: objectives that re-engineering is designed to achieve
4. Finding the Right Structure : Different structures and organizational models of IMs
5. BPR: Description of specific mechanisms and options for re-engineering
6. Implementing BPR: Describes how to get from concept to effective implementation

4. Summary and conclusions

The undertaking of business process re-engineering on railway infrastructure managers is a very complicated task, which requires a good level of experience. Best practices provide a frame of reference, but they are usually case-specific and complicated which is not beneficial to decision-making. BPR requires a structure and a systematic way for its presentation, clarification and improved intuitive understanding.

The methodology along with the Toolbox provides such a means for the decision-maker by allowing discerning all the levels of information involved without loosing touch with the rest of the decision-making context.

This systematisation and presentation of the complex information is the Toolbox's most important feature. Other features include its capability to provide users with support in:

- understanding the need for and challenges associated with business process re-engineering in light of the changing business and regulatory environment affecting railway operations;
- choosing among options of suitable organizational structures and analyzing their implications for redefining interdependent, operational and more cost-effective business processes;
- managing procurement, track possession, slot allocation and other important aspects which lie at the hart of the IM's re-engineering problem;
- preparing the transactions needed for any attempt to shift the boundary between the traditional and a more market oriented capacity managing institution.

Last but not least, the Toolbox has been developed using an open architecture, which makes the system easily adaptable to new information (e.g. new processes and alternative re-engineering solutions), just by feeding this information to the database. This is a very important feature, since it makes the tool applicable to more complex decision-situations that might come up in dealing with re-engineering of IMs in Europe and worldwide.

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