

Next Generation Railway Operating Systems

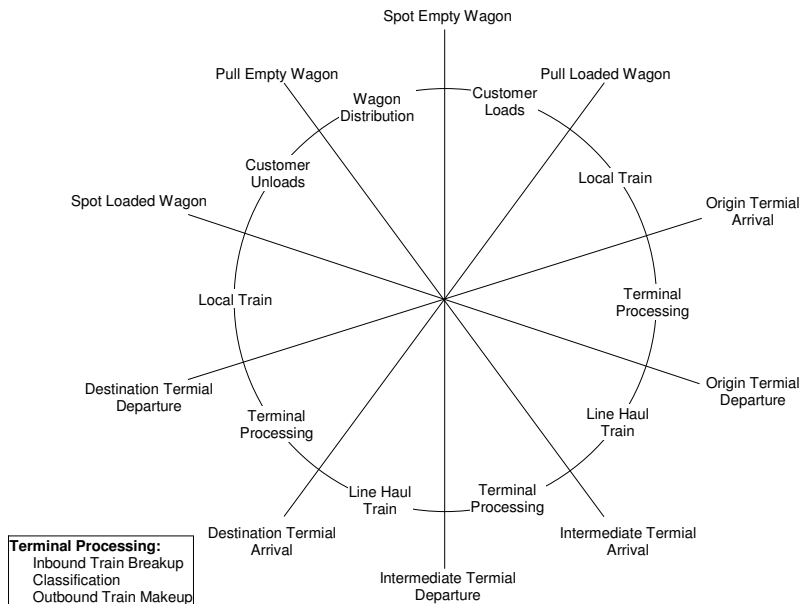
Introduction

This discussion document examines the reach, range,¹ behavior² and business value³ of Next Generation Railway Operating Systems (NGROS), postulates the shape of NGROS, deals with matters regarding its acceptance and implementation, and recommends next steps.

The success and failure of information technology investments over the last 30 or so years has made it clear that investments well-aligned with the business model of the firm have the best chance of achieving the desired outcome.

The railway provides place-time value to the shipper's products through the physical nature of the transportation process. This is what the customer buys and this is unlikely to change to any great degree in the near future.

This place-time value can be represented by the car cycle.⁴



NGROS is concerned with the business system⁵ directly supporting the planning and execution of the car cycle.

Technology trends, particularly at a detailed level, are increasingly difficult to predict – the pace of change is simply becoming too great. It is not too useful to describe NGROS in such detailed terms as Pentium IV running Microsoft XP. Therefore, the technology aspects of NGROS will be described in broad strokes.

¹ Reach and range come from Peter G. W. Keen's *Shaping the Future* (1991). Reach refers to the locations (people and things) linked to; range refers to the variety of functional support.

² Behavior means the underlying behavior of the system. For example, response time and reliability are examples of underlying behavior.

³ Business value is expressed in terms (e.g., revenue, margin, cycle time) understood by railway senior executives.

⁴ *The Railway Value Chain* (1998)

⁵ A Business System comprises people, processes and information.

This paper contains the following:

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The Shape of NGROS

Objective

The objective of NGROS is to improve customer service and asset utilization leading to increases in revenue (through capture of market share) and margin (through more efficient deployment of assets). This will necessitate, in an increasingly interdependent transportation environment, strong linkages between the major players.

Railway Process Integration

First, it will be necessary to more closely integrate the activities of the railway.

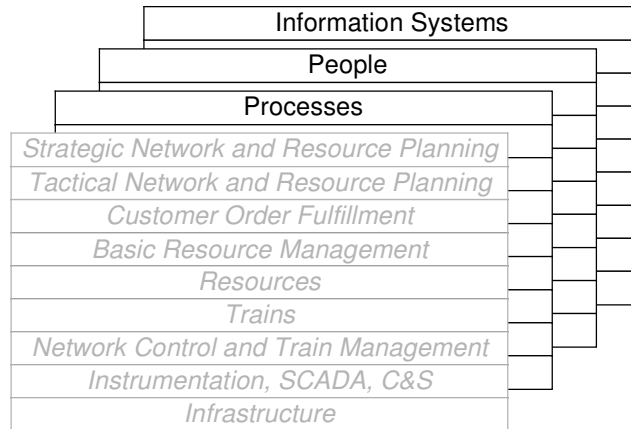
| |
|---|
| Strategic Network and Resource Planning |
| Tactical Network and Resource Planning |
| Customer Order Fulfillment |
| Basic Resource Management |
| Resources |
| Trains |
| Network Control and Train Management |
| Instrumentation, SCADA, C&S |
| Infrastructure |

What has heretofore been a loosely coordinated set of processes associated with the service cycle will need to be more integrated and coordinated. A common view of service, commitment and performance will need to prevail through the structure⁶ shown above. A more holistic approach to planning and execution will need to prevail.⁷

⁶ Some Ideas on the Application of Information Technology to the Freight Railway (2000)

⁷ A number of railways have looked at this. Union Pacific in Project Sunrise, Queensland Rail in Project Impact, and Canadian National in Operating to Plan.

The holistic approach has at its the heart an integrated view of the components of the new solution.

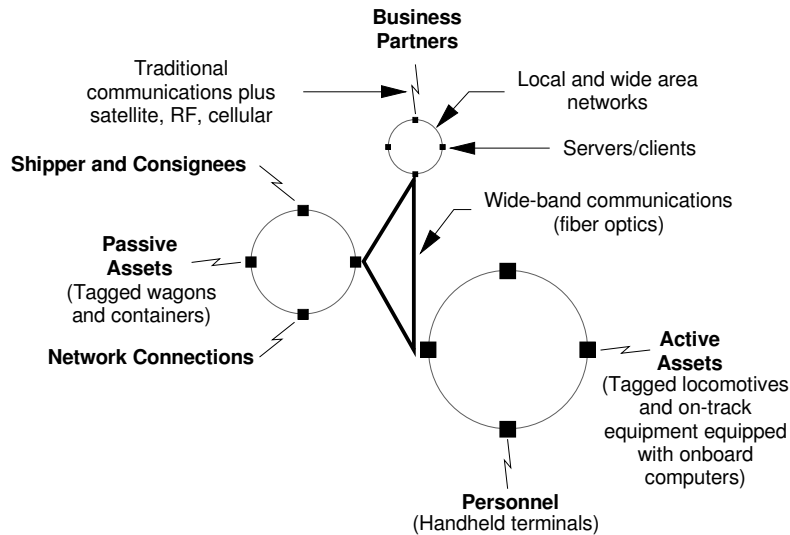


NGROS will feature this sort of integration in thought and action.

Railway Communications Network

Fundamental to success of NGROS will be a network⁸ providing two essential qualities.

1. Everything needing to be managed is always reachable.
2. Everything important is always visible.



The State of Railway Assets

The traditional means -- communications and signals, scanning of tags, and manual entry of information into systems -- of gathering state information regarding assets will continue. Over time an increasing amount of this information will come through additional real-time data capture systems such as the Global Positioning System (GPS) and tags.

GPS, for example, provides for very precise measurement in four dimensions. Tag technology continues to trend in a direction marked by the retail industry's Universal Product Code. One can begin to see how the objective of everything important always being visible may be met.

⁸ 21st Century Railroads and 21st Century Information Technology - First Contact (1996)

An example of currently available components for inclusion in NGROS comes from Sky Eye Railway Services.

“Sky Eye installs sensors and communication equipment on mobile unaccompanied assets such as railcars, containers and swapbodies in order to monitor their location, status and behavior.

Relevant messages are sent from these assets to Sky Eye's data management center where the data is processed, analyzed, and distributed to its customers in user-definable formats.

The resulting information can be retrieved by or transmitted to Sky Eye's customers.

Sky Eye's service includes the monitoring, processing and integration of collected data into the customer's IT infrastructure.”⁹

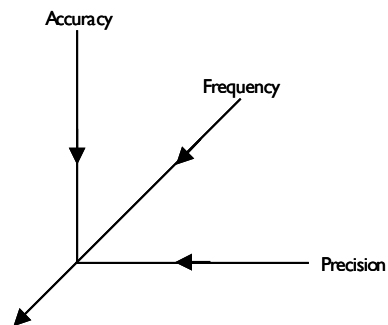
Another example comes from Nexterna.

“Nexterna provides the rail industry with specific solutions for:

- Locomotive Tracking
- Maintenance of Way
- Communication and Signaling
- Customer Service and Work Order Management

Nexterna's rail solutions are fully scalable and designed to help you do more with less. Our modular approach enables you to start with a foundation, like GPS tracking, then add more functionality as you need it. No matter what you need, we provide the entire suite of business applications you need to implement and manage a complete solution.”¹⁰

However, the availability of these proven components begs deeper and more significant questions.¹¹



Does the increasing “fineness” of measure lead to business decisions of value?
What sort of decision support systems are required?

NGROS will also be marked by new decision support systems.

Railway Decision Support Systems

NGROS may well lead to a fundamental redefinition of what railroads are all about.¹²

- From moving shipments and managing assets.
- To movement of customer value.

⁹ <http://www.sky-eye.com/en/products/index.html>

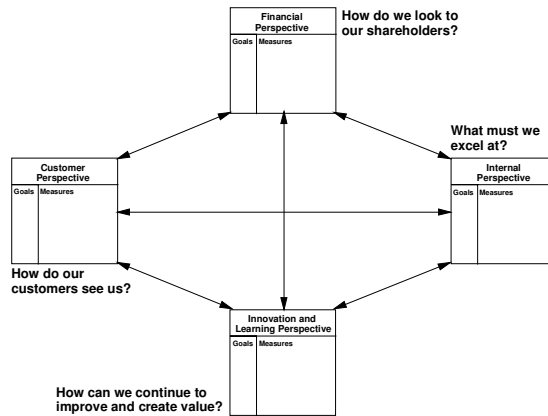
¹⁰ http://www.nexterna.com/industry_solutions/rail/

¹¹ *Ideas to Initiatives to Business Value* (1999)

¹² *An Innovative Business Model for GAR Corporation* (2000)

Next action = f(value to the customer, value of the customer).

It is anticipated that NGROS will also give rise to the implementation of a balanced score card¹³ for the railway.



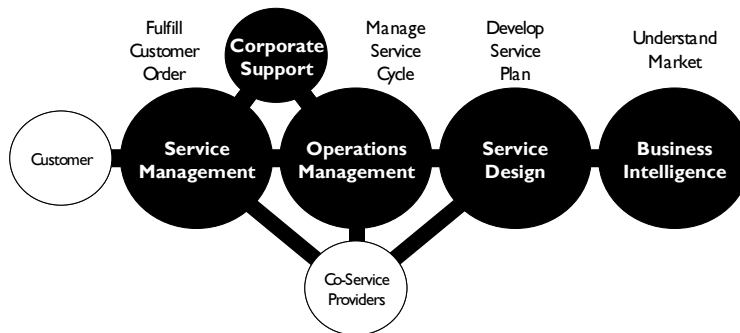
Value to the customer can arise only if NGROS understands and acts on the customer's perception of value. Indeed, as early as 1990 this approach to decision making was being considered.

“To continue to grow, a railroad must offer reliable service - in particular timely delivery. The segments of timely delivery divide into the actions taken on its roads and those taken in its yards. Currently the actions taken in processing cars through a rail yard are largely blind to the time commitment made to the customer about his shipment, the importance of the customer to the railroad and the importance of the shipment to the customer.”¹⁴

Two points are to be made here. First, the concepts and components from which NGROS can be fabricated may well be available. Little invention may be required. Second, far more profound and leading to the next section of this document, is the issue of the relationship with customers required to enable the sort of decision making espoused herein.

Beyond the Railway Boundaries

It will not be enough to form a relationship with the customers; the co-service providers will also be required.¹⁵



¹³ Robert S. Kaplan and David P. Norton, *The Balanced Scorecard - Measures that Drive Performance*, Harvard Business Review, January-February 1992 as depicted in *Ideas to Initiatives to Business Value*

¹⁴ *Customer-Driven Shipment Priority Measures for Rail Yard Decision Making and Yard Evaluation* (1990)

¹⁵ *Ideas to Initiatives to Business Value* (1999)

NGROS is a component of Operations Management linking to the customer through a Service Management process and linking directly with Co-Service Providers. Critical to this linkage is that the parties have a shared definition of the service and the desired outcome, and a shared commitment to excellence of execution in order to deliver these outcomes. NGROS is the railway's business system for delivering on these commitments.

NGROS can deliver business value within the boundaries of the railway and this ought to be the first focus, but the end game is in delivering value lying beyond the railway boundaries.

The linkages will require a common definition for the exchange of messages. An example of such a purpose-built common definition is provided by Transentric in TransXML.

“TranXML, a new extensible markup language (XML) solution, is being proposed as the new industry standard for e-commerce related activities between shippers and carriers. It was created specifically for the procurement and delivery of transportation and logistics services required for supply chain execution. This groundbreaking work to introduce TranXML to the market was accomplished by Transentric, based on the X.12 and XMLSolutions meta data repository. Transentric 's goal for TranXML is to remove barriers and to dramatically increase the use of e-Commerce as it relates to transportation and logistics services.”¹⁶

The Supply Chain

In this context NGROS becomes a key component of a multiparty supply chain whose objective is to put the product at a place and a price such that the consumer finds it more valuable to him than a competing product. This means that:

- It all starts with understanding customer need and it all ends with customer satisfaction. If a firm does a world-class job at both that firm will be a high performance firm reaping all the rewards customarily given firms of this sort.
- It means a cohesive, interdependent bonding of the processes, people, measurement and reward systems, and information technology of the participants in the supply chain.
- It means managing not for the individual needs of a firm, but to the collective needs of the participants.¹⁷

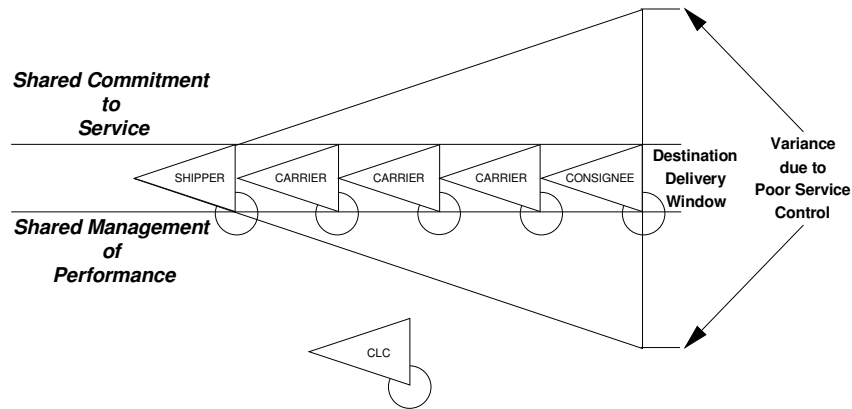
There are major issues associated with moving into the supply chain.

- Management of process across company boundaries.
- People, process, measurement and reward, information technology.

This next chart shows a supply chain as a set of parties all aimed at meeting the destination delivery window requirements.

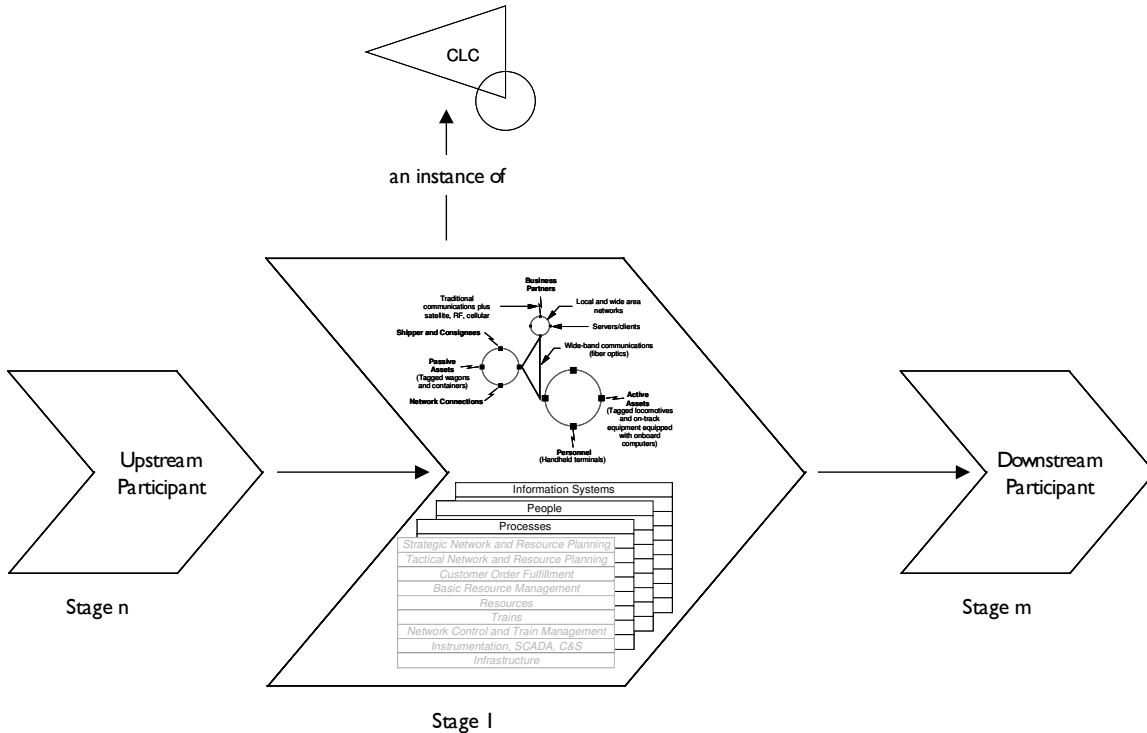
¹⁶ <http://www.transentric.com/products/commerce/tranXML.asp>

¹⁷ *Ideas to Initiatives to Business Value* (1999)



The CLC in the above graphic refers to the notion of Closed Loop Control exercised at every critical point in the service cycle assuring continual tuning to the destination delivery window.

Summing Up the Shape



NGROS is an instance of closed loop control and comprises integrated processes and data coupled with a network that enables visibility and control of the objects critical to planning and execution to provide the desired service.

Stage I of NGROS will have a focus internal to the railway. Stage n and m, with no indication which will come first, will integrate NGROS into the larger value chains.

NGROS will display behavioral characteristics¹⁸ such as:

- No interruption of service to the user under any circumstances.
- An ability to recognize and adapt to any change in, or change of, a resource in the infrastructure.

¹⁸ The Intelligent Environment Project (1990)

- Automatic recognition of a user and configuration to meet the user's needs.
- An ability to match performance of the infrastructure to the needs of the supported processes.
- Self-assessment of performance against criteria coupled with an ability to suggest opportunities for improvement.
- Translation of user needs directly into executable processes.
- Horizontal integration of multiparty supply chain management systems and vertical integration of management information, and command, communication and control systems.
- Usefulness and usability.

IT Process Management

Assuming, for the moment, implementation, a business system focused on evaluating, maintaining, exploiting and enhancing NGROS is required. Something along the lines of the IBM *IT Process Model*¹⁹ is appropriate. This model comprises:

1. Satisfy Customer Relationships: Focuses on communication with customers. Encompasses understanding needs as well as supporting and satisfying customer requirements.
2. Provide Enterprise IT Management: Plans and creates a system for managing IT within an enterprise.
3. Manage IT Business Value: Ensures that the enterprise receives a return on the investment it has made in information technology.
4. Realize Solutions: Produces (creates/enhances/maintains) system solutions. Solicits customer agreement on their suitability for deployment.
5. Deploy Solutions: Introduces changes to the IT environment in a way that minimizes disruptions to that environment.
6. Deliver Operational Services: Provides agreed-upon IT services to customers. Represents the culmination of all previously occurring activities.
7. Support IT Services and Solutions: Provides operational support to assure continuity of operations. Supports a focus on high levels of customer satisfaction. Provides capabilities that improve operational efficiencies.
8. Manage IT Assets and Infrastructure: Builds and manages the infrastructure necessary to control IT assets, including hardware, software, and people.

Business Value

NGROS is sensible to the extent that it results in attracting additional share of the customers' external spend on transportation, and lowers the operating ratio leading to improved margins.

Transportation Spend

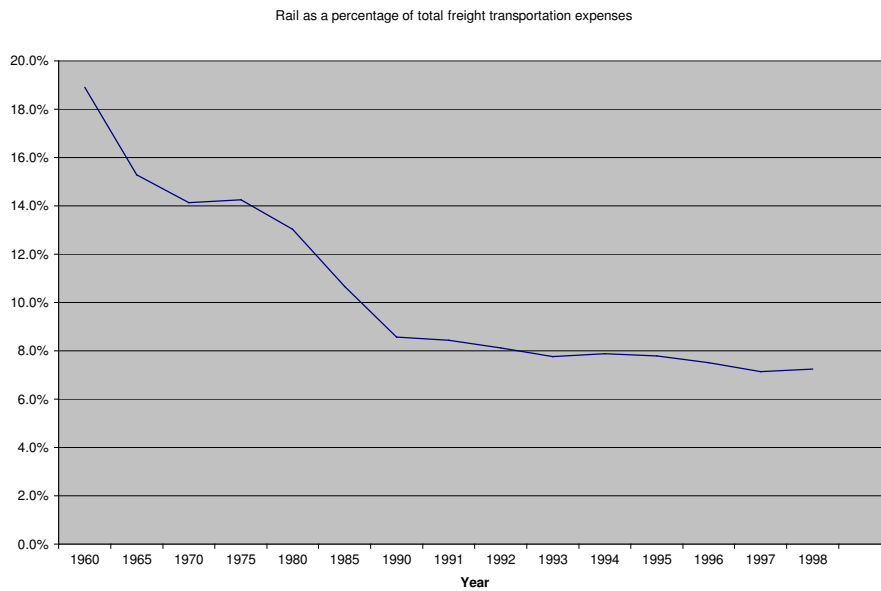
In 1998 railways had 6.7% of the US freight transportation market.²⁰

¹⁹ IBM, *Managing information technology in a new age*, IBM G510-1178-00, June 2000

²⁰ *National Transportation Statistics 2000*, US Department of Transportation, Bureau of Transportation Statistics

| | 1998 \$B | % of Total |
|--|----------------|---------------|
| Freight transportation expenditures | | |
| Highway | | |
| Local, truck | 144,276 | 27.3% |
| Intercity | | |
| Bus | 141 | 0.0% |
| Truck | 282,814 | 53.4% |
| Total highway | 427,231 | 80.7% |
| Air total (domestic and international) | 24,523 | 4.6% |
| Rail total | 35,294 | 6.7% |
| Water total | 22,565 | 4.3% |
| Oil pipeline total | 8,656 | 1.6% |
| Other total | 11,100 | 2.1% |
| Total freight transportation expenditures | 529,369 | 100.0% |

I note, in passing, that railways exhibit a long-term trend in loss of share.



Please note that this chart can confuse if one doesn't notice that the data is every five years from 1960 to 1990, then every year thereafter. During this 1960-1998 period total freight transportation expenditures grew from \$47,767 to \$529,369 billions, a factor a bit over 11.

The present business world values reliability and speed. To the extent that NGROS can address these two values, then the railroads can reverse the divergence of trends mentioned above.

Lower Operating Ratio

This table comes from the annual reports for the major carriers for 2000.

2000 Operating Ratios for the Major North American Rail Carriers

| | OpRev | OpExp | OR | OpExp at Best OR | OpExp Change |
|-----------|--------|--------------------|-------|------------------|--------------|
| BNSF | 9.205 | 7.097 | 77.1% | 6.410 | 0.687 |
| CN* | 5.428 | 3.780 | 69.6% | 3.780 | 0.000 |
| CP* | 3.655 | 2.810 | 76.9% | 2.545 | 0.169 |
| CSX | 6.075 | 5.460 | 89.9% | 4.231 | 1.229 |
| NS | 6.159 | 5.526 | 89.7% | 4.289 | 1.237 |
| UP | 11.900 | 10.000 | 84.0% | 8.287 | 1.713 |
| | | | | | 5.036 |
| \$CN/\$US | 0.6402 | WSJ 6 October 2001 | | | |

* CN and CP figures are in \$C except for the column labeled OPExp Change. Numbers on this rightmost column have been converted to \$US using the conversion factor shown.

If these railroads all operated at the best OR of 69.6% (CN) then approximately \$5 billions could potentially have moved to the bottom line in 2000.

The financial reward exists at the industry level, but may not be sufficiently strong at the individual railway level to motivate action.

Acceptance

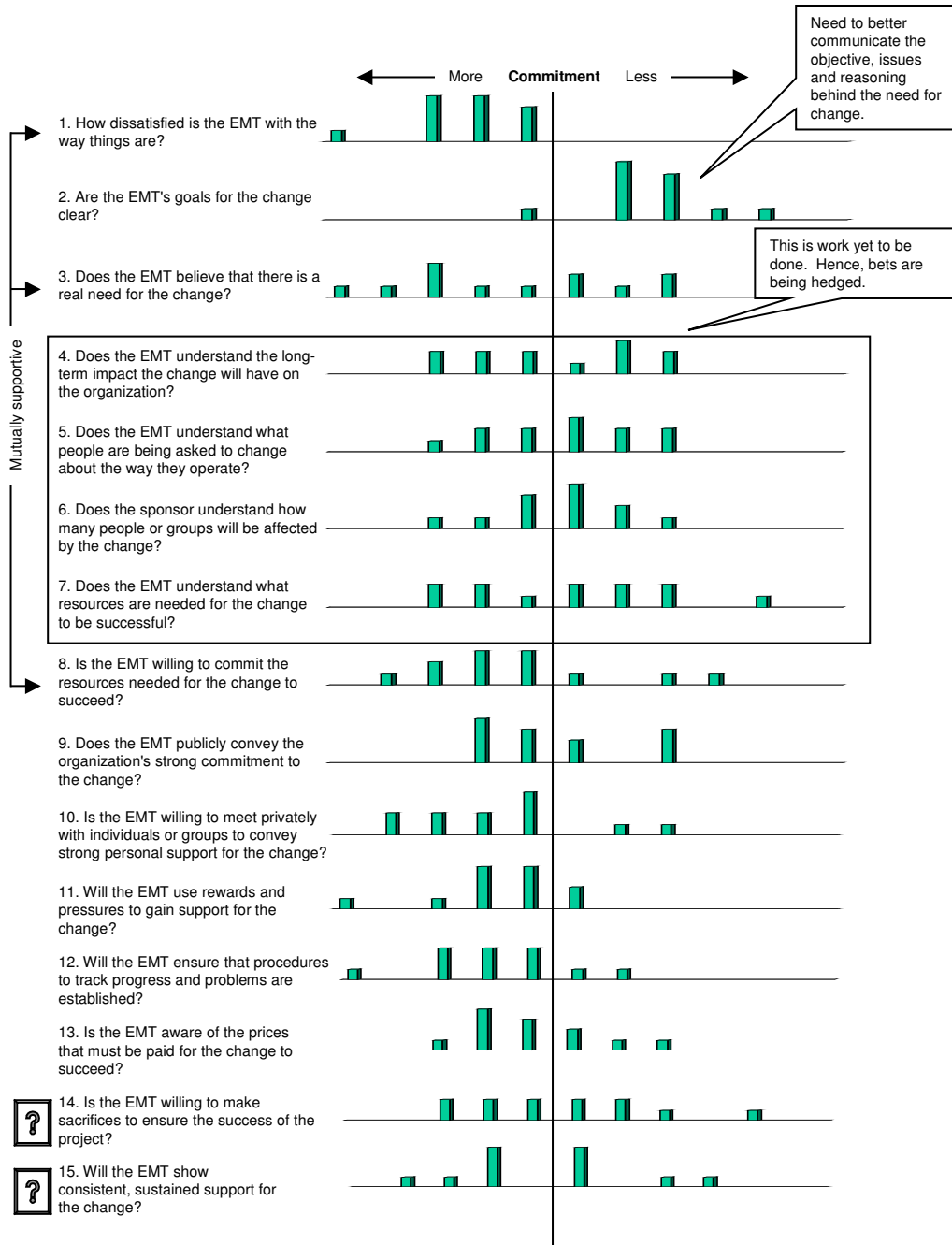
That NGROS could be built and maintained in pursuit of the business value noted above may not be enough. The potential outcome of NGROS needs to be sufficiently aligned with senior executive agendas to compel their commitment and support.

One needs to assess this commitment and support before proceeding too far down the NGROS path. It is thought that in least two of the three cases cited on page 2 progress was not made due to lack of senior executive commitment and support.

There are a number of ways in which this commitment and support can be assessed.

For example, in one project the following arrangement was used to draw conclusions regarding the commitment of the executive management team to the project.²¹

²¹ Information Technology Enabled Business Value (1999)



Change of the magnitude of NGROS is unlikely to happen without executive acceptance, commitment and support.

Another way to approach this topic is to consider the experience accumulated by the IT industry as a set of critical success factors. Then one asks whether a success factor is critical to the specific situation under consideration, and whether this factor is or can be made to be present.

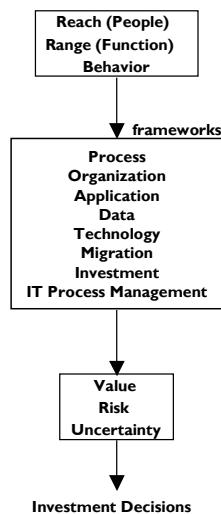
For example, consider the following list:

1. Executives must be aligned on issues, needs, priorities, actions, resource commitments and realistic schedule expectations.
2. The initiatives must support the business strategy.

3. Executives must exhibit e-business ownership, leadership and evangelism.
4. Process owners with project responsibility must come from the business, not IT.
5. Effective and efficient communications amongst all interested parties.
6. Instantiation of the e-business culture throughout the firm.
7. Focus on multifunctional core processes, not functional silos.
8. Involve the real users of the processes to document, assess and confirm the "as is" and "to be" scenarios---obtain their buy-in and support.
9. Appropriate numbers and levels of skills; appropriate levels of investment of time and money.
10. Alliance with key e-business technology providers.
11. Adaptive e-business infrastructure and management processes.
12. Execution of the e-business plan.
13. Use a proven, professional methodology for process improvement, system development, implementation and outsourcing operations.
14. Develop I/T architecture based upon enterprise requirements.²²

If one concludes these factors to be relevant and the chance of them being present is small, then the likelihood of success is also small.

Acceptance also implies a more formal specification of NGROS as a set of investment decisions resulting from the review of reach, range and behavior through a number of frameworks.



The frameworks are considered under conditions of value, risk and uncertainty to arrive at the final investment decisions. The data gathering, analysis and synthesis required to arrive at the frameworks, then their subsequent evaluation to render investment decisions, is a significant effort in its own right.

Next Steps

NGROS is an undertaking of significance in terms of changes required in:

1. Processes: processes will be retired and combined, and new processes developed.
2. People: skills and the manner in which the skills are organized.

²² *Business Alignment and Application of IT* (2000)

3. Information: applications, data and the business system to manage these.

Probably the most significant changes of all will need to occur in the fabric of the culture of the railroad and, as it begins to exert influence beyond its traditional boundaries, the culture of its customers and co-service providers.

This is not a casual undertaking.

“The hardest single part of building a software system is deciding what to build,” observes computer software design pioneer Fred Brooks, author of the classic *The Mythical Man-Month*. “No other part of conceptual work is so difficult as establishing the detailed technical requirements....No other part of the work so cripples the resulting system if done wrong....Therefore the most important function that software builders do for their client is the iterative extraction and refinement of the product requirements.”²³

What Brooks has eloquently said can be shortened to a prescription for thought, and lots of it, before a spade is turned for NGROS.

The first steps need to include serious discussion amongst the critical parties as to whether NGROS can be achieved and whether the business value is attainable in a reasonable period of time.

The efforts of other railways at looking at NGROS have been mentioned earlier (page 2). In a recent project²⁴, the railway identified five near term strategic development areas:

1. Control of daily train operations
2. Customer interfaces
3. Cost exposure in Train & Engine labor claims processing
4. Cost and risk exposure in safety management
5. Communication of train bulletins and work orders

It seems that the opportunity exists to do a better job at railway operations. The concepts and components from which NGROS can be built are available. Skills, knowledge, and experience are present. The compelling business reason seems to be evident.

Whether all this is enough to cause, at a minimum, thought, and at the maximum, action, remains to be seen.

James Drogan
Westport CT
December 26, 2001

²³ Michael Schrage, *Serious Play: How the World's Best Companies Simulate to Innovate*, Harvard Business School Press (1999) p. 15

²⁴ *Business Alignment and Application of IT* (2000)