SOME GLOBAL TOUCHSTONES IN RAILWAY ADAPTATION

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ABSTRACT

More than three quarters of the world's railways are constrained in various ways. The authors aimed to develop touchstones to give stakeholders insight into present positioning, and guidance regarding requisite adaptation. The study examined railway adaptation by application of corporate pathology theory. The authors have shown how countries and railways adapted to changing environments, with reference to their systemic nature, and to the clusters within which they currently reside. It was found that mechanistic adaptation is ineffective. Organismic adaptation is recommended where an environment is receptive to privatized railways. Socio-cultural adaptation is recommended where the environment is unreceptive and needs to be prepared as part of the intervention.

1 INTRODUCTION

1.1 The state of the global railway industry

1.1.1 Previous research background

In examining railway globalization to leverage insight from developed- into developing regions, the authors found six clusters[1] in which the world's countries with significant line-haul railways reside (Van der Meulen & Möller, 2006), namely Constrained Railways, Railways under Intense Competition, Railways under Rising-, Unreceptive- and Liberal Private Participation, and Railways in Emerging Economies. To avoid unnecessarily maintaining pedantically rigorous distinctions among the Private Participation clusters, the authors took the liberty of rolling them, and five statistically independent cases that separated the clusters, into the reduced number of clusters below, with an indication of the portion of the total that they represent.

Constrained Railways	76.3%
Railways in Intense Competition	4.4%
Railways in Privatization	14.9%
Railways in Emerging Economies	4.4%

More than three quarters of the world's railways are constrained in one way or another, so it will become evident that the liberty does not materially affect the aim of this paper.

1.1.2 Vital railway clusters

Countries and railways that adapted to globalization followed a particular path, which supports ex post facto research into their behaviour. The following brief descriptions of the key clusters give leads to unlocking the learning they contain.

[1] Cluster analysis is a technique for grouping cases (countries in the present paper) into clusters, such that cases in a cluster exhibit within-cluster homogeneity, and between-cluster heterogeneity.

Constrained Railways are typified by low freight and/or passenger traffic; insignificant operator or route diversity; low connectivity with strategic horizon limited to national borders; low technology that does not exploit rail's competitive strengths; public ownership with long commitment horizons; low economic freedom and relatively low national income; and low sustainability. The cluster comprises all countries not mentioned below.

Railways in Intense Competition are typified by dominant freight traffic; high market diversity; high connectivity and continental strategic horizons; high technology and intense exploitation of competitive strengths (heavy axle load, double stacking, and distributed power); private sector ownership, still with relatively long commitment horizons; relatively high economic freedom and relatively high national income; and relatively high sustainability. The cluster comprises Australia, Canada, the United States, and Mexico.

Railways in Privatization are typified by mixed traffic, moderate-volume freight traffic and high-volume passenger traffic; rising operator diversity; high networkability, conservative strategic horizon; high technology and exploitation of high-speed competitive strength; emerging private ownership with moderate commitment horizon; relatively high economic freedom with moderately high national income; and moderately high sustainability. The cluster comprises Austria, Czech Republic, Italy, Sweden, Belgium, the Netherlands, Switzerland, Denmark, Norway, Finland, South Korea, Luxembourg, France, Germany, the United Kingdom, Japan, and Spain.

Railways in Emerging Economies are typified by substantial freight traffic, plus significant passenger traffic; monopolistic markets; relatively low connectivity and conservative strategic horizon; relatively high technology with each member deploying at least one rail strength; public ownership with relatively short commitment horizon; low economic freedom and low national income, and relatively high sustainability. The cluster comprises Brazil, South Africa, China, India, and Russia.

1.1.3 Vital railway market spaces and orientations

In addition to the four clusters mentioned, Van der Meulen & Möller (2006) also found ten factors that explain positioning of the railway industry. They are discussed comprehensively in South African and African context in a companion paper at the present conference (Van der Meulen, 2007a). Therefore, two vital factors only will be mentioned here, for later integration into this paper. The first factor, *Societal Orientation*, suggested a societal or people orientation, advanced economic- and technological development, with a modicum of freight traffic associated with a passenger-oriented railway. It suggested the Western European archetype, where contention between freight- and passenger demands does indeed exist. The second factor, *Territorial Orientation*, suggested freight railways that deployed advanced technology, with investor-driven competition among railways. Long, heavy trains conveying bulk commodities and manufactured goods suggested a territorial orientation toward economic-, natural-, and spatial resources, as in the North American archetype. Comparison of the variables that loaded onto these factors suggested that they represent two mutually exclusive railway archetypes.

Guided surface transport is predicated on a vehicle-guideway pair, which ensures precise application of vertical loads, and secure application of lateral loads. In the final analysis, steel-wheel-on-steel-rail contact mechanics develop vertical and lateral force components, technologies named *Bearing* and *Guiding*: They support respectively heavy axle load and high speed. Cross-breaking Bearing and Guiding yields four market spaces, of which three are intensely competitive—Heavy Haul, High-speed Intercity, and Heavy Intermodal (or Double Stack)—and in which railways have demonstrated inherent sustainability (Van der

Meulen, 2006). One may leverage these applications by linking vehicles, to scale capacity as required, a technology named *Coupling*. Bearing, Guiding, and Coupling are the three *genetic technologies* that distinguish railways from all other transport modes.

The two factors and three market spaces described above enable one to appreciate railway positioning. To complete the context, note that the research referenced here was predicated on line haul railways only, which the authors recognize limits generality: Nevertheless, the drivers of urban rail differ so far from those of line haul, that they are establishing a separate urban railway database, for future research.

1.2 The state of the South African railway industry

To introduce the South African context, consider that its taxi industry is relatively asset-light, yet its ZAR8-billion recapitalization has drawn intense and lengthy public debate. By contrast, its railway industry is relatively asset-heavy, yet little dialogue has thus far preceded its ZAR40-billion recapitalization, to adapt and reposition it for relevance to current and future environments. Ineffective adaptation has allowed rail's competitors to punch above their weight—e.g. minibus taxis convey intercity passengers, and trucks haul export minerals to ports. Railways indeed appear incapable of rising to their share of the national transport task. While a National Freight Logistics Strategy exists, its railway implementation has proceeded at glacial speed. The author therefore examined key global railway adaptation models, to develop references against which to evaluate direction and progress towards realizing South Africa's requisite railway dispensation.

1.3 Searching for a consensus

South Africa's many railway stakeholders do not yet seem to be converging on a consensus solution, or even a process to find one. For example, the Department of Transport has a position on standard track gauge, but Spoornet is investing massively in existing gauge. Provinces are developing a rail strategy, yet from a corporate citizenship perspective, urban rail is a local government issue, whereas the scale of other railways rates them national- or continental issues. This paper addresses the problem of many stakeholders, for many reasons, being unaware that South Africa is not alone in needing to deal with a railway legacy that no longer meets current and future expectations.

1.4 Learning from others

From the state of the global railway industry described in §1.1, it is evident that one fourth of railway countries have indeed adapted to railway globalization, by transforming from the Constrained Railways cluster to one of the more sustainable clusters. The authors therefore set out to develop touchstones that can give stakeholders insight into their present situation, and guidance regarding requisite adaptation, by learning how countries and railways that have already adapted to their changing environment did so.

1.5 Strategic adaptation models

1.5.1 Model selection

Jamshid Gharajedaghi's (1983) work in corporate pathology examined the underlying assumptions of management philosophy regarding the nature of social systems, which he observed were at the core of the problems and dilemmas faced by corporations. Noting the neat fit with railway industry adaptation, and the insight to be gained by examining the four clusters in the light of corporate pathology, the authors applied his three adaptation

models, namely *mechanistic*, *organismic*, and *socio-cultural*, to examine that adaptation. They are typified in terms of their structure, dynamics, and purpose, as follows:

1.5.2 Mechanistic systems

Mechanistic systems are relatively closed, with energy-bonded structures. Their dynamics are deterministic, their purpose a single predetermined goal. They respond to command and control management. Their closed nature subjects their structure to entropic decay. From time to time they need external intervention, to add energy to sustain them, until entropic decay once again demands intervention. Without creative ability to respond to their environment, mechanistic systems eventually break down. South African Rail Commuter Corporation (SARCC)/Metrorail and Spoornet exemplify such systems. It is evident that, despite the imperative to adapt, they have proven incapable of doing so. Only external intervention can regenerate them.

1.5.3 Organismic systems

Organismic systems are also energy-bonded, but open to their environment. Their dynamics are equifinal, with a fixed destination and a purpose defined by their cybernetically controlled parts. Their basic limitation is failure to recognize that a social system exists on a higher and more complex level. The emergence of high speed intercity trains in Japan, and heavy haul- and double-stack container trains in the United States, are examples of changes in liberalization and technology stimulating changes in railway competiveness. Relative competitive strengths ultimately determined equi-final—that is the same regardless of path—market outcomes.

1.5.4 Socio-cultural systems

Socio-cultural systems are open, with an information-bonded structure. Members create, elaborate, or recreate their structure in terms of a shared image. The system dynamics produce multifinal outcomes—that is several are possible, but only one emerges—through the dialectic interaction of opposing though concurrent processes, which can be paired as integration and differentiation, entropic and neg-entropic, morphostatic and morphogenetic, competition and cooperation, generation and distribution, and creation and recreation. The way in which dynamic interaction leads unpredictably to one of several possible outcomes, is observable in changes currently underway in Europe's railways.

2 AN APPROPRIATE RESEARCH METHODOLOGY

2.1 The population sub-set

The original research (Van der Meulen & Möller, 2006), of which the research reported here is a continuation, set out to establish a scientifically rigorous foundation for understanding railway competitiveness, and its relation to sustainability, within a country setting, to leverage railway insight from developed- into developing regions. Although the limited population of countries with significant railways only supported a relatively small number of high-level variables, leading to rather granular multivariate analysis, it did reveal clusters and factors that have stood the test of several peer-reviewed publications (Van der Meulen & Möller, 2006; Van der Meulen, 2006; Van der Meulen, 2007b).

2.2 Justification for a case study approach

For the present research, statistical analysis is inappropriate, because the twenty-seven countries outside the Constrained Railways cluster represent a small sample. However, case study methodology is relevant in settings where a rigidly structured research design

imposes undue limitations, and where human cognition naturally unravels fuzzy aspects. Furthermore, in the present setting, the case study methodology is already bounded by clusters that have been scientifically determined, and by Gharajedaghi's (1983) corporate pathology precepts. It can thus not follow flights of intellectual fancy. The authors therefore considered a case study approach to be appropriate. By inspection, it is evident that the four clusters mentioned in §1.1.2 each relate to one of Gharajedaghi's categories. Members of the Constrained Railways cluster function as mechanistic systems. To a large extent, members of the Railways in Developing Countries cluster also function as mechanistic systems, due to their monopolistic markets and public ownership. Members of the Railways in Intense Competition cluster function as organismic systems, typified by an equifinal outcome: Japan is also a significant example. European railways currently best illustrate socio-cultural adaptation. The case study methodology was therefore applied by reviewing significant global adaptation processes, which yielded the following cases that one could consider archetypal examples of Gharajedaghi's categories.

3 FINDINGS—ARCHETYPAL EXAMPLES

3.1 Organismic adaptation 1—Japan

3.1.1 Setting

This brief history was paraphrased from Van der Meulen (1994: 175 et seq.).Japan's 1906 *National Railroad Law* nationalized seventeen railways, later restructured into Japanese National Railways (JNR). A *National Railways Tariff Law* prescribed basic rates, hindering flexible tariff revision, and promoting regional development rather than adequate returns. Government partly compensated operating deficits; the remainder becoming JNR's responsibility. The Tokaido Shinkansen, the world's first High-speed Intercity railway application, opened in 1964. Nevertheless, JNR suffered its first deficit in 1965. Passenger traffic on narrow gauge increased until 1974, after which rising car ownership, -air transport, and bus transport eroded market share. In 1977 the government authorized commercial activities other than transport, provided that users also used JNR services. Freight business went critical in 1984, when its bulk commodity orientation no longer aligned with the high-tech freight on offer. Despite its Shinkansen success, JNR's service and pricing let it down. The government offered no protection because changed social and economic conditions had diminished the importance of public enterprises. Eventually it became impossible for JNR to operate unless the government eased cumulative deficits. The 1980 *Japanese National Railways Reconstruction Law* wrote off debts that JNR could not repay out of revenue, and subsidized projects that JNR undertook at government behest. The resultant major tunnel and bridge network links contributed prosperity to outlying islands, but by the mid 1980s JNR no longer accepted such financial burdens. Although Shinkansen services operated profitably since their inception, many other services accumulated mounting deficits. JNR adopted corrective plans in 1969, 1973, 1975 and 1977, involving tariff increases and pruning underutilized services, but did not fully implement them, because of political opposition, market rejection, and labour's resistance.

3.1.2 Intervention

Despite the palliatives, an *Ad Hoc Commission on Administrative Reform* found that JNR suffered government involvement, unclear management, business constraints, and abnormal labour-management relationships. Ultimately, in 1985 JNR posted a record deficit of ¥ $1{,}85 \times 10^{12}$, signaling utter inability to achieve fit with its environment. A *Conference on Fundamental Issues of Public Enterprises* demanded drastic revision of JNR, and its president conceded that its plans were unworkable. Government-business

relationships had advocated deregulation since the mid 1960s: JNR was the last holdout of nationalization, by then considered an improper method of resource allocation. A 1987 law reformed JNR, dividing it into six regional passenger railway operating companies; JR-Central, JR-East, JR-Hokkaido, JR-Kyushu, JR-Shikoku and JR-West; a national freight railway operating company, JR-Freight; a holding company for Shinkansen infrastructure; a settlement corporation to dispose of surplus assets and personnel; and several minor companies. The reform closed 3000 kilometers of unprofitable lines, restricted freight services to high-density routes, and reduced personnel. JR-Central, JR-East and JR-West prepared to sell government owned shares in the early 1990s, which the government postponed due to unfavourable stock market conditions, but initial public offerings were nevertheless made in the mid 1990s. Government still holds some stock in the three Shinkansen operating companies, and fully owns all the others.

3.1.3 Learning

JNR is an extreme example of the inability of mechanistic systems to adapt to a changing environment. Like many a machine, it required regular structural adjustment and energy (read money) replenishment, only to deplete that entropy once again. The Government-business intervention initiated organismic adaptation, releasing JNR's parts to function cybernetically within their environment. Note that the process led to an equi-final, or single, predictable outcome, because the government-business alliance had already created an environment within which an open, purposive organization could find a sustainable marketplace, specifically High-speed Intercity. The three Shinkansen companies now enjoy a robustly positioned Societal Orientation. Appreciate nevertheless that a single outcome could mean extinction: Although JR-Freight is an innovative railway, Japan is simply too small to allow a Territorial Orientation toward rail freight. Mixing freight- and passenger traffic on the same infrastructure precludes exploitation of the Bearing genetic technology: JR-Freight's highest aspiration is thus limited to a marginal contribution to its passenger host railways.

3.2 Organismic adaptation 2—North America

3.2.1 The United States: Setting and intervention

The early 1970s were perilous times for North-eastern United States railways, as bankruptcy courts ruled that the Penn Central, Reading, Central New Jersey and Lehigh Valley railways were un-reorganizable, a predictable outcome of one-hundred-and-fifty years of ad-hoc transportation policy (Orenstein 1990: 69, 73-75). Conrail emerged from their remnants, following the 1976 *Railroad Revitalization and Regulatory Reform Act*, which partially reformed regulation by affording more freedom regarding rates, abandonments and mergers. The 1980 *Staggers Rail Act* freed freight railways of the most onerous economic regulations governing rates and services: The resulting flexibility improved their ability to offer efficient, competitive transportation (United States Department …, 1990: 70). Building on the heavy haul foundation, ratemaking freedom soon stimulated double-stack container trains, destined to become the eminent domain of global freight railway growth. Freedom to negotiate rates and exit unprofitable business, changed the investment direction. The government-financed, profit-seeking National Railroad Passenger Corporation, Amtrak, was created by the 1970 *Rail Passenger Service Act*, by which time passenger traffic had declined, and passenger service losses of participating railways were alarming (Orenstein 1990: 92, 95). Since then, Amtrak has become progressively more gaunt, as its defensible domain shrank to its North-eastern base. Nevertheless, from time to time dedicated High-speed Intercity railway prospects loom large: Proponents now believe they are closer than ever to convincing Congress of the need for high speed (Cotey, 2006: 28).

3.2.2 Canada: Setting and intervention

Canadian National Railways (CN) originated in 1917-23 by amalgamating several financially troubled leftovers from Canada's railway-building mania. The Crown corporation inherited a track network so huge it could never make business sense, had too much debt and too much political interference. CN plunged into financial difficulties so severe that, government granted it fresh starts in 1937, 1952, and 1978, by forgiving debt or converting it to equity. The latter recapitalization stipulated that the corporation become financially self-sufficient: Through the 1980s it disposed of non-core assets to remain solvent, and by 1992 was in terminal trouble, with no prospect of government bailout. Between 1992 and 1995 the government prepared the corporation for privatization. Privatized 1995 in one tranche advised by external advisers, the initial public offering was a resounding success (Bruce, 1997). Having transformed from a Crown corporation to an investor-owned company, CN is now profitable, and a strategic partner in the NAFTA railroad (§3.2.4).

3.2.3 Mexico: Setting and intervention

The 1988 Canada-United States Free Trade Agreement was expanded in 1994 to include Mexico, thereby establishing the North American Free Trade Agreement (NAFTA). As part of its 1995-2000 National Development Plan, the government divided Mexican National Railways (FNM), then a financially strapped, resource-poor, government-run bureaucracy, into three regional freight railways, a Mexico City terminal operation, and several short lines. Operations on each were privatized by way of fifty-year concessions, renewable for a further fifty years. Bids for sole franchise concessions were invited in a single tranche, the government retaining 20% ownership pending either a public stock offering within two years, or sale to the respective concessionaires. The government retained ownership of infrastructure, franchisees are responsible for maintenance and improvement. The government expected its return via taxes on profits. The Northeast Railroad was concessioned in 1997 to Transportacion Ferroviaria Mexicana (TFM), a joint venture of Transportacion Maritima Mexicana and the United States railway Kansas City Southern: The latter gained a controlling interest in 2005. The Pacific-North Railway was concessioned in 1998 to a consortium of Grupo Mexico, Ingenerios Civiles Asaciados, and the United States railway Union Pacific. The South-East Railway was concessioned to Mexican interests. The Mexico City terminal operation was split four ways, each main line concession taking a 25% share, with the remainder temporarily retained by government, possibly to become part of a future commuter rail concession. Many of the branch lines were closed. (Foran, 2005; Sale of FNM …, 1995; Vantuono, 1997).

3.2.4 Learning

North America exemplifies the nexus of a Territorial Orientation to railways and Gharajedaghi's organismic adaptation. Following the Staggers Act, commercial freedom predictably stimulated organismic development of freight railway state-of-the-art in the Heavy Haul and Heavy Intermodal market spaces, and Distributed Power as application of the Coupling genetic technology. An environment that favoured private investment and free competition, in the United States first, followed by Canada and later Mexico, culminated in NAFTA. Parallel competition among railways[2], long upheld in the United States and Canada, became the role model for Mexico., The outcome of the respective interventions could be predicted in all three countries, because Gharajedaghi's organismic system admitted only one, equifinal, outcome. Dividing Mexico's FNM before concessioning was thus an essential first step to parallel competition. All the interventions mentioned launched railways that exploited, or potentially could exploit, rail's genetic technologies into a free and competitive environment. The only outcome would be

[2] Parallel competition is upheld by allowing end-to-end mergers among railways, and disallowing parallel mergers that could reduce competition.

successful, the only variable was procedure. Ongoing organismic development has produced the NAFTA Railway: Kansas City Southern, which controls TFM, operates from Mexico City to Chicago, from where it has a strategic alliance with CN to points in Canada.

3.3 Socio-cultural adaptation: Europe

3.3.1 Setting

Railways in Europe have until comparatively recently been national- or state railways. Their history of competition has been all but obliterated, although relics such as multiple terminal stations in capital cities remind perceptive observers. Traditionally, emphasis and investment have been skewed to passenger services, and freight market share is consequently insignificant, with rail struggling not only for survival, but for relevance. While at face value the situation may seem to illustrate mechanistic adaptation, which indeed is also present, the unresolved contention between Societal Orientation and Territorial Orientation point to a deeper malaise.

3.3.2 Intervention

Europe's railway predicament is that it still lacks a free and competitive environment, like Japan and North America, into which to launch privatized railways. Uncompetitiveness further confounds the problem: Of freight railways in general, due to sharing infrastructure with dominant passenger services, and also of passenger operations that do not fully exploit one or more of rail's genetic technologies. Privatization and uncompetitiveness are uncomfortable bedfellows. A competitive environment, acceptable and attractive to all stakeholders, including private investors, can only be crafted by socio-cultural adaptation, through dialectic interaction among them. Following Sweden's separation of infrastructure and operations in 1988, as a first step toward solving its perennial railway deficit problem, the European Commission introduced competition through a similar arrangement. The first major railway legislation was Directive 440 of 1991, which required member states to understand the need for competitiveness and sound financial management, and reduce the indebtedness of railways; make railways independent by separating their budget and accounts from those of the state; open the market for international freight and passenger services under certain conditions; and separate accounting for infrastructure and operations, to ensure transparency and to measure their performance. As expected in socio-cultural adaptation, the directive required amendment over time, by the First Package in 2001, to incorporate experience with implementation and developments in the railway sector; the Second Package in 2002, to speed up opening of the market; and the Third Package in 2004, to address quality issues. Thus from 2007 all rail freight is open access. Nevertheless, substantial issues still remain. One is dedicated rail freight corridors to match global competition. The European Commission is sponsoring examination of that issue through the New Opera project. Another is the modalities of fairly allocating and pricing train slots in an open access regime. Interoperability is yet another, and so on. These examples well illustrate the multi-final nature of socio-cultural outcomes: The end-state is not yet visible, but to achieve it stakeholders need to create a shared image of what they want through a consensus-building process.

3.3.3 Learning

Europe is by far the most complex example presented here. It had to dismantle vertically integrated, monolithic national railway structures, and replace them with new, open access continental structures. The outcome so far still does not assert a Territorial Orientation, which means that its freight rail business is not as competitive as the global benchmark, North America. Parallel competition will no doubt emerge through different countries, but that will take time. Recall that socio-cultural systems are open, with information-bonded

structure, which members create, elaborate, or recreate in terms of a shared image. The exact contents of the EC directives are less important for the present paper than observing the socio-cultural adaptation process in operation. While the overall outcome is unpredictable in both form and time, it will surely be robust. The learning would not be complete without placing two significant cases in context. The United Kingdom arguably jumped the gun in the mid 1990s—there was no framework within which to launch privatized railways, and many of its outcomes were simply not competitive, hence it is destined to remain turbulent. It was nevertheless a valuable caution signal for many others. Germany, at the crossroads of Europe, is intending to list its state railway on the stock exchange, in a manner not dissimilar to Mexico, where the government will retain ownership of infrastructure, but DB will have an exclusive franchise. The competitive element will come from surrounding countries and pan-European freight train operators.

4 CONCLUSIONS AND RECOMMENDATIONS—SOME TOUCHSTONES

4.1 Global

The author has shown how countries and railways have adapted to their changing environments with reference to their systemic nature, and to the clusters within which they currently reside. It is evident that mechanistic systems do not adapt effectively. They either change after external intervention, or waste away. Placing undeserving railways on life support incurs an opportunity cost that few societies can afford. Organismic and socio-cultural systems are the ticket to adaptation. Organismic adaptation suffices where an environment is receptive to privatized railways. Socio-cultural adaptation is indicated if the environment is unreceptive and needs to be prepared as part of the intervention. As is typically the case with railways that have derailed, competitiveness and focus are lacking, and it would be necessary to work on their Societal Orientation and Territorial Orientation, to ensure that they exploit the full advantages if rail's competitive strengths.

4.2 With respect to emerging economies

Railways in Emerging Economies, §1.1.2, have positive aspects, but are not yet stable. All are state owned, with relatively closed systems, and mechanistic adaptation, which can work as long as entropy is maintained. They thus require political will, plus money, to sustain them—the mechanistic system thus literally requires stakeholders to put their money where their mouth is. Problems arise when priorities change and such railways must fend for themselves. Their adaptation mechanisms are therefore changing as the managed aspects of their economies recede. Private participation already exists in Brazil. Russia initiated financial transparency in 2003, followed by a legal framework to promote competition, and a third phase to attract investment and encourage large-scale expansion of rail transport (www.rzd.ru). China is also attracting private investors (Chinese investment up …, 2006). This cluster could well morph into one of the others over time, begging the question of how and when India and South Africa will reposition their railways.

4.3 With respect to South Africa

South Africa's railways are not an open system. SARCC/ Metrorail seems to be in stasis; Spoornet investments seem to be driven by necessity rather than by open interaction with a market. These could be warning lights: The odds are against investment into a closed system being as effective as into an organismic or a socio-cultural system. Possibly excluding heavy haul, South Africa's railway legacy is uncompetitive and wanting, so it too must adapt. The outcome will necessarily include funding suppliers, and mitigation of the

risks to which they are averse. This will likely also introduce competition, a notion that might be anathema to some stakeholders. Open access has its limitations, while the Mexican version of parallel competition is attractive, particularly as competitive colonial railways have not been obliterated, and there are several examples of terminal or belt railways link them as required. A blend of European and Mexican could serve as a useful role model. However, there is currently no institutional framework within which to launch competitive railways. Reference to socio-cultural systemic adaptation, reveals that although considerable pent-up pressure might exist to transform railways in South Africa, the necessary preconditions for such a process to commence have not yet been met. Nevertheless, the country's democratization process has demonstrated an ability to undertake one of the most critical socio-cultural adaptations in recent memory, so it clearly has the wherewithal to deal with its railway problem, should stakeholders so wish.

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