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R. Bridges
Interdynamics Pty Ltd

N. Buckley
Queensland Rail

J. Goodall
Westrail

D. Seeley
Interdynamics Pty Ltd

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Joint Industry Planning Platforms for Coal Export Supply Chains

R Bridges¹, N Buckley², J Goodall³, D Seeley⁴

ABSTRACT

Improving the performance and reducing the costs associated with export logistics chains is critical to the competitiveness of export coal mines. The fundamental practices associated with the use of export logistics chains made up of mine, trucking, rail and port operations are being challenged by the advent of third party operators on rail systems and the use of the Internet.

Whilst individual mines can improve their processes to drive down their mining costs, they face major challenges in their endeavour to improve the performance of export logistics chains and reduce the significant logistics costs of moving coal from the mine to export ships, via the shared infrastructure of rail systems and ports. There is an increasing realisation that global competition is not only between mines but between coal export regions that are defined by their rail system and ports infrastructure.

The development and use of a joint industry planning platform for the export logistics chains of the Western Australian Grain Industry has demonstrated that an industry facing significant restructuring and increased competitiveness can achieve major throughput and cost reduction gains when stakeholders in export logistics chains share key planning information using the Internet and state of the art planning tools.

Joint industry planning platforms for export logistics chains are being considered or are at initial stages of development for a number of Australasian coal export logistics chains. This paper reviews the development of a joint industry platform for the WA Grain industry and reports on the state of development of similar planning platforms for the export logistics chains of the Illawarra, Hunter Valley, SE Queensland, Blackwater / Moura, Goonyella and Mt Isa / Townsville export coal regions.

This paper addresses the key components of joint industry planning platforms, the key information that should be shared, the use of the internet and information servers, and the contractual structures required to enable stakeholders of an export logistics chain, who are competitors or potential competitors, to work together to improve the competitiveness of a coal export region.

"Simple schedules for complex coal supply chains."

INTRODUCTION

Improving the performance and reducing the costs associated with export supply chains is critical to the competitiveness of export coal mines. The fundamental practices associated with the use of export supply chains made up of mine, trucking, rail and port operations are being challenged by the advent of third party operators on rail systems and by the use of the Internet. Moreover, there is an increasing realisation that global competition is not just between mines but between coal export regions that are defined by their rail system and ports infrastructure. Hence as Ohmae (1995) has pointed out, these supply chains form the estuaries of entire economic regions. Further, Ohmae (1990) makes the point, that it is these regions which are actually in competition in a borderless economy.

A client of a coal supply chain wants the most effective supply of high quality product at the best price possible, from anywhere in the world. This client will spread their risk over a number of suppliers in order to avoid over-exposure to any single one. The various risk factors typically include:

¹ InterDynamics Pty Ltd

² Queensland Rail

³ Westrail

⁴ PhD, InterDynamics Pty Ltd

- regional politics (as it affects stability of supply);
- industrial relations (track records of steady supply, e.g. Hunter Valley);
- weather influences (e.g. havoc caused by El Nino);
- changes in rail/road infrastructure (affecting reliability and performance);
- performance of the ports involved (e.g. Newcastle, Vancouver BC.);
- reliability of mine production; and
- the nature and the development stage of the ore deposit.

The coal buyer's requirements are shaped by the buyer's own clients, and a provision of steady supply, say to power stations. This supply will be made as economic as possible, without extra burdens such as overly large stockpiles. The buyer considers orders for specific quanta of time, what shipment sizes, shipping delays, cargo assembly delays, etc. are like within that quantum, e.g. a month. Hence, they minimise the drain on their financial position by taking into account their risk covers and working capital.

The buyer will negotiate a variety of contracts with its suppliers, contracts which take into account the following:

- long or short term nature;
- available pricing;
- necessary lead times;
- roughly uniform supply flow; and
- a positive on-demand arrangement with minimal cost penalties

From the client or buyer's whole-of-business perspective (Fig. 1), they wish to know the answers to the following questions about a given export chain:

- How long does it take to move the ore from mine to port?
- In a given campaign, how many tonnes/day can be supplied at port, under what assumptions about the transport infrastructure and port loading?
- What is the nominal capacity of the chain on a daily basis?
- What assumptions occur around the perceived performance of a chain (e.g. that ships are delayed at least ten days at the port of Newcastle)?

Such being the case with the clients of a coal supply chain, it behoves the stakeholder in a given chain to determine how their own supply and production process serves these clients, and to find a behaviour and performance which will effectively provide the best revenue by taking the client's needs into account. This entails as well the transport performance of the entire supply chain, and it is herein that some of the best opportunities lay for improved competition. These improvements are with the opportunistic synergies which exist with other stakeholders, and it is here that benefits of joint industry planning platforms come to the fore.

Joint industry planning platforms

The development and use of joint industry planning software for the export supply chains of the Western Australian Grain Industry has demonstrated that an industry facing significant restructuring and increased competition, can achieve major throughput and cost reduction gains using this approach. Such joint industry planning is made possible when stakeholders in export supply chains share key planning information using the Internet and state-of-the-art planning tools. This of course applies equally to coal export.

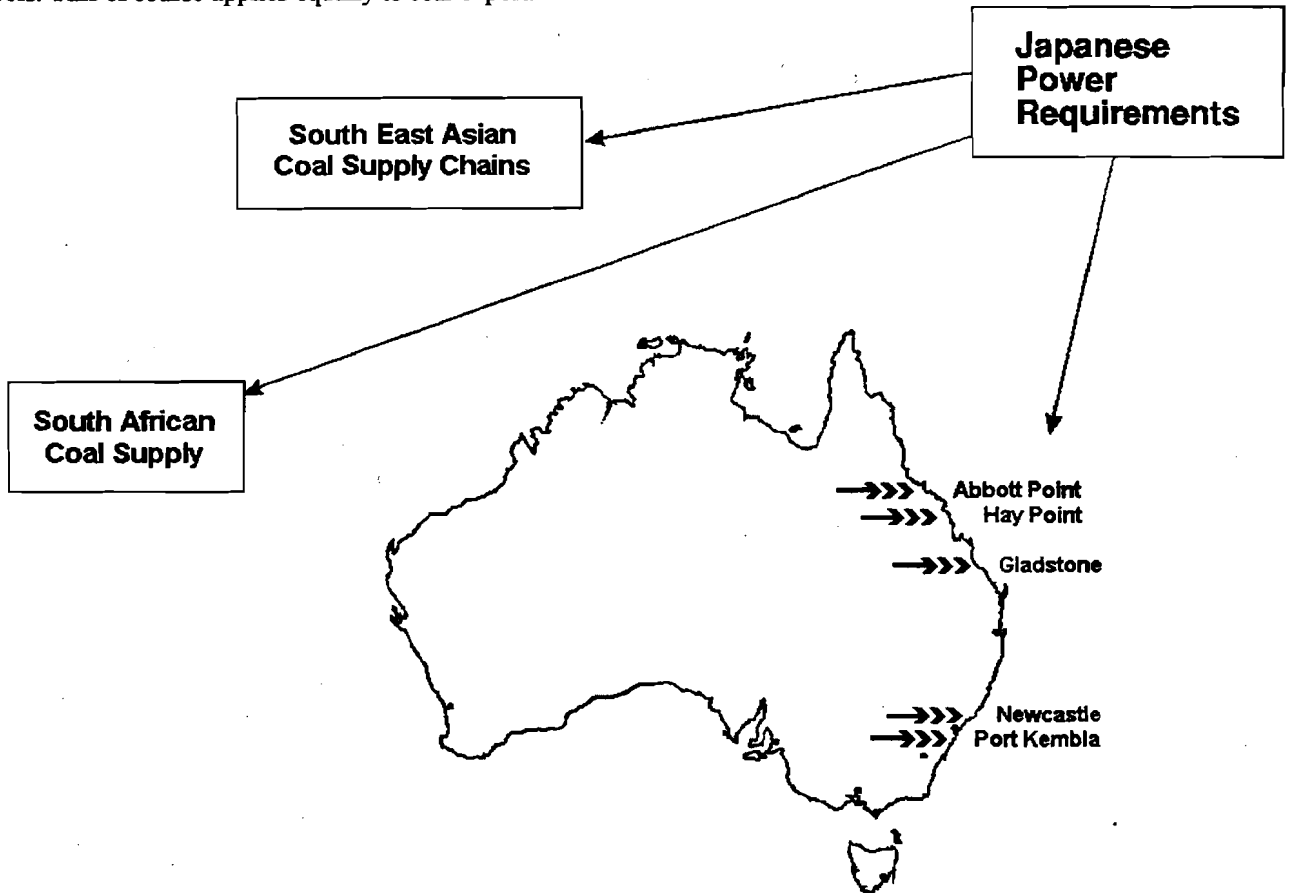


Fig. 1 - Coal supply chain competition is global

Joint industry planning is based upon the capability to visualise and understand how our organisations and systems work as a whole. Hence, there is a natural flow from a concern for the effectiveness of various parts of an organisation to the effectiveness of the whole-of-business. Once focus is brought to bear on export supply chains, this concern naturally extends to the performance of the whole-of-regional-industry. Again the opportunity to open up to a wider perspective beckons, by considering the supply chain relationship to its client base, onto the relevant global commodity market.

Joint industry planning software for export supply chains are also being considered or are at initial stages of development for a number of Australasian coal export supply chains. This paper addresses the key components of joint industry planning platforms, the information provisions, and the contractual structures required to enable the stakeholders of an export supply chain, who are often competitors or potential competitors, to work together dynamically. This enables them to improve the competitiveness of a coal export region. In addition, it describes the various capabilities which joint planning platforms make available.

Hence, the construction and use of joint industry planning platforms involves a gradual extension of awareness of the business milieu, through the whole-of-system visualisations which software can support (Fig. 2).

Once a whole-of-system view of the operations of the supply chain becomes available in software, stakeholders are enabled to view the whole-of-business relationships between them in action. Then opportunities for effective information sharing and for specific dynamic stakeholder relationships in the planning platform, become clear amongst themselves. Next, access management is applied to the key resource, often the rail infrastructure or a port infrastructure, and a variety of forward capabilities of the entire chain, become truly possible. When an effective means to steward this global view of the export chain is achieved, then successful world competitiveness becomes realisable and sustainable.

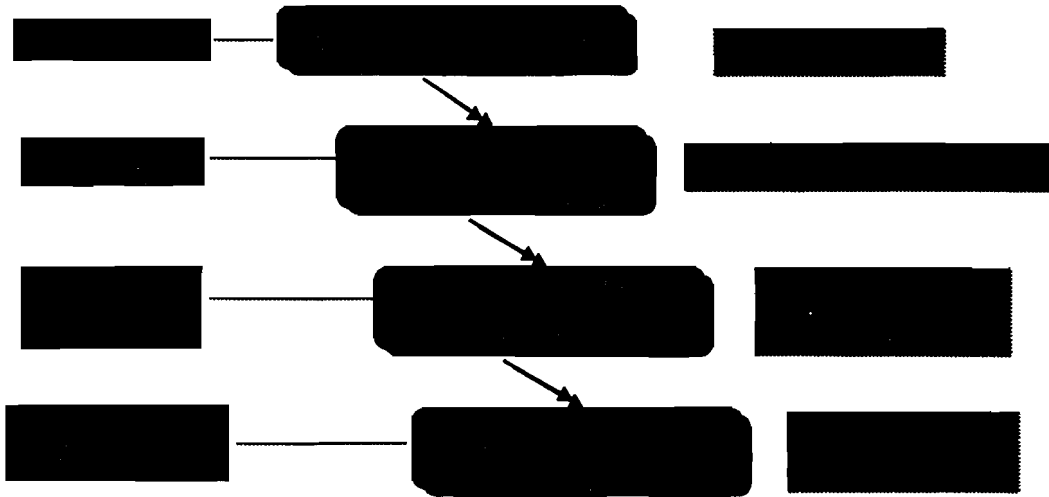


Fig. 2 - Whole-of-system planning

PERFORMANCE IMPROVEMENTS IN THE SUPPLY CHAIN

Rail system managers and planners can have difficulties to determine the actual capacities of complex rail networks because of different assumptions of what to include in their calculations, and a lack of tools which adequately accounted for dynamic variations. It may not be straightforward to determine what kinds and quantities of rolling stock should be included for consideration, what mine production regimes and working practices should be assumed, what interfering traffic is assumed as background, and what equipment and rail maintenance to account for. Furthermore dynamic variations due to irregular production, irregular ship arrivals, equipment breakdown, and track speed reductions for maintenance are part of the real operations of the railroad, and significantly impact available capacity. It is for this reason that software tools have been developed for various railroads and other companies, which provide a realistic reference for the productivity of the current system. Bell (19) has summed up these matters as follows: *'...we are now able to monitor all aspects of the chain that are relevant to our business. As an example, this has allowed us to achieve much greater flexibility and increased utilisation from our locomotive and wagon fleets.'* – Michael Bell, Westrail

Reference capacity models

Reference capacity models (RCMs) have been developed for Queensland Rail's coal and minerals export chains, using animated management tools (Seeley et al 1995) which provide a benchmark for the current throughput capacity of operations, against which all potential improvements can be assessed. Often the RCM is used to identify the performance bottlenecks and the constraints which need the most attention that are implicit in the current system. Such identification focuses upon how resources can be best applied to yield immediate improvements in overall throughput. Bell (19) explains that *"The tools can be used to assess the capacity requirements of the chain by identifying its constraints and bottlenecks. This enhances the overall logistics performance of the industry and allows us to make informed decisions when planning transport capacity."* –Michael Bell, Westrail

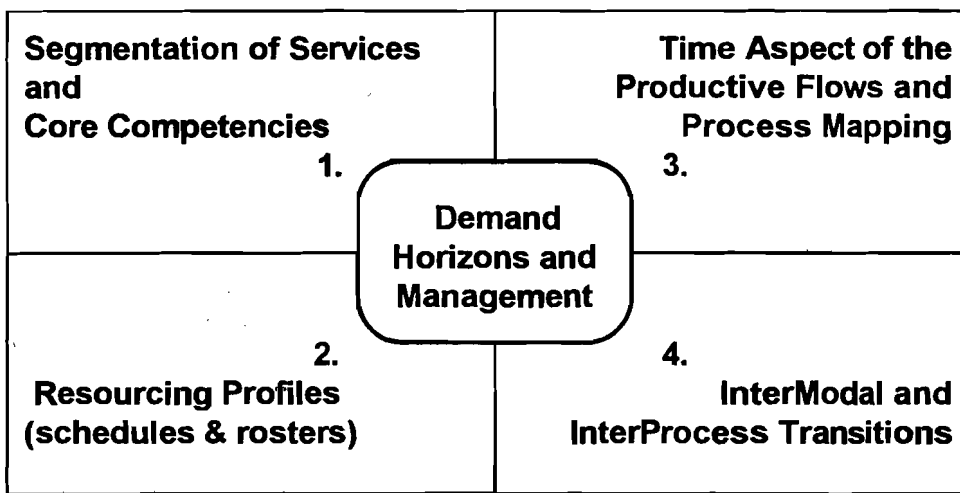


Fig. 3 - The basic structure of a reference capacity model

Fig. 3 is a schematic of the major components in a reference capacity model for mines, railroads and other commodities. In the planning tool the four quadrants specify the current system as it exists or is being contemplated. The central function both specifies the nature and specifics of the demand on the supply chain, and the available tactics for managing how the demand will be met.

The four quadrants and central activity perform the following sketched functions:

- **Services** - It is here that the major service components provided by the organisation's core competency is specified. For the rail component of a supply chain this would mean the specification of the contractual requirements to the mines serviced by the supply chain. This is a description of the way the service provider mobilises and deploys its resources, via its dispatch rules, and defines other elements, such as background traffic, around which it has to operate. The organisation's history and culture is revealed in this quadrant, via the specification of these rules.
- **Resourcing** - In this quadrant, the availability of the various resources in the system are detailed; for example, the track accessibility slots, the availability of rolling stock via schedules and the rostering of crews. It covers long, medium and short term resourcing profiles via these schedules.
- **Productive Flows** - In this quadrant, the sequence of process steps which make up the productive flows and internal processes of the business are mapped. For example, the haul cycle steps required for a consist to go to the mine, load, travel to the port and unload, and then return would make up one of the productive flows. This "process mapping" data covers cycle details, sequencing rules and routing information.
- **InterModal Transfers** - It is here that storage buffering and handling delays will be specified when commodities are transferred from one sub-system to another, or from one mode of transport to another. For example, the details of the unloading process at the port would be one of the intermodal transfers so specified. This information also covers scheduled and unscheduled availability of these inter-modal resources. It is differentiated from the process quadrant due to the tendency for intermodal points to be located at system boundaries, and also because intermodal transfer points tend to be points of high capital value, often becoming determining constraints.
- **Demand Management** - In this central component the actual nature and details of the demand requirements on the system are detailed. A good part of this demand profile follows on from current contractual obligations, while the remainder is often the capability to handle "spot" opportunities. Here is where the decisions on how the available resources will be utilised in order to meet those demands are determined through robust scheduling and contingency planning. The customer sits at the heart of this component - customer profiles are segmented

here, cascading from the future to the present, via future demand projections, converted to annual demands, then converted into Monthly/Weekly/Daily, as appropriate.

The detail of how this set of inputs is translated into the software by our underlying Planimate™ software platform originating in Australia, (Seeley and Warren, 1994) are beyond the scope of this paper, but how they work can be seen by viewing the software in operation. Outputs are also divided in a similar fashion.

The application of reference capacity models

With these models, such phenomena as the spread of system congestion can be reduced, work practices can be changed to relieve pressure on a key constraint, and improvements made to haul cycles which are critical to throughput. Expensive capital investments can often be avoided or significantly delayed by implementing policy changes which improve performance. Least cost outcomes can truly be found without looking to expenditures on more capital resources as a way out.

Such performance improvements are very important, however, more significant opportunities open up when rail movements can be coordinated with commodity suppliers such as mines, and with loading/unloading activities at the ports. This is typically done by regularising production flows and their take-up by the logistics network. This approach enables managers in the various stakeholders to take a more proactive planning approach, by gradually progressing through a series of steps from reaction to significant planning horizons. In this manner, both mines and rail can improve their competitiveness through the identification of dynamic coordination opportunities which enable them to improve utilisation of assets, and improve the competitive positions of the various service providers on the rail system.

In this manner, real advantage for all concerned emerges by focusing improvements across the entire supply chain. It is clear then that improving the performance and reducing the costs associated with export supply chains is critical to the competitiveness of export coal mines. This takes on added urgency when external competition and the realities of the international marketplace are taken into account.

World competitive performance

Whilst individual mines and railroads can improve their processes in order to drive down their running costs and capital burden, they face major challenges in their endeavour to improve the performance of export supply chains. Individual mines and other commodity suppliers are intimately constrained by the overall performance of the supply chain. Global competition will not yield simply to the biggest provider, but rather to the combined synergy of the stakeholders in a given region, which can function as a coordinated unit in order to meet client requirements. It is a more effective way to be a clever provider. Such providers will reduce the significant system-wide logistics costs of moving coal from the mine to export ships, via the shared infrastructure of rail systems and ports.

What follows in this paper, is a description of how the empowerment of supply chains has been done, and is being done, with the assistance of a powerful software platform, called Planimate™ (Seeley et al 1995), which enables all of the stakeholders to view a common "Big Picture" of the current situation, and to evaluate any number of potential scenarios which would effectively meet future demands. The implementation steps are straightforward but are greatly assisted by a pragmatic trust of the other stakeholders, the will to make internal political adjustments within each organisation, and a good software platform which provides dynamic visualisations and an effective distribution of information.

The time when a mine could consider only optimising the costs of its own internal operations and price negotiations with the rail provider are effectively over. Medium and long term survival and profitable exploitation of the mineral resource, is now intimately tied to the performance of the entire supply chain and its ability to compete in a world market.

Visualising the whole-of-business

What is meant here by the term "a visualisation of the Whole-of-Business" is not merely the bottom line of some accountant's static analysis, or a pie chart from some sophisticated but unproven spreadsheet financial model. Rather, it is an animation of the entire supply chain which enables people to see the various interactions which occur between client and provider, intermodally, and with respect to external demands on the overall chain. This animation also delivers in-depth analysis of the behaviour of the whole logistics system. This kind of visualisation is a powerful tool for achieving agreement on how the supply chain actually works overall, what is the key determining constraint (see "Capacity

Assessment and Planning”), and upon what issues stand out for immediate attention. Moreover, everyone can see how the system works and achieves its numbers. Our *Planimate*TM software platform delivers such visualisations quickly and dramatically.

When whole-of-business animations also provide excellent reporting and graphics of key performance indicators, stakeholders are enabled to see a much greater perspective from which to make decisions than when they are only focused upon their own internal measurements as in Seeley and Griffith (1994b). Stakeholder mines are very autonomous companies which prefer a lack of commercial regulation. Typically, a number of opportunities are rapidly seen which can promote their own self-interest in their own individualised manner. Some of the typical opportunities are:

- **Looking over fences** - The ability to see how one’s own performance affects or is affected by neighbouring stakeholders in the chain; dynamic collaborations where mutual benefits are possible, almost leap out from the screen.
- **Deeper Understanding of Capacity** - Whole-of-system understanding enables each to notice what enhances, and what limits their use of resources, providing practical alternatives which keep costs minimised.
- **Including the Client Loop** - The ability to see the relationships between the throughput productivity of the supply chain, its impact upon the marketplace, and the resultant demand requirements placed on the chain by its world clients.
- **Schedule Harmonisation** - There are many possible benefits from harmonising the production schedules of the mines with the consist schedules of the railroad, and with the situation at the ports.

In using the software platform which delivers this whole-of-system picture, individual stakeholders can greatly profit from being able to alternate their perspective from their own self-interests back and forth with a perspective which reports on the overall interests of the entire supply chain and a global view. Such global views by keeping their relevance to individual stakeholders, avoid any undue influence from dominant positions, such as a railroad or a port authority.

For example, a mine might explore how a more continuous supply of labor can be achieved in its environment, then watch what affect such a policy change has on the overall performance of the supply chain. Only in this manner can stakeholders such as mines, truly appreciate the interplay of their actions within the synergy of the regional industry. Such synergy emerges from dynamic collaborations chosen for their benefit to the self-interest of both parties, as opposed to any enforced cooperation or rules of equity.

However, the practicality of working with a number of stakeholders, each with their own self-interest and management, does not indicate the requirement of some overall chain authority, directing the actions of the stakeholders. Rather it becomes far more useful to think in terms of sustaining a global perspective which includes an individual planning capability that acknowledges the unique business style and processes of that company. An individual focus can then be established and sustained by the contractual relationships from which effective global performance will naturally emerge from the best efforts of each of the stakeholders pursuing their own interests. This theme is taken up in a later section on Stakeholder Relationships. Our understanding and tactics for addressing the issues for the entire supply chain is presented next, under the term "supply chain management".

Supply chain management

In this section, key understandings of an export supply chain are discussed, including how all of the pieces come together to function as a unit, and working with the dynamic concept of the haul cycle taken from train graphs, can incur significant savings. A mine depends upon the other players in the supply chain in order to meet its client’s demands effectively. This is then followed by brief discussions of our two main tools for getting the most productivity from the supply chain, capacity assessment and robust scheduling.

The logistics network

The components of the supply chain, including producers, productive flows, primary transport, intermodal transport, storage, depots, cargo assembly, and shipping stem, can be viewed as all one network (Fig. 4). That is, the chain is a network consisting of various transport (process) flows alternately connected by buffered interfaces. The software modelling capability includes entities for directly modelling each of these components and their dynamic behaviours.

Road/Rail Logistics Network

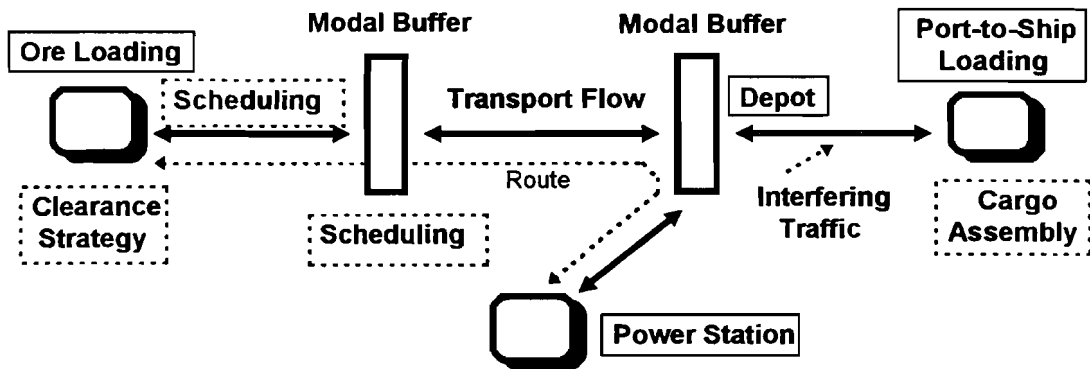


Fig. 4 - Schematic of a logistics network

The components in the supply chain, excluding the actual transport carriers, consist of the components with plain labels. Dotted labels indicate planning functions, while solid labels indicate possible entities:

- Transport flows - A single mode movement of a commodity between two buffers; such movements can be considered single step in a larger movement called a route which follows a particular sequence of steps; these route often return to their origin, and are labelled route cycles. Generally speaking, each flow will have a transport rate as a commodity volume/per time unit.
- Modal buffers - These are storage locations which handle modal changes in an overall transport flow, such as truck to rail, mine to rail, rail to off-loader. They are particularly useful for handling changes in transport rates between flows. For example a high rate in requires a buffer in order to provide a low rate out. In this case, an in-flow provides an input burst to the system. In the opposite case, a build-up in the buffer is required in order to release commodity at a higher out-flow rate, and more fully utilising the output modality. Variability in transport flows across the network, actually generates temporary periods of substantial rate changes at various locations.
- Buffer costs - Modal buffers, when considered in this dynamic way, have a very different cost basis from the usual cost basis for inventories. So-called economic order quantities are irrelevant for getting the highest performance for the lowest cost in logistics networks. They do not account for transport rate dynamics, especially for production and shipping buffers.
- Dwell (time) buffers - These are the time intervals at the end or middle of a haul cycle before the return trip or next cycle begins, and applies to the trips which trains, trucks, etc. take. Reducing the dwell time, shortens the overall haul cycle time for transport resources, and increases utilisation.

Capacity assessment and planning

There can be significant misunderstandings and confusions around the capacity of a transport network, from various viewpoints within the organisation. There is a contractual capacity for example, implied by contract commitments and often with a number of significant assumptions not articulated. There is also an "optimal capacity" which is used for planning purposes, which is often idealistic with assumptions of no delays, linear behaviours and perfectly clear running. This optimal capacity can be contrasted with the nominal capacity which acknowledges actual and, currently necessary,

interference, congestion and breakdown, and is normally only available through a dynamic reference capacity model (RCM).

In contrast to train scheduling requirements, capacity planning endeavours to maximise commodity flows recognising the impact of intra-traffic conflict for the primary transport resource (network). Various current operational policies (e.g. daylight loading only) are also acknowledged, further reducing nominal capacity. Business planning can proceed by exploring various measures and policy changes, such as those involved in manipulating the haul cycle parameters. Pooling diagrams (which show a week's availability for the rail network) and train/transport graphs, available with the animated management tools used for capacity reference, are also useful for supporting such explorations.

These management tools are making a significant contribution to assisting mining and rail to improve their competitiveness. Through them, effective methods for improving the utilisation of mine and rail assets, therefore enhancing network capacity can be explored, especially in coordination with other stakeholders. Furthermore, exploring the feasibility and future returns of joint ventures to establish economic transport networks for the opening of new mines, can also be carried out in a similar manner.

The **determining constraint** is that resource which is the current operational bottleneck. A change to the determining constraint tends to financially overwhelm other parameters, hence strategic choices regarding it need to be made first, before other alternatives can be considered.

Robust scheduling

Scheduling the carrier resources in a transport network with many clients, can become a complex and vexing issue. The operational experience is often that all resources are either running flat out, or else that everything is broken. If an approach is taken which searches for some optimum "academic" schedule, it is our position that typically a number of blind and impractical avenues will be taken, which often yield complex schedules which are only relevant for the assumed conditions existing at a single moment in time. When said conditions change, these schedules often become infeasible or very difficult to adapt to on-going change or contingency; that is, these schedules are often "brittle". Further difficulties which can be encountered with the optimum approach is that the resulting schedules may not be easy for operations to understand or work with, and may impose quite tricky and sometimes costly demands upon labor.

The situation which enables the use of resources required to meet a given demand to be driven down the most, is a continuous and uniform demand. However, if planning is carried out under the assumption that such demand exists when in fact the demand is highly variable, natural vagaries in the whole-of-system will ensure that things will become very congested. However, it is possible to respond to bursts of heavy demand by temporarily doubling or tripling capacity, by making adjustments to the haul cycle or work practices for short periods. How can a manager approach this proactively, without having to undergo expensive reactions?

One way that this can be accomplished is by taking an approach which produces a great deal of uniformity and regularity for a base load of demand on the logistics network, and then sets aside capacity for bursts in demand or other contingencies. In this manner, flexibility can be built into the schedule. Further, by rehearsing responses to potential breakdown situations, and accounting in the schedule for their potential, scheduling can become very robust. Schedules which are robust are basically valid no matter what happens, and impose a degree of regularity which makes operational planning easier. This entire approach is called Robust Scheduling, because it adds flexibility and manageability to scheduling in a manner which optimal approaches find difficult.

This approach to overall logistics was proven out in many applications for mines and railways, before applying them to a substantial multi-stakeholder logistics situation for grain export. Moreover, robust scheduling has been shown to be a very effective method for access **management** (beyond the scope of this paper) to a determining transport resource such as rail. For now, it is enough to observe that there exist many rewarding opportunities for rail and port providers across the globe, to handle the booking of access slots effectively.

The prospect of integrating logistics considerations across all of the stakeholders in a supply chain has been an opportunity staring at our applications from the beginning. However, it was out of a recent multi-stakeholder application in the grain supply chain for Western Australia, that the joint industry planning platform, now being applied to coal supply chains, has emerged.

JOINT INDUSTRY PLANNING PLATFORMS

Since September 1992, InterDynamics has been working with various components of export chains involving coal, sugar and nickel, largely with Queensland Rail and Westrail. These often involved either a mine or refinery and the railroad, or the railroad and the port loading facility. InterDynamics' whole-of-business approach indicated that modelling the overall export chain made a lot of sense. However, it was the WA Grain supply chain experience which crystallised many of the ideas now being applied to coal supply.

The WA grain export chain experience

"There is a need for us to be able to respond quickly to the dynamics of the market place which requires up to date information on shipping requirements and stock inventory levels." – Michael Bell, Westrail

Beginning in early 1996, an initiative was undertaken in Western Australia, which took about 18 months to mature, and which has seen emerge a "joint industry planning platform". Spearheaded by John Goodall of Westrail, Bob Bridges and Klaus Fahrner of InterDynamics, this project gradually marshalled the interests and information resources of the stakeholders in the export of grain from that state. The stakeholders included marketing authorities, bulk handlers and assemblers, transporters and port loading roles in the export chain.

The construction of the WA Grain planning platform was undertaken to optimise financial returns from export grain by delivering a high level of customer satisfaction through available product quality and quantities, and by effective timing of grain delivery to international markets. Delivering such returns also means minimising overall logistics costs through performance enhancement and effective use of logistics resources and assets.

Various animated management tools were constructed to assist the various parties to effectively anticipate the on-going and highly volatile, shipping demands at each port. These included a seasonal planner for how the harvest would be handled, a clearance planner to schedule transportation movements, shipping planners which monitor the ship demand, rail capacity planners, and cargo assembly planners.

Using the individual planning tools and the Navigator, which provides an overall picture of the state of play in the grain supply chain, enables planners to achieve the best balance between ordering and administration, warehousing, inventory and transportation in order to minimise overall logistics costs.

The development and use of a joint industry planning platform for the export supply chains of the Western Australian Grain Industry has demonstrated that an industry facing significant restructuring and increased competition can achieve major throughput and cost reduction gains when stakeholders in export supply chains share key planning information using the Internet and state-of-the-art planning tools. There has been agreement between the stakeholders to share more information on an open basis using the shared planning tools of the supply chain.

Coal export supply chains

Joint industry planning platforms for export supply chains have been developed, are being considered, or are at initial stages of development for a number of Australasian coal export supply chains (Fig. 5). These include: the Illawarra, Hunter Valley, SE Queensland, Blackwater / Moura, Goonyella, Mt Isa / Townsville and New Zealand export coal regions.

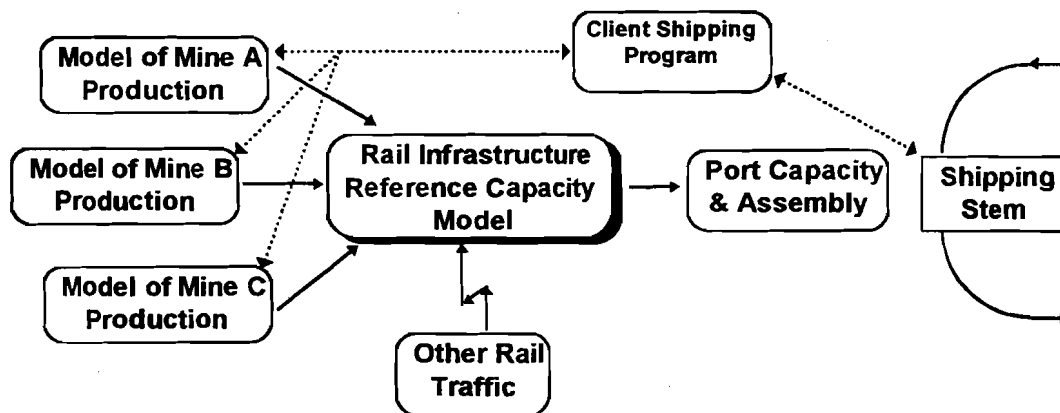


Fig. 5 - A typical coal supply chain

A typical example of a coal export chain is in the Blackwater / Moura system where transport is provided by Queensland Rail (QR). Initial tripartite meetings amongst the mines, the Gladstone Port Authority and QR started in early 1996, at QR's initiative. These meetings are now held monthly where discussions centre on possible coordinated activities that the stakeholders could pursue and commit to. Relevant statistics on the system monthly performance are tabled and the degree of adherence to any previous recommendations made is examined.

All three groups in this chain had their own vested interests in making their initial commitment. While there was a prudent and cautious uptake of the process in the initial stages, the spread of chain relationships have gradually developed to the level where the idea of group coordination is central in everyone's everyday thinking.

Some of the coordinated activity which has resulted from this process includes:

- A representative from the Gladstone Port Authority (GPA) meets each week with Queensland Rail operational staff to establish the train schedule for the week. Matters for discussion include the shipping stem, belt-line and conveyor availability, and stockpiles. While these meetings are now well established, this coordination was a watershed for both the QR and GPA organisations. Some IT developments designed to facilitate scheduling initiatives and implementation have also been developed and instituted as a direct consequence of this approach.
- When particular mines may have immediate demand to service (i.e. ships berthed at port) and low stockpile levels, QR has [on request] negotiated to defer some services to mines where demand is at a lower priority.
- Currently QR is arranging to trial the removal of one consist from the present complement of 15 which services ten mines in the Blackwater system, with overall about seven major mine owners. The system is also required at times, to service railings from five mines in the northern Goonyella system, sent "cross-system".
- "Even" railing demand has been identified as critical for system efficiency. In response, QR has offered the mines the opportunity to trial, over a period of time, a schedule that is negotiated by all the system stake-holders. If this schedule is adhered to, QR will provide the mines collectively, a significant financial incentive. This approach is designed to encourage an even railing pattern and significantly decrease the need to hold surplus rollingstock assets to cater for variability in production and shipping demand.

The continued work of the tripartite coordinating meetings has gradually altered attitudes in a way that has promoted good-will and system efficiencies. This has allowed the evolution of a culture of evenness in production and transport flows where flexibility is still retained. The entrenchment of such a culture will serve the future well, when very significant increases in coal demand are anticipated.

Testimonials from the coal supply chain

According to Robert Elliott of the Gladstone Port Authority,

"Once the initial contacts were made, the spirit of co-operation and good-will snow-balled. Between the Port Authority and Queensland Rail at least, there still exists no firm contractual arrangements and I see the over-riding benefit as enabling what is after all a very complex system the scope to continue to operate even more efficiently without being tied to inflexible contracts. The meetings have set a scene where ideas may be interchanged and a better understanding of each other's business be gained. People on the floor have also begun to develop a better appreciation of the coal system."

The following are comments provided by mining representatives,

"I have gained a better understanding of QR operations and the complexities involved. "
"We are more prepared to sacrifice trains for someone else, in an emergency."
"We are prepared to work together even to the extent of sharing stockpile space. A recognition that capacity provision rather than on-time performance by QR is the vital factor."

Components of a joint planning platform

In approaching this project, there are a number of important considerations regarding the business realities in export chains. First of all, any synergistic collaboration must come out of the context of a group of highly independent and autonomous organisations, each pursuing their own self-interests. This context is called the Joint Industry Planning Group.

In the planning group and subsequent contractual relationships, one exploits the individual business styles and scales of commitment to the industry of each stakeholder, assuming that individual organisations have explored the whole-of-industry perspective for themselves. This avoids both the dependent attitude of an organisation which wants the supply chain to look only for it, and any centralist attitudes which could force ineffective policy in the name of equity. Instead no one has to be led, the supply chain organises itself for overall benefits through opportunistic contracts and individual respect.

What typically transpires is that individual models are undertaken for each of the stakeholders which reflect their own viewpoint of their own operations, their own self-interest and their perception of the rest of the supply chain. In effect, the multiple viewpoints of each of the stakeholders is acknowledged via these individual models (Fig. 6). This then provides an important basis when one returns to an overall supply chain model. This overall model, termed a joint industry planning platform, is able to be constructed in a manner which respects these multiple viewpoints, by ensuring that data sources and business rules are also respected, and that their individual key, but not sensitive, performance indicators (KPIs) are readily accessible.

In all of its dynamic modelling, InterDynamics attempts to provide what can be termed "congruent systems images" of the organisation involved as described in Seeley (1996). Weinberg (1994) has described some of the utility of congruence in his book, and Taylor (1995) has utilised a similar kind of notion in his term "convergent". Briefly, "congruent" in this context means that for every component and business process in the actual organisation, there is a corresponding component in the software model, kind of like the software also "walks the talk". This is in distinction to the distorted images which other information systems may convey. What congruent means in this situation is that the way in which the organisation actually behaves over time, with all of its variability and non-linearity, is accurately reflected by the model's execution. This means that a precise application of the corporate business processes, embodying all of their business rules is carried out. InterDynamics has learned from long experience in object-oriented software, how effective this degree of congruency is, in constructing robust and flexible models very quickly.

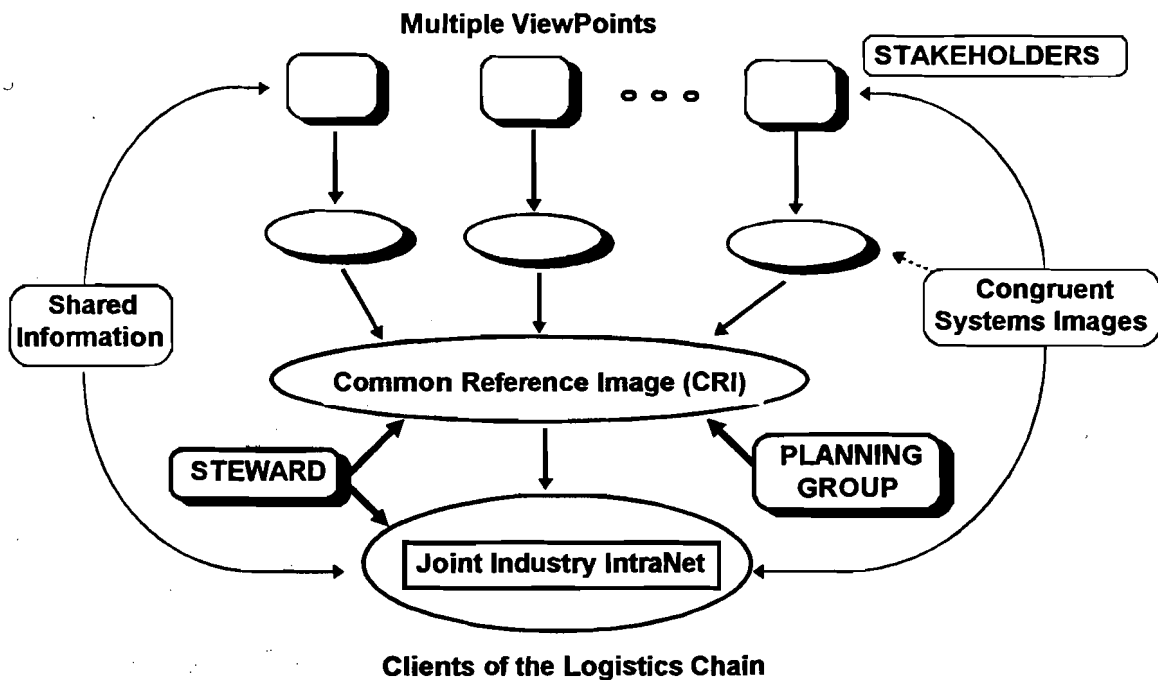


Fig. 6 - Schematic of a joint industry planning platform

However, in order for a joint industry planning platform to become a practical reality, these individual organisational images must be blended into an effective and congruent systems image of the entire export chain. Often, the individual stakeholders have only a limited view of the operation of the overall chain. It then becomes possible to achieve a consensus on the overall model by getting each to participate in the process of building a joint industry platform, and to view the result as an animation of how the entire chain works. In this fashion, the dynamic images appearing on the screen become a very effective mediator between the perceptions of the various stakeholders. Since the individual stakeholder perspectives have been respected in the software, then a common reference image (CRI) can emerge for joint industry planning.

With a CRI available, the issues for a joint industry planning platform focus around obtaining source information from the stakeholders, and in distributing the current status of the CRI and its behaviour to the interested parties. This brings us into the area of shared information, and it is a delicate process. It is only the factual, what-is-happening kind of information which is needed by the CRI, and effectively by the other stakeholders. This is in contrast to financial and performance measurement data, information around which each of the stakeholders naturally feels sensitive and should not be divulged to others. This data requirement may well involve accessing and filtering data from a stakeholder's databases and perhaps mainframes. InterDynamics has focused on constructing such filters in coordination with corporate IT departments. Once it is seen that this distinction can be made, then the planning platform can be progressed to completion. However, it may well need to be supported by contractual relationships.

Once a joint planning platform is completed and validated with a congruent systems image, the next step is to attend to the effective distribution of its data and behaviour to interested parties. This could be done within the IT department of one of the stakeholders. However, competitive energies being what they are, it is difficult to assure all of the stakeholders, that an unfair advantage will not be gleaned by the host. Another approach is to entrust the planning platform to a respected custodian who can then securely distribute the information via the Internet from their host system which can either be a website or an internal bulletin board capability. In effect, an Intranet for the industry is created. As described in the next section however, an effective coordinating caucus between the stakeholders is also necessary.

Hence, the following components are necessary for the construction of a joint industry planning platform:

- Multiple viewpoints
- Congruent Systems Images
- Common Reference Image
- Shared Information
- Contractual Structures
- Information Servers for a Regional Industry Intranet
- Individual Board Approval for the Industry Coordinated Planning group.

STAKEHOLDER RELATIONSHIPS

"It is refreshing to note that all of the relevant parties are committed to seeing InterDynamics' [application] system being developed to its optimum capacity. This will in turn allow a more transparent supply chain to be finessed for the benefit of WA grain growers." – Craig Thompson, the Grain Pool of WA

Regional export supply chains often had a heritage of little communication between the links in the chain and a tribalistic culture. With the advent of the commercialisation of government owned trading corporations and the development of a team culture in the various logistics supply chains, this situation has changed significantly. A key question for regional export industries is whether this new freedom will be frittered away by acting only from local viewpoints, or will the parties involved take advantage of the opportunities afforded from a whole-of-industry view?

Contribution relativities

In entering into contractual agreements, organisations take care to see that their self-interest in the matter is safeguarded. Once the contract is settled, then actions and expenditures are guided by the contract's requirements and performance measurements, while the individual self-interest of the parties is pursued. In effect, the overall behaviour emerges from the rules of relationship and measurements. This is because the rules shape and constrain the expression of self-interest in the shared context, while the measurement process directs the individual development process of this interest. When considering joint industry planning, how can the mutual self-interest of the industry be pursued given the behaviour of the individual stakeholders?

For example, if one player considers only their own costs relative to the system's overall level of activity, then it can easily happen that isolated cost containment activities can strangle the overall system. Moreover, a small expenditure in resources by one party may earn many times that amount for the entire system, but their accounting measurements and contract agreements may prevent that party from realising any benefit in a measurable manner. The system-wide benefit may not acknowledge the source of the original investment, or the place where the benefit is realised does not appear to be directly connected to this source. In such circumstances, management would be laughed out of any boardroom.

However, if an investment or cost reduction by a stakeholder creates significant losses for the other stakeholders, yet earns a significant return for the originator, then local management will traditionally be judged to be very successful. Hence, players in the system need to recognise that there exists contribution relativities to system performance of additional investment in resources, depending upon the location of the investment. Our conventional approaches to good financial

decision-making deter the profitable synergy which can occur for an entire export industry. How can this be turned around so that the entire supply chain can benefit?

One point is to observe that enforced equity and cooperation does not recognise the structure and business styles of individual stakeholders. Such an approach implicitly makes assumptions about marginal contributions and opportunities which are simply not valid, and prevent significant opportunities from being taken up for the performance of the entire supply chain. One need not hold up a bulk carrier at a port while waiting for the cargo of a small ship to be assembled from the hinterland. Instead, there are better effects across the board when a robust scheduling and proactive planning approach is applied. Predictability is encouraged and there are rehearsed responses to bursts of demand, and maintenance opportunities when there are gaps in demand (planned cancellations).

Moreover, in comparing the performance of the supply chain or any of its components to its global competitors, it should be kept in mind that only wholistic performance measures, as described in Seeley and Griffith (1994b), should be used. This will avoid suboptimisations and counter-productive measurements, such as using the number of employees when resource investment is far more appropriate.

Behaviour derives from the rules of relationship

Further to our response to the question of how the entire chain can benefit, is to encourage contractual relationships between parties which encourage predictable (planned) flows of production or service. Compliance to the plans can be handled by utilising rewards and penalties, and by tying contractual satisfaction to global measurements of system-wide performance.

In effect, contracts in regional industry planning should establish rules of relationship which encourage the individual self-interest of each stakeholder to be tied to the overall mutual self-interest of the entire supply chain.

When such relationships are set up, the desirable and profitable synergy (win-win) will naturally emerge without any imposition from outside parties. Hence, the elements seen as necessary for effective stakeholder relationships in joint industry planning are:

- management and board support for synergy, backed by information sharing
- tying self-interest to the mutual interest
- key performance indicators which measure overall system performance
- contract performance tied to global measurements
- contracts which support predictable flows between stakeholders
- recognition that behaviour emerges from relationship rules and measurements

As a result of the information sharing required by the joint planning platform, and suitable contractual relationships like those described above, the participants are committed to continuously improving the throughput performance. The supply chain planning platform enables multiple stakeholders in the chain to work effectively together to improve the performance of their own respective companies as well as the chain itself. Of course, this cannot work in a strictly automated fashion without the face to face discussion and negotiation of an associated joint industry planning group.

Stewardship of the joint planning platform

One can certainly conceive of a central authority which would model, assess, and impose decisions based upon a joint industry planning platform. However, in modern economic climates, both the expense of an additional bureaucracy and a

natural resistance to centralised control mitigate against such a direction. One alternative approach which InterDynamics believes is viable, is a **stewardship role** which would look after and sustain the joint industry platform. The steward could be an agreed upon stakeholder, or rotating participating stakeholder, or an external but trusted agent such as the platform supplier. The latter approach can be very effective because it avoids the pitfall of the internal politics of a steward stakeholder diverting energy and attention from this very important global function.

The stewardship role would include the following attitudes and functions:

- **Supports stakeholder relationships, rather than taking a top-down role** - The steward facilitates the functioning of the joint industry planning group, and both technical and political aspects of relationships between stakeholders. This is not seen from a command and control perspective.
- **Provides capabilities, not solutions** - The steward ensures that joint planning needs can be responded to effectively and that the capabilities of the planning platform are evolving to meet the growing needs of the industry. The steward avoids responding to any expectations that he should provide and promote joint industry issues.
- **Maintains a global perspective, not a global management** - The steward ensures that an effective whole-of-industry view of the functioning of the export chain is maintained and its data relevant and current, and attempts to enlarge the platform's scope to include relationships with international clients. The steward avoids any top-down managing.
- **Ensures the Congruency of the Common Reference Image** - The steward is vigilant about making sure that the CRI accurately reflects the actual components and behaviour of the supply chain, and also maintains an on-going verification of the platform's operation.
- **Monitors and safeguards information sharing** - The steward ensures that only information which is shared is that agreed upon, avoiding any compromise to the positioning of individual stakeholders, and securing its transmission and exchange.

The regional industry steward is a possible new component in supply chains, and it signals a potentially new kind of organisation which could deliver and steward joint planning platforms, now and in the future

CONCLUSIONS AND FUTURE DEVELOPMENTS

The major benefit from the use of a Joint Industry Planning Platform is in the establishment of an analytical framework from which alternatives can be explored with which to best meet the overall demand upon the chain. This advantage is supplemented by the road/rail response capability that can be activated through the coordination of stakeholders which have often seen themselves as competitors. For example in early 1997, this was dramatically demonstrated by the WA Grain industry's coordinated response to a windfall opportunity. This opportunity occurred while a major port was shut down, and while there was severe pressure on a supplying region. During the second quarter, a coordinated response came out of this shared analytical framework.

The use of the Joint Industry Planning Platform enables both opportunities and difficulties to be anticipated in a manner far more effectively than what can be done via a single stakeholder. Moreover, the establishment of a coordinating or liaison planning group to oversee the construction and maintenance of the JIPP, ensures that a political vehicle is in place, which can when prompted obtain the appropriate internal actions from each of the parties.

"Our ability to achieve greater throughput from the supply chain at a time of higher world grain prices has resulted in a major revenue benefit in excess of two million dollars." — Rob Allen, Australian Wheat Board

There are a variety of other improvements to the operation of the supply chain which may also come out, once the parties can visualise the impact of their actions upon the rest of chain, and how all of this comes around to effect them. For example, consider the filling of stockpiles with different grades of export coal which are adjacent to the ports. If this is

done without regard to the upcoming shipping stem's requirements, a situation can be created where a ship has to wait, incurring demurrage, for the correct grades of coal. Limited storage capacity at the port could make this situation sticky. When the big picture of this pending situation is provided in a context of coordinated decision-making among stakeholders, then appropriate planning can be done to minimise expenses. Strictly local considerations by a mine give way to a global perspective which benefits everyone.

Another acknowledged benefit is that the business rules and business processes by which the joint industry works, become very clear and negotiable through the animated visualisation process. Constructive changes then become readily evident, and the role of these business rules in contractual agreements becomes highlighted.

Overall, the joint industry coordinating committee can become an effective leader for the individual business planning and decision support units within each stakeholder's organisation. Not only does its strategic perspective open up many opportunities for the individual stakeholder to make overall savings, but it also opens up and makes visual, prospects for coordinated business development. Hence, the establishment of a joint industry coordinating group which is given the stamp of approval from the board level of each stakeholder, becomes the final necessary requirement to make a joint industry planning platform work.

As experience with joint industry planning platforms grows and their capabilities mature, especially in key commodity export chains such as coal, grain, sugar and other minerals, a number of further capabilities could be explored. These include:

- **Responding with additional capacity** - Developing more sophisticated end-user routines in the platform which would find increased capacity alternatives, both for temporary responses or for long-term requirements.
- **Live Imaging and Live Scheduling** - Using data from currently available databases, live imaging provides end-users throughout an organisation, with a dynamic whole-of-business visualisation. Live scheduling enables re-scheduling which accounts for changing requirements and resources, to proceed from any point in time.
- **Refining the construction of collaborative contract relationships** - A critical component of an effective joint planning platform is the completion of contract relationships which enhance the synergy of the supply chain. Refining the formulation of such contracts as experience with them matures, will be a necessity.
- **Global Models & Positioning** - Expanding the scope of the dynamic modelling within the platform to include the state of play within the global commodity marketplace. Developing global commodity models which include the export client relationships, is a natural extension.

Recent business developments in adopting effective organisational structures and utilisation of the Internet, have made it possible for new forms of business organisations to emerge, which carry out functions which were only dreamed about in previous business climates, or functions which were hopelessly left to government regulations to solve. The pressure from the economic competition of globalisation has challenged the smaller national export industries to play smarter, in order to reap the benefits of locally generated wealth. The innovation of the joint industry planning platform and its application to coal and other commodity export chains, based on our experience so far, should make a significant contribution to the health of economic regions in this age of the borderless economy.

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