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Relating Information and Transportation

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Introduction

The transformation of organizations from lower to higher levels of performance is sometimes dependent upon the degree to which the information seen by decision makers relates, or links to reality. For example, in one case a large freight transportation carrier indicated this to be a major issue inhibiting the achievement of its goals.

What follows a discussion of this issue in terms of:

1. What do we mean by the transportation? How do you measure its performance? How do you find and analyze opportunities for performance improvement?
2. What do we mean by the information? What comprises information and why are these components important? What is its contribution to the value chain and how can this contribution be maximized? What is the role of information technology in information?
3. What are the components of transportation enabled by information technology versus transportation components shaped by information technology?
4. What are the roles and responsibilities of the interested, affected and effecting parties in this issue?
5. Under what conditions should one be concerned about the linkage between the transportation and information?
6. How can performance improvements be introduced, managed and assessed?

The intent here is to identify an important set of issues, hypotheses, and questions that require consideration, then to provide a set of conclusions and recommendations.

The principle objective of "marrying up" the transportation with information is to improve the performance of transportation.

This paper is intended for the general management of a transportation firm.

Discussion

The Transportation Chain

What do we mean by transportation?

Transportation comprises those activities that the *shipper would view as creating value* in return for the price charged. These activities are 1.) those representing the dialogue that takes place between the shipper and carrier, and 2.) those undertaken by the carrier to provide place-time utility to the shipper's product.

Scheer [1] establishes a basis for describing the customer-supplier dialogue that is useful for looking at the first value-adding activity of transportation. I have somewhat modified Scheer's description.

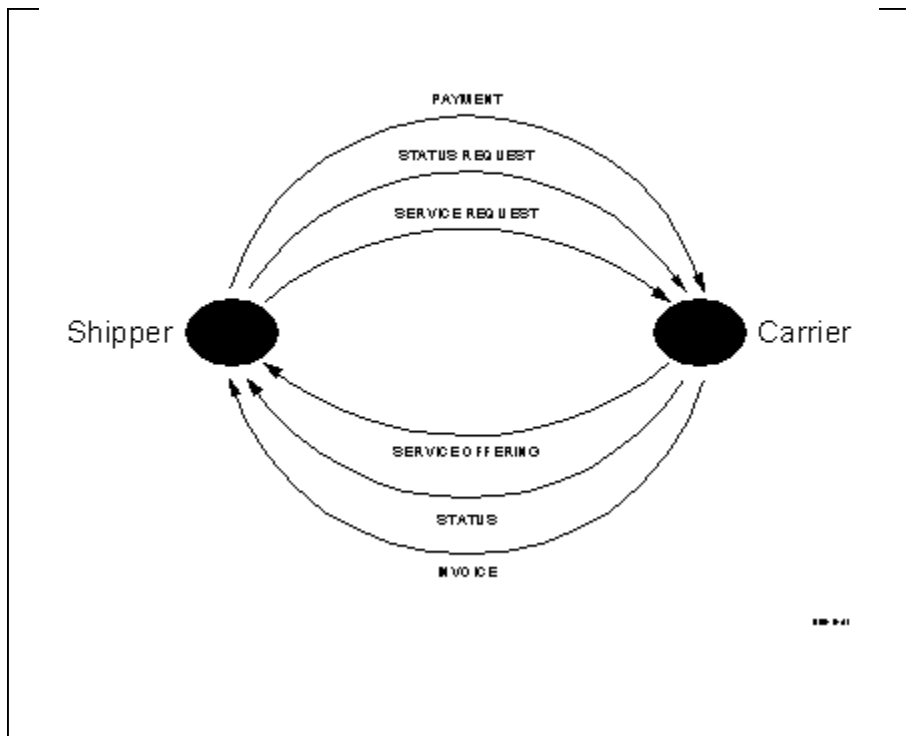


Figure 1 Shipper-Carrier Dialogue

The dialogue may begin with either the *Service Request* or the *Service Offering*. The dialogue will continue alternating between these elements until either a deal is struck, or the carrier or shipper decides that an agreement cannot be reached and the dialogue is broken off.

The carrier will then perform the service and, from time to time, may receive a *Status Request* from the shipper to which a *Status* reply is made. The carrier may also provide *Status* in an unsolicited manner.

The carrier indicates completion of the service by the *Invoice* and the shipper indicates acceptance of the service by the *Payment*.

This shipper-carrier dialogue is of value to the shipper

1. if the grammar and syntax of the messages being exchanged is easily understood, and
2. if the information communicated in the messages is relevant, and
3. if the medium of communication is acceptable.

The only way to be sure of the value is to have the discussion with the shipper. [2]

A second aspect of the shipper-carrier dialogue deals with what goes on at either end of the communication. In all cases, there is a process whose outcome is the message. So, for example, the shipper undertakes some process whose output is a *Service Request*. As the result of recognizing some event (e.g., an order for products made by the consignee), the shipper analyzes the event, determines its impact on his business, identifies and evaluates alternative ways to respond to the impact, selects an alternative or alternatives, and implements the alternative(s). See Figure 2.

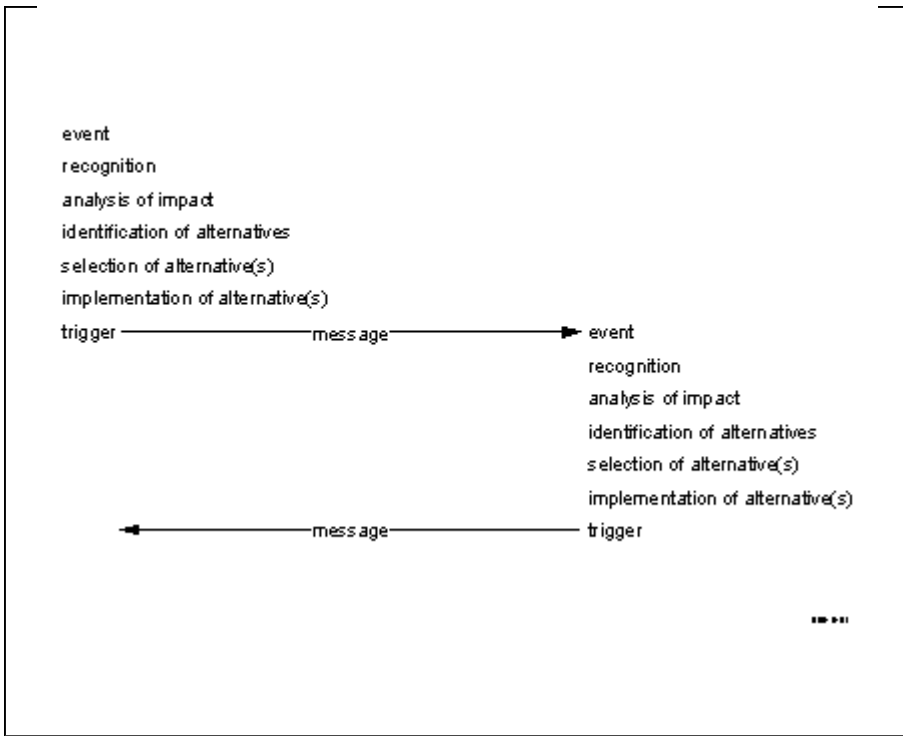


Figure 2 Meta-Processes Related to Shipper-Carrier Dialogue

The quality of the messages is directly related to the quality of these processes. Hence, transportation, as it relates to the shipper-carrier dialogue, comprises messages and the processes that receive and generate these messages. Our understanding of transportation must begin with a discussion of shipper-carrier dialogue and must feature the viewpoint of the shipper.

The second aspect of transportation deals with the physical nature of the transportation process.

The carrier provides place-time value to the shipper's products through the physical nature of the transportation process.

The value equation for this portion of the transportation chain might look like:

the gross value the shipper will realize by having a product at a certain place and time

less

the cost of the service provided by the carrier,

the inventory carrying cost,

the costs associated with the variability in the carrier's service,

the costs of loss and damage that can occur in transit,

the costs of the business infrastructure required to transact business with the carrier.

The literature is replete with cost and transportation accounting, and operations research methods that can assist in understanding this portion of the transportation chain. I don't propose to deal with this matter in any more detail except to say that knowledge of the shipper's place-time value metric is fundamental to managing the transportation chain for optimum performance.

Transportation, as a provider of value to the shipper, comprises a dialogue between the shipper and the carrier, the processes execute by both parties to originate and receive the messages, and the physical aspects of transportation.

How do you measure transportation performance?

A bit earlier I introduced the notion of something that can be termed a decision window.

Begins with	event
Includes	recognition
	analysis of impact
	identification of alternative(s)
	selection of alternative(s)
	implementation of the alternative(s)
Ends with	trigger

Table 1 Characteristics of a Decision Window

The decision window suggests two things regarding measurements.

1. Do not measure anything that cannot be processed through a decision window.
2. The trigger must be produced before the decision window closes.

The decision window must be one that is meaningful to the business. Furthermore, if the trigger is produced too late, that it is it will not change the outcome of a situation, then the decision window has closed. The process for making decisions is ineffectual and the measurement has little value.

There is an old adage that “You can’t manage what you can’t measure.” We should also recognize that just because something can be measured it does not necessarily follow that it can be or should be measured and subsequently managed.

The steps to deciding what to measure are these:

1. Identify the decisions important to the business.
2. Define how these decisions can be made within the decision window.
3. Extract the measurements and methods that must work together to produce the decision.
4. Determine where the measurement probes should be introduced and the characteristics of the probes.

Having said all that, what should be measured in the context of the transportation chain?

Messages	Completeness Clarity Timeliness Accuracy Precision
Processes	Inputs Outputs Cycle time Resources consumed Defects Satisfaction
Transportation	Transit time Variability in transit time Place-time value

Table 2 Transportation Chain Measurements

Earlier, in defining the transportation chain, I recommended that the shipper's point of view be sought out and understood. The same recommendation applies to the identification and definition of the measurements to be taken. The basic operating premise here is that you measure and manage to the customer's value points. If you do that and if you bring real value to the customer beyond that which he can get elsewhere, then you will be successful.

The point is also made here that the traditional customer-supplier relationship may need to transcend into something more meaningful. This discussion advances the idea of shared measurements. This in turn implies shared processes. One doesn't need too much prompting to enter into a discussion regarding shared organizations as well as other items that compose an enterprise.

How do you find and analyze opportunities for performance improvement?

One can overlay the structure of the processes composing the supply chain with measures of value added, and resource and time consumed. An example of this is a modified Level of Visibility Model (LOVM). See Figure 3 Modified LOVM with Measurements.

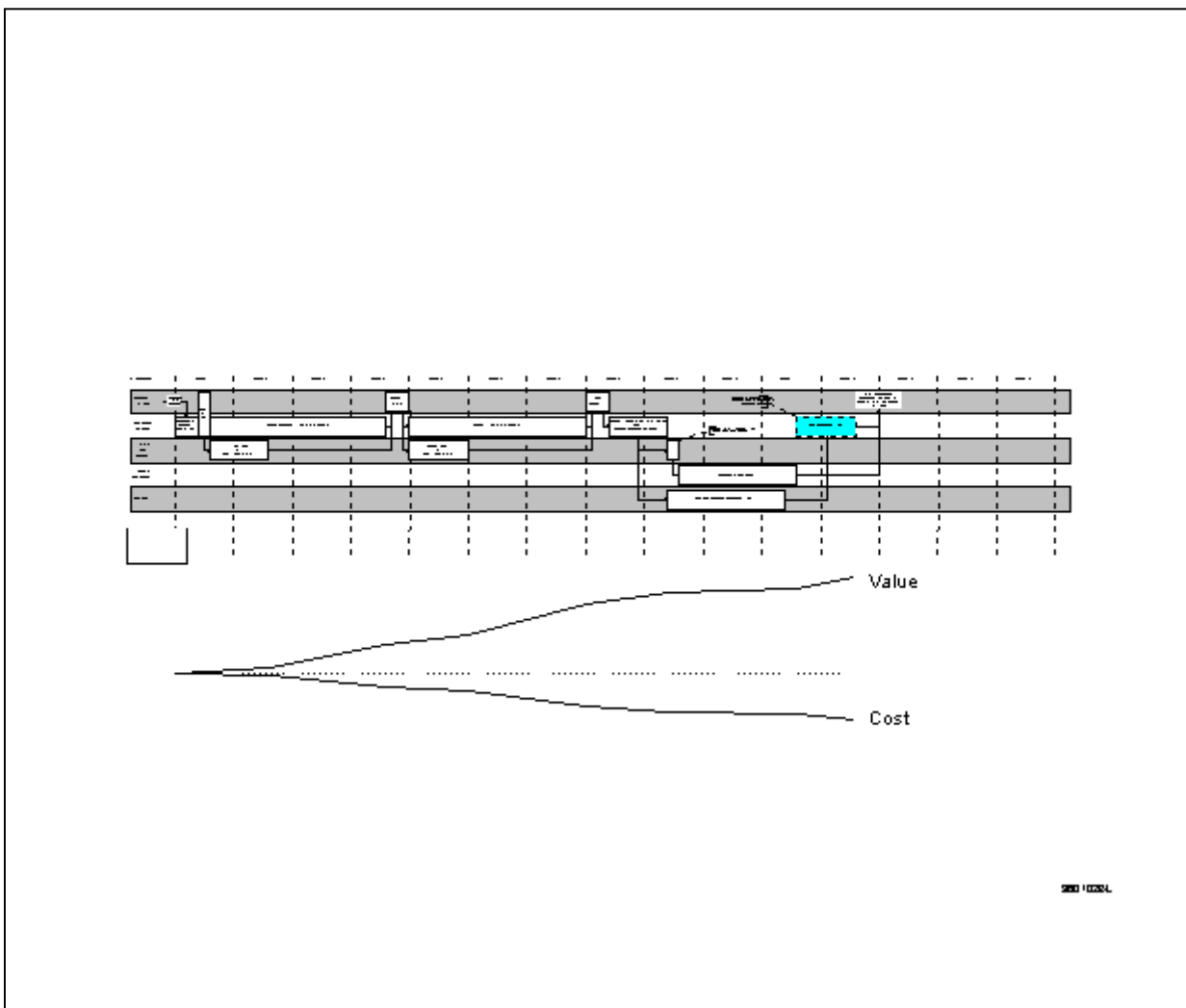


Figure 3 Modified LOVM with Measurements

In Figure 3 time is measured on the horizontal axis. Along the vertical axis are identified the elements of the organization that participate in this process. In this example there are five with one being external to the firm. Each of the rectangles on the chart represents a subprocess. The length of the rectangle represents the time involved while its height encompasses those elements of the organization involved in the process. In this example there are twelve subprocesses, one of which involves two elements of the organization simultaneously. The lines between the subprocesses indicate that the output of one becomes the input of another (i.e.,

the subprocess dependencies are called out). The gray bands simply help distinguish between elements of the organization.

Beneath the process map are two hypothetical lines, composed strictly for illustrative purposes, indicating how cost is consumed and value added by the subprocesses.

Now Figure 3 can be viewed by an expert who might direct our attention to aspects of the process that, in his opinion, seem too long, or too costly, or not producing enough value. Expertise points out the opportunities.

The other thing that can be done is to plot best practice on Figure 3. When compared against current practice the opportunities for improvement will be revealed.

In sum, the transportation chain comprises processes and messages that directly provide value to the shipper. Measurement and management is focused on the shipper's value points. The transportation chain also includes the place-time utility provided by the physical transportation process. Only by looking at the transportation chain from the shipper's point of view can the requisite understanding be developed that enables management and control for optimum business performance.

The Information Chain

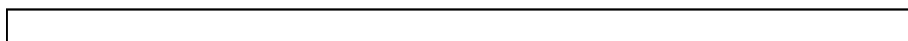
What do we mean by the information chain?

Information resolves uncertainty. In the prior discussion of the transportation chain the messages exchanged between processes remove uncertainty as to intention and accomplishment. They are of a transient nature, generated by a process, received by a process, and, with the exception of recording them as history, cease to be relevant after they have been exchanged.

There is also information that is persistent. This information, or attributes, describes things of interest to us in the business domain (e.g., the location of a customer or the dimensions of a shipping container). These attributes also tell us something about the state of the thing. For example, is the customer credit worthy or not, is the shipping container in transit or not.

The information chain then, comprises objects (the generally accepted term for referring to things of interest in the business domain), including their attributes, and the messages that cause these objects to change something about themselves and to describe themselves. For example, we might direct a container to assign itself to a particular flight number and date thereby changing its state, or we may ask the container to tell us whether it is in transit.

We need some way to describe this linkage of messages and objects. Figure 4 State Trigger Diagram is an example of such an approach.



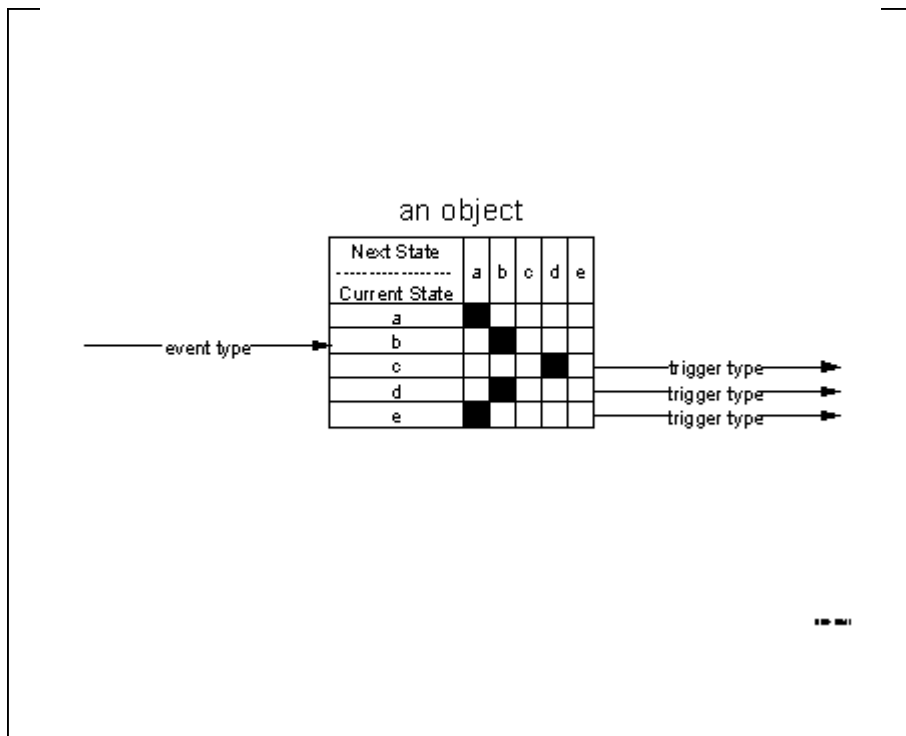


Figure 4 State Trigger Diagram

The object can be in one of a number of states. When it receives a certain event type (recall from the discussion of the transportation chain that events are the inbound messages) there is no *a priori* knowledge of the state of the object. So, the object will choose to deal with the event on the basis of its current state and the rules it carries regarding how state transitions are made. In Figure 4 if the object is in state *a* or *b*, no state change is made. Furthermore, as can be implied from the right side of the figure, no trigger type is generated. The event is effectively ignored.

One can see what will happen if the object is in states *c*, *d* or *e*.

If diagrams like Figure 4 are then linked together one can complete a picture of how the events, objects and triggers are related and interact to achieve some objective. When the picture is complete then one has in hand the information chain.

Here in Table 3 State Transition Table is an example of using a narrative to describe the information chain.

Event	Object and State Change	Trigger
Empty car order.	Car - change the state of cars with characteristics matching the car order from unassigned to assigned.	<ul style="list-style-type: none"> Movement instruction to Train identifying specific cars to moved to comply with the empty car order. Open instruction to Waybill to create templates for cars that will be moved in revenue service when released loaded. Reservation message to Train to reserve space on future train that will move the loaded cars.
Bill of lading.	Waybill - change attributes; change status to complete if all attributes are complete. Car - change attributes.	

Release loaded.	Car - change state of cars to available for pickup.	Movement instruction to Train identifying specific cars to be picked up.
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Table 3 State Transition Table

Now Table 3 is meant only to illustrate this idea, not to be a complete and accurate description of the information chain. State transition tables in a narrative form are useful for explaining what happens in a common language easily understood. The graphical form as shown in Figure 4 is to be preferred from a systems point of view since it more readily reveals inconsistencies.

Figure 4 and Table 3 may seem a bit excessive. However, it is important to recognize that there are two important constituencies -- the IT organization and the user community -- that must know and approve of this description of the information chain. The two different views help do this and, of course, they must be kept in synchronization.

What comprises the information chain and why are these components important?

One is tempted to associate an information chain exclusively with information technology. Since, by some estimates, only 5-10 percent of the information in a firm is digitized, one should consider that there is a very broad context to the information chain.

I propose we keep that in the back of our mind and start with just the portion of the information chain that finds its way into, through, and out of the information technology investment.

Why?

Well, first if all, we want to extract maximum return from the information technology investment. This is very similar to the construct I used in discussing the transportation chain when I intentionally limited the scope to those processes and messages that directly related to providing value to the shipper. Second, the problem is much more tractable when partitioned.

So, the information chain under consideration is that set of messages and objects, and the manner in which they interrelate, that is contained within the information technology investment.

As an aside, I maintain that the information chain is derived solely from the transportation chain. The information chain is, in a sense, imbedded in the transportation chain. We tend to make portions of it visible by using information technology. Now this suggests to me two things:

1. The best way to understand the information chain is to start by understanding the transportation chain.
2. There needs to be traceability from the components of the information chain back to the transportation chain.

What is the contribution of the information chain to the transportation chain and how can this contribution be maximized?

The information chain tells us what is going on in the transportation chain if we ask the correct questions at the correct time and make the correct interpretation of the response.

The contribution of the information chain to the transportation chain is maximized when we focus on those components of the information chain that tell us what we need to know about managing the critical elements of the transportation chain in the optimum manner. This presumes, of course, that we have some notion of optimum which relates directly to the shipper's notion of optimum (as brought out in the first section of this paper), and the performance that can be measured and manipulated through processes to achieve the optimum.

What is the role of information technology in the information chain?

The role of information technology is 1.) to be a means whereby measurement probes (e.g., barcode reader) are imbedded in the transportation chain, 2.) to support quality decisions within the decision window, and 3.) to implement decisions that will effect outcomes in the transportation chain (e.g., issuance of work orders to train crews). The messages from (the events) and to (the triggers) the transportation chain constitute the linkage with the information chain.

The use of information technology should always be traceable to positive impact on business performance. An example of this would be the use of the Internet to speed the exchange of messages and eliminate the human element in this exchange. In this case an impact is made in terms of cost savings and cost avoidance that can be directly traced to the use of the Internet.

We also need a high level technical specification that shows how the objects and messages are distributed across the information technology.

What are the considerations of a transportation chain enabled by information technology versus a transportation chain shaped by information technology?

What has been put forward in this paper is an approach to thinking about the transportation chain, the information chain, the manner in which they are related and ways in which these chains and their interrelationships can be understood and subsequently managed.

In summary, this starts with a high-level view of the dialogue between the shipper and carrier, resolves this view into a set of messages and process, and extracts from this a set of objects and messages which are implemented atop an information technology infrastructure.

The discussion to this point has been driven from the business point of view with information technology serving as a means to enable a high performance business. That is, information technology is shaped by the business.

But the converse is equally valid. A business can be shaped by information technology. An Automated Teller Machine (ATM) is an example of information technology that fundamentally reshaped the banking business. The Internet is an example of a business shaping information technology that is incredibly pervasive.

There are some promising information technologies that bear consideration for their potential to reshape the business in ways heretofore impossible to conceive or impossible to realize. Among them are:

1. High capacity, high reliability wireless communications.
2. Satellite position sensing at submeter accuracy.
3. Combinations of active sensor technology and wireless communication leading to the real-time monitoring of hazardous materials.
4. Object technology leading to change-centric, adaptable businesses.
5. User interfaces more like the problem domain. The window into the information system looks like the window into the real world.

Consideration of these technologies requires one rethink the business from first principles. In fact, some work in the field of object technology suggests that we need to rethink the way we think.

The greatest danger in considering these technologies is that we think about them in a way constrained by generally accepted, readily available and comfortable knowledge, lore, and myth. While paradigm is a somewhat overused word, it is very applicable here. Our existing paradigms are often petrified and their application paralyzes. The hardest and most frightening thing to do when thinking about these new technologies is unlearning what one already believes to be truth.

What are the roles and responsibilities of the interested, affected and effecting parties in this issue?

Understanding the transportation and information chains, their linkages and the manner in which this collection can be managed to result in a higher performance transportation company does not just lie within the purview of the transportation company. There are many parties involved to various degrees. Understanding this set of roles and responsibilities is critical to enabling and/or reshaping a business with information technology. The questions of cultural change dominate: What needs to be done? Can it be done? How will it be done? Who will do it? When?

Table 4 is provided as a means of stimulating discussion in order to arrive at conclusions and decisions for action on this most critical of matters.

Party	Role	Responsibility
The Transportation Company		
The Customers (shippers and consignees)		
The Complementary Service Providers		
The Suppliers		
The Regulatory Authorities		
The Trade Associations		
The Academics		
The General Public		

Table 4 Interested, Effected and Affecting Parties

Under what conditions should one be concerned about the linkage between the transportation chain and the information chain?

The easy way out of this, particularly with the rapid pace of change and constant turmoil that characterizes today’s business environment is to say that one always ought to be concerned. However, always being concerned and always expending effort trying to allay this concern is probably not appropriate. One needs to know when to leave a good thing well enough alone.

On the other hand, one needs to know when to begin to look and look hard at questions of linkage. One needs to see the management of change as not a one-time thing, but something continuous and critical to the business like breathing is to the person. Figure 5 is intended to help illustrate the importance of managing change.

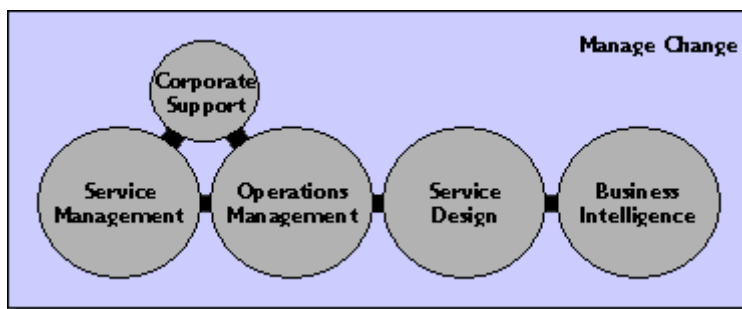


Figure 5 Transportation Meta-Processes

These five meta-processes describe, at a very high level, what goes on in a transportation firm. The significance is that these rest atop a “substrate” meta-process called Manage Change.

Now Manage Change needs to be concerned about, in addition to other things, the linkage between the transportation and information chains. Since these linkages constitute messages we ought to be able to measure the quality and performance of the linkages using the characteristics described in Table 2 Transportation Chain Measurements. To make this work we need to establish performance criteria that, if met, mean that the linkages are appropriate and performing well. We will then let Manage Change monitor these links and alert us when out-of-specification conditions are met.

And, to iterate one more time on the fundamental theme of this paper, start with the customer.

Some Comments on How to Do This

“...marrying up” the transportation chain with the information chain is to improve the performance of the transportation chain. It’s a call to action. It’s appropriate to give some thought as to how to do this.

The majority of comments in this section will deal with people and organizational issues --admittedly the soft issues – but, in the experience of the author, the issues that are the most fundamental and critical of all. I see these issues as associated with two groups of people -- the sponsors and the changers.

The sponsors compose a team of senior executives drawn from the two main parties -- the Customers and the Transportation Company -- to this transportation chain. These senior executives have all the authority required to commit their companies to this endeavor. And they also accept all responsibility for its outcome. Their main purpose is to establish a shared sense of purpose that, I would suggest, is really about how the firms can, by working together, achieve a greater combined value in the marketplace. This represents the desired outcome.

To provide this desired outcome the firms, working together, must have a set of capabilities. It is at this point that some divergence in focus begins to take place. For example, it might be deemed that the shipper must be capable of accurately forecasting demand for product from its customers while the transportation firm must be capable of providing suitable equipment to meet the shipper's service requests. These are clearly two different capabilities, but they must be provided together in order to achieve the desired outcome. The sponsors, together, must determine and agree upon the set of required capabilities.

The final agreement on the part of the sponsors takes place at a tertiary level where they determine and agree on the enablers that must be present to secure the capabilities.

These three things -- outcomes, capabilities and enablers -- when defined and agreed to by the sponsors, represent the blueprint for change. It is this blueprint that becomes the responsibility of the second group -- the changers.

The changers represent a team of executives -- empowered, trusted and held accountable by the sponsors -- drawn from the two main parties and whose objective is the realization of the blueprint. These people are likely to be looked on by the sponsors as the next generation of leadership in the respective firms. They possess knowledge and experience that is both broad and deep across the business, technical and personnel disciplines.

What's being discussed here, and being trusted to the sponsors and the changers, is a transformation of the business of both firms. Experience suggests that there are several factors critical to the success of this endeavor:

Vision

- Senior management driven

- Customer-defined, focused and measured

- Communicated and understood

Top Executive Sponsorship and Involvement

Organization-wide Motivation and Commitment

- Cross-functional teams

- People buy-in and involvement

Measurable Goals and Objectives

Methodical Structured Approach

- Controlled and managed evolution

- Holistic, balanced approach

Professionalism

- Industry knowledge

- Transformation and change management disciplines

Some Summary Comments

I started this paper with the issue:

How to marry up the information chain with the transport chain.

I then departed for an exploration of this issue from the point of view of the shipper. I suggested a way to examine the dialogue between the shipper and carrier as one of the two sources of value to the shipper. The second was the physical transportation.

I argued for adopting a more detailed view of this dialogue in the form of messages and processes. Building on that notion I touched on matters of measurement and introduced the notion of decision windows.

The modified LOVM chart was described as a way to find and analyze opportunities for improvement.

The information chain was considered as imbedded in the transportation chain and information technology used to make portions of the information chain visible allowing us to analyze, decide and act on measures to improve performance. The argument was advanced for describing information chains in terms of message and objects, and adopting a state trigger diagram for their portrayal.

I then briefly dealt with matters pertaining to enabling and shaping technologies, and the roles and responsibilities of the various parties involved in this linkage question. This last point was presented as one of the most fundamental that must be addressed in order to be successful.

Finally, I dealt with the matter of managing change with the strong recommendation it not be an *ad hoc* process left to the wit and whimsy of whomsoever comes along.

This paper represents my view of the fundamental issues, hypotheses and questions surrounding this top level issue of linkage. Some suggestions are made with respect to course of action.

If I have left more questions than answers, and if I have raised points considered meriting of debate, then I have achieved my objective. These are matters that should not be dealt with only by consultants, and managers and front line people of the firm. These are matters that should occupy a reasonable amount of time of the Board and Senior Management of the company.

Previously I said that "...if you bring real value to the customer beyond that which he can get elsewhere, then you will be successful." That's what this paper is all about.

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[1] AL Scheer, A New Approach to Business Processes, IBM Systems Journal Vol 32 No 1, 1993.

[2] Value to the carrier is meaningless outside the context of value to the shipper. Hence, there is no discussion in this paper of anything that produces value solely for the carrier.