REVENUE MANAGEMENT IN THE

FREIGHT RAIL INDUSTRY

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A research report submitted to the faculty of Commerce, Law and Management, University of the Witwatersrand, in partial fulfillment of the requirements for the degree of Master of Business Administration.

Johannesburg

February 2005

ABSTRACT

This exploratory research questions whether revenue (or yield) management, as practiced in other service industries, is applicable to the freight rail industry by garnering the perspectives of rail executives from a select, purposeful sample taken from Spoornet, a division of Transnet Limited, in South Africa.

This research utilised the semi-structured in-depth interview as the data gathering method. There were nine research questions that covered the main research problem and sub problems. Another objective was to ascertain whether state-owned railroads would be permitted to practise yield management. The research questions and resultant open-ended and categorised questionnaire items were based on the literature review.

The significance of this research is to contribute to the knowledge in this field by providing an alternative perspective on yield management for the freight rail environment. In support of this objective, the questions covered aspects of the freight rail yield management problem such as definitions of yield management, it's translation for the railroad industry, how it could be implemented in a freight railroad and the capacity unit that would be the focus of yield management initiatives. Yield management functions and industry characteristics as well as market segments favouring yield management were investigated.

The major findings of this research are: (i) that due to the nature of this industry, there is an *operational aspect* besides a *pricing* aspect to yield management in this industry; (ii) that there are long-term and short-term approaches to yield management in this industry and (iii) that freight rail capacity consists of many types of capacity that are interrelated and care should be taken when implementing yield management compared to other service industries with singular units of capacity.

In conclusion, even though this research has established that yield management seems suitable for freight railroads, its application may differ significantly from the short-term yield management found in other service industries such as the airlines and hotels.

THE DECLARATION

I, Charl Francois Albert Feris, declare that this research report is my own, unaided work. It is submitted in partial fulfillment of the requirements for the degree of Master of Business Administration at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other university.

Charl Francois Albert Feris
28 February 2005

DEDICATION

To my wife, Lizl, Our children,

Azariah

and

Connor – our miracle for 2004.

ACKNOWLEDGEMENTS

- To the interviewees for their willingness to participate in the in-depth interviews
- The staff at the company library for acquiring additional reference material at their expense
- My father who encouraged me during times of despair and disillusionment.
- And my supervisor, Mike Pycraft, for guidance during the research exercise

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1 INTRODUCTION

1.1 Background to Research

The revenue (or yield) management concept was first introduced in the airline industry in the USA soon after deregulation, as a competitive weapon against the new entrants to this market, as outlined by McGill & Van Ryzin (1999).

American Airlines pioneered the use of yield management in the 1980's as a tactical 'weapon' to ward off the low-cost competitors such as *PeopleExpress*.

At that time 'traditional' airlines were characterised by high fixed cost structures that restricted their ability to compete effectively once the market had been deregulated. Smaller upstarts such as *PeopleExpress* soon made significant inroads to existing markets previously dominated by the larger airlines by offering airfares below that of the established airlines.

The market share and revenue of the larger, older airlines soon started to decline and these established airlines soon responded with the concept of yield management as a means to regain profitability and market share.

Burr, former CEO of People Express, summarised the reasons behind *Peoples Express'* 1996 bankruptcy as follows:

"We were a vibrant, profitable company from 1981 to 1985, and then we tipped right over into losing $50 millions a month. We were still the same company. What changed was American's ability to do widespread Yield Management in everyone of our markets. We had been profitable from the day we started until American came at us with Ultimate Super Savers. That was the end of our run because they were able to underprice us at will and surreptitiously. There was nothing left to defend us." (Burr, *undated*).

American Airlines reported that the benefits of yield management were US$ 1.4 billion over 3 years, which translates to an increase of 4% to 5% of revenue. This figure exceeded the net profit of the company over the same period (Smith, Leimkuhler & Darrow, 1992). Yield

management proved to be an indispensable tactical management tool to challenge its competitors, restore profitability and market share.

1.2 Purpose of the Study

The primary goal of this exploratory research is to establish whether the concept of yield management, including the associated functions or activities, can be applied within the freight rail industry**.**

The concept has been applied with success in various service industries such as the airline-, hospitality and tourism-, car rental-, and passenger-rail industries. Yield management has been hailed as a new business strategy (Strasser, 1996) or even a subset of a broader concept called *revenue enhancement* (Shuman, 1991).

However, very little has been researched and documented about yield management in the freight rail industry; even though, Kraft (1996), in his doctoral dissertation, has investigated the applicability of a bid-price approach to revenue management using a reservations based system. Briefly, the overall objective of a yield management exercise is *to maximise the yield or revenue per unit of capacity* as summarised by Kimes (1999).

1.3 Context

The applicability of yield management in the freight rail industry is questioned from both *economic (financial)* and *operational* perspectives; that is, for:

- *the economic aspect* as encapsulated in a quote by Rennicke & Clute (1995:53), "Shareholders seek a solid return, but earnings growth achieved by increasing revenue and market share is prized much more highly than earnings growth driven by cost reductions".
- *operationally* – from a capacity constrained viewpoint; i.e., how best to improve yield given periods of limits to capacity. Low levels of capacity severely limit a freight railroad to improve revenue earnings and sustain its level of service to the industry. There are

limits to operational efficiency and productivity in terms of the revenue-earning potential of assets as stated by Rennicke & Clute (1995).

The yield management technique presents one possible solution to these challenges for freight railroads.

1.4 Problem Statement

The aim of this research is to *explore the perspectives* of a select group of industry practitioners, experts and management of North American class 1 railroads and Spoornet, a division of TRANSNET Limited, with regards to the application and implementation of yield management in the freight rail industry.

1.4.1 Sub Problems

- The first sub-problem. To ascertain how the yield management concept might be adapted for the freight rail industry.

- The second sub-problem. To determine how such ideas for adaptation might influence the approach to implementing the yield management concept.

- The third sub-problem To develop (or identify) a yield management assessment *framework for the freight rail industry, from service industries* where yield management has been applied successfully.

- The fourth sub-problem. To identify the context (if any) for the application of yield management within the freight rail industry.

- The fifth sub-problem. To determine whether the freight rail industry presents unique challenges to the application of the yield management concept.

- The sixth sub-problem. To determine whether there are any differences between the management views of private and state owned enterprises (*or parastatals*) with regards to yield management.

1.5 Importance of the Study

The literature sources have lauded the yield management (hereafter, YM) concept as a 'breakthrough' for service industries in general and suggest the concept can be applied just as successfully in the freight rail transport industry.

(Strasser, 1996) claims that railroads could follow multiple competitive strategies and improve their scheduling decisions to both improve the customer service and lower their costs. Furthermore, YM has the potential to improve performance and increase market share for railroads.

The significance of this study is to determine whether the YM concept can be *transferred* to the freight rail industry, essentially a service industry, as has been done in other industries as mentioned earlier.

In essence, the question of whether this is "snake oil" for the railroad industry Shuman (1991), encapsulates the significance of this research.

1.6 Limitations and Delimitations

- This research is limited to the question of whether the freight rail industry is suitable for the yield management concept.
- The researcher does not attempt to propose methods or solutions to implement the YM concept within the freight rail industry.
- The research will focus on freight rail in South Africa only. Here freight rail encompasses both low- and high volume traffic as well as intermodal (that is, *containerised*) traffic.
- Pricing strategies, as part of yield or revenue management, was not covered in this research study, because of the sensitivity of the topic.

1.7 Assumptions

The assumptions for this research are listed below:

- The identified sources of data are comprehensive and adequate for the purposes of the study
- All selected data sources are readily available
- The time set aside for the interviews was sufficient to extract the relevant data

- It was assumed that commercial or profit-orientated railroads are not restricted from practising yield management

1.8 Structure of the Research Report

The research report commences with a comprehensive literature review in Chapter two (hereafter) in which definitions for yield management from various service industries are outlined to gain a better understanding thereof. Also, the market characteristics that favour yield management are explored, the functions that are associated with yield management are listed, the advantages and disadvantages (or risks) are discussed, and the managerial and critical success factors are elaborated upon as encountered in the various other service industries practicing yield management. Established yield management approaches or solution techniques are outlined for these industries as well.

The application of yield management in other industries such as the airline-, hotel, and rail-passenger industries are noted to gain an understanding of the concept across these various domains. Known research items concerning the freight rail applications of yield management are overviewed.

Chapter three contains the research questions that were formulated based on the literature review and the sub-problems that were generated.

Chapter four discusses the research methodology that was undertaken to complete this study. Here the justification for the research method is presented together with supporting evidence for the sample size selection.

Furthermore, the data collection aspects are covered in which the two data gathering methods are substantiated in relation to the sampling method chosen for this research. In-depth, semi-structured interviews were deemed appropriate for this investigation. Issues of reliability and validity are discussed with reference to the chosen method for this research. Finally, the data analysis methods selected are elaborated upon and substantiated.

Chapter five contains the results of the data-gathering phase. The results are presented according to the structure of the interview schedule and corresponding research questions.

Tables and figures are presented here based on the content and induction analyses of the interview transcriptions.

Chapter six comprises the interpretation and discussion of the results and presents a few arguments that explore the responses to the research questions from the in-depth semi-structured interviews.

Chapter seven concludes with a summary of the findings and provides recommendations for future research concerning the application of revenue management in the freight rail industry.

2 LITERATURE REVIEW

The literature review comprised data sources such as peer-review journals, company annual reports, business journals, and documented opinions of leading practitioners and academics. The literature review is structured as follows:

a. the relevant journals and articles were reviewed to obtain a better understanding and definition of the term yield management as applied to different industries. The interpretation of yield management for a specific (*service*) industry is important, since it governs the yield management functions or implementation approach for the selected domain.
b. a broader comprehension of the concept was gleaned from the applications in other service industries such as airline industry, hotel industry and passenger rail industry.
c. the market characteristics that favour yield management or alternatively, the assessment framework, for the application of yield management was be obtained from relevant sources.
d. the functions that constitute yield management were obtained from the literature
e. the advantages and disadvantages of yield management were identified
f. the managerial issues (or challenges) and risks arising from the implementation of yield management were listed
g. the critical success factors governing the implementation of yield management in general (that is, for industries that have successfully implemented yield management) were identified

2.1 Definitions

- Yield Management (also, referred to as revenue management)

American Airlines, the original adopters of YM, defined the objective of yield management as the following: “to maximise passenger revenue by selling the right seats to the right customers at the right time” (Smith, Leimkuhler & Darrow, 1992:8).

Airline yield management was defined to be “the process by which discount fares are allocated to *scheduled* flights for the purposes of balancing demand and increasing revenues” (Pfeifer, 1989:1).

Shuman (1991:24) had the following insights to yield management: “…is a system of price discrimination that works best in industries with the following characteristics; namely, (a) perishable inventory (e.g., airline seats and train slots); (b) relatively predictable demand; (c) high-fixed and low variable demand; (d) customers with different price sensitivities…”

In addition, he noted that yield management maximises the net revenue by obtaining an optimal balance between capacity utilisation and rate structure integrity. This is achieved by varying the proportion of capacity made available to different market segments in response to changes in demand on a real-time basis.

Furthermore, it was noted that industries that practice yield management often serve two distinct markets; i.e., bulk or contract purchasers who order in advance and a spot market. Finally, the trend with railroads is opposite to that of airlines where the spot market is less sensitive and the bulk market more price sensitive. Lastly, Shuman (1991) perceived the YM concept to be a subset of a broader topic called ‘*revenue enhancement*’, the sole purpose of which is to *provide special service attributes at the highest price the market is willing to pay*.

Lieberman (*undated*) said that yield management is “systems & procedures to maximize results from the sale of a product or service in more or less fixed supply whose revenue producing ability diminishes with time”.

In addition, Lieberman (1993) views yield management as neither a computer system nor set of mathematical techniques; rather, it is an approach to increasing revenues and

improving service by responding to current demand. In short it is a *business process,* a *way of conducting business*.

The following definition by Jauncey, Mitchell & Slamet (1995:25) provides a definition relevant to the hotel industry: "…is an integrated, continuous and systematic approach to maximizing room revenue through the manipulation of room rates in response to forecasted patterns of demand". This process involves the close analysis of historical information to predict future demand. In addition, this process must be monitored to determine the effect of unexpected (non-historical) influence.

Cross (1997), suggested that revenue management is the art and science of predicting real-time customer demand at the micro-market level and optimising the price and availability of products. According to Reed (1998:4), yield management "…is a system or method of analysing a business, with many elements that may be applied differently in different businesses". Furthermore, he claims it is easier to define the objectives of yield management rather than to explain what it actually is; in other words, "the outcomes are easier to understand than the process".

Oberwetter (2001) observes that most companies *practice aspects of revenue management intuitively*. He cites the movie theatres and restaurants that charge reduced prices during periods of low demand such as early morning movie screenings and at lunchtimes, respectively. Both examples are intended to illustrate the practice of attempting to stimulate demand during lower demand times.

Oberwetter (2001) concludes by remarking that these are not true practices of yield management, since these do not "*utilize a continuous and systematic approach to maximizing revenue through the manipulation of price, in response to forecasted patterns of demand, correlated with actual demand*. An *organised, cognizant approach is suggested to manage demand and price to maximize revenue*".

Cross (1997), outlined seven principles of yield management as follows:

- *focus on the price* and *not the costs* when balancing supply and demand;
- replace cost-based pricing with market-based pricing;
- sell to segmented micro markets, not to mass markets;

- reserve sufficient product (or capacity) for your most valuable customers;
- base *decisions on knowledge* and *not suppositions*;
- exploit each products value cycle; that is, price it according to its freshness and the urgency with which customers are willing to purchase it; and,
- continually re-evaluate your revenue opportunities.

Also, Cross (1997) stated that revenue or yield management was the application of disciplined tactics that predict consumer behaviour at the micro-market level and that optimise product (or capacity) availability and price to maximise revenue growth. The question of which level and appropriateness of yield management is suitable, depends on (a) the market-environment, (b) the size and technical sophistication of the company and (c) the marketing-tactics of the company and its competitors.

Weatherford & Bodily (1992) propose an alternative definition to YM, called 'Perishable-Asset-Revenue-Management' or PARM. The view expressed is that a proper definition should be able to describe the broad categories of revenue-management approaches.

Also, the proper term must allow for finding the optimal trade-off between average price paid and capacity utilisation, *and be meaningful in all applicable industries*. PARM, therefore, is defined to be "*the optimal revenue management of perishable assets through price segmentation"* (Weatherford & Bodily, 1992:833).

Furthermore, Weatherford & Bodily (1992), provide two key questions that PARM attempts to satisfy (on a unit-by-unit basis), namely:

- "How many units should be made available initially at various price levels (or, alternatively, what are the optimal pricing levels?)" (Weatherford & Bodily, 1992:833)
- "How should this availability of units change over time as the time of actual availability approaches; that is, when should certain price levels be closed-out or opened up?" (Weatherford & Bodily, 1992:833)

For the purposes of this exploratory study, the researcher regards yield- and revenue management as synonymous; i.e., there is no differentiation between the two terms.

2.2 Characteristics of Yield Management

According to Kimes (1989) the application of a yield management system is not appropriate for all industries. The following six characteristics can be used to determine whether revenue management is appropriate for a particular product or service:

a. *The product or service is perishable.* This means that, at some point, the product becomes worthless because it can no longer be sold, and it cannot be held in inventory for future demand, generally because the time of its availability has passed. For example, once an aeroplane has taken off, the empty seat cannot be sold; also, once a train has departed there is no opportunity to utilise spare capacity.

b. *Capacity of the product is limited.* A *fixed amount* of product is available, and additional inventory cannot be added without a long lead-time, or a significant amount of capital investment or both. For example, a hotel has a certain number of rooms and more cannot be added without costly, lengthy construction. This is similar to airlines, for example, that move planes around to different routes temporarily, when there are periods of high or low demand.

c. *Market segmentation.* The nature of the product is such that it can be priced to appeal and target different market segments. It is important that there is some service or purchase characteristic that the customer can understand as the reason for the price differential (Lieberman, 1993). The time of purchase is often used to segment markets (Weatherford, 1991). Based upon the time remaining until the product can be consumed and other demand factors, it can be priced to appeal to different market segments.

   The airlines are a prime example of market segmentation. An airline seat, on a given flight, within the same class, is the same as any other, but the airlines have implemented a meaningful segmentation strategy that differentiates customers who are willing and able to pay higher prices from those who are *willing to change their behaviour* in exchange *for a lower price*. In other words, if you are price sensitive, you book your ticket well in advance of the flight; if you are not price sensitive, you wait until it is convenient for you to book your ticket.

Weatherford & Bodily (1992) suggest another method to segment customers by utilising *how much business a customer generates*; that is, the larger discounts go to the larger customers. This method is called *quantity discounting* and is a marketing tool – distinct from revenue management.

d. *The product or service can be sold in advance.* Often this is done through reservation systems which, when combined with other technologies, enable a system of forecasting and control to manipulate demand and pricing. Some theatres have advance sales today, but the number of days you can buy the ticket in advance is limited, you have to go to the theatre to actually purchase the ticket, and there is no price difference for buying the ticket in advance.

e. *The variable costs of the product are low.* An incremental sale does not cost the vendor much, but enables the product to be sold at a wide range of prices rather than letting it spoil and go unsold. For example, a hotel operation has high fixed costs and relatively low variable costs. Therefore once the break-even point has been achieved with respect to the fixed costs, any revenue generated in excess of the variable costs would go towards profits (Kimes, 1989).

f. *Demand for the product varies over time.* Revenue management can help to smooth the demand curve by stimulating demand during low demand times and increasing revenue during high demand times (Kimes, 1989).

The list above will be augmented by the additional attributes as listed below:

g. Van der Meulen (1994) noted that a *business or service organisation must have static capacity*. Examples such as hotels with fixed number of rooms; onboard seating in airlines and passenger seating on TGV-trains.

   However, Weatherford & Bodily (1992) have stated that *fixed capacity is not a prerequisite* to practise yield management. Citing car rental companies, railroads and trucking companies as being able to increase capacity at a reasonable cost, substantiates their assertion. But, allowing for this *variable capacity would require complex logistics planning*.

h. "*Demand* for the particular service *ought to be 'direct' and not 'derived'",* Marmorstein, Rossomme & Sarel (2003:162).

i. "*It is expensive or impossible to store excess resource* (we cannot store tonight's room for use by tomorrow night's customer)" by Netessine & Shumsky (2002:3).

j. "*The same unit of capacity can be used to deliver many different products or services* [rooms are essentially the same, whether used by business or leisure travellers]"(Netessine & Shumsky, 2002:4).

k. "*Producers are profit-oriented and have broad freedom of action* (in the hotel industry, *withholding rooms* from current customers for future profit is *not illegal or morally irresponsible*)", by Netessine & Shumsky (2002:4).

Cross (1997), refers to seven '*marketplace uncertainties*' that correspond to these characteristics above, as follows:

- products *and opportunities* are perishable*;*
- presence of seasonal and other demand peaks;
- the value of a product (or service) in different market segments;
- threat of product waste;
- prevalence of competition between individuals and bulk purchasers;
- employing discounting to meet competition; and
- problem of rapidly changing market circumstances.

Furthermore, Cross (1997), states that these uncertainties, when encountered in a specific business environment, will provide the understanding to evaluate how useful YM might be for that business. In addition, these marketplace uncertainties would also assist in the development of appropriate tools and processes for that business.

2.2 Solution Techniques for Yield Management

Kimes (1989) reviewed four solution approaches to yield management that existed at that time; namely, mathematical programming, economics-based solutions, threshold approaches, and expert systems. Noted too, was the characteristic of the YM problem that it needed to be solved repeatedly. Consequently, the solution method should be *fast*, *accurate* and *inexpensive*. *Optimality* is not as important as being *able to provide a fast solution*. These four techniques are outlined in the following sections.

2.3.1 Mathematical Programming

Mathematical programming techniques comprise linear programming, probabilistic linear programming, dynamic and network approaches.

- *linear programming* (hereafter, LP): is the simplest of the approaches above, and relies on a revenue maximisation objective function with constraints of capacity and allocation of capacity to expected demand (Kimes, 1989).
- *probabilistic linear programming:* the basic LP formulation is modified to include constraints in the objective function. These constraints are in probabilistic form. The objective function is still to maximise expected revenue (Kimes, 1989).
- *dynamic programming:* was thought to be the best alternative because of its stochastic dynamic characteristics in relation to the repetitive, sequential and probabilistic nature of the yield management problem. The objective is to maximise expected revenue subject to constraints with states defined as demand (or reservations) at any time before service delivery (Kimes, 1989).

2.3.2 Economics-based Solutions

These approaches concern the trade-off between the expected marginal revenue of various reservations or demand requests over time. In short, the expected revenue from an additional protected high-fare class seat tends to equal the fare-level of the lower fare class (Kimes, 1989). The decision to allocate or protect capacity for different fare classes occurs at this point of indifference. This expected marginal seat revenue (EMSR) method was well developed and researched by Belobaba (1987a), covered elsewhere in this document.

2.3.3 Threshold Approaches

Kimes (1989) observes that many threshold solution approaches are proprietary, but nevertheless a popular method used by hotels and airlines. Basically, threshold curves are complied from historical data based on past booking behaviour and aggregate demand patterns as noted by Cross (1986, cited by Kimes, 1989). Threshold curves are constructed for days of the week and seasons of the year for dissimilar units of inventory. If demand is higher than expected, one more rate categories are closed, or vice versa.

2.3.4 Expert Systems

Kimes (1989) acknowledged the development of *expert systems* and *neural networks* in the field of yield management; however, there was insufficient research to substantiate widespread application of these approaches.

2.4 Yield Management Functions

McGill & Van Ryzin (1999) conducted a survey, which reviewed the 40-year history of (transportation) revenue management. Their main focus was on developments in *forecasting*, *overbooking*, *seat inventory control* and *pricing* as part of revenue management.

Their survey spanned 190 references and each of the four aspects above will be explored briefly according to their survey findings and references. Also, their survey concentrated on yield management within the airline industry, since it had the “longest history of development in revenue management”, McGill & Van Ryzin (1999:233):

a. *Forecasting* – the ability to predict future demand (*disaggregated* or *aggregated*), based on historic information by using a number of techniques, one of which is *time-series analysis*.

b. *Overbooking* – is the practice of ticketing seats beyond the capacity of the aircraft (or passenger train) to allow for the probability of no-shows.

c. *Reservations Control Logic* (seat inventory control)– a component of a revenue management system that controls the availability of seats for different booking-classes.

d. Price discrimination – the practice of charging customers different prices for (perceived) differentiated services; differentiation (~segmentation) could be along a number of factors, that most common being time or market segments (e.g., *first class* versus *economy class* seats in an airplane).

Yield Management tracks and *forecasts demand*, *estimates elasticities*, *reviews* and *may adjust* available *supply* (or capacity); *establishes prices* and *availability of supply* (or capacity) *at each price* (Shuman, 1991). Also, he regards the monitoring of competitors as essential and the unique factors, that influence demand at specific times, should be considered.

"Yield management is about the *marketing mix*, *cost* and *price relationships* and the *distribution of product*. It is a *suite of components* that, when *working in harmony*, will present the *best opportunity to maximise returns*", (Reed, 1998:4).

2.5 Yield Management Applications and Service Industry Characteristics

2.5.1 Airline Industry

McGill & Van Ryzin (1999:1) observed that before 1972, the quantitative techniques in reservations control focused on controlled overbookings. Overbooking calculations centred on predicting the probabilities of passenger numbers who would appear (*show*) for boarding at departure time. Research on overbooking therefore led to advances in forecasting – both *aggregate* and *disaggregate* – of passenger cancellations, no-shows and go-shows. Airlines practise overbooking to minimise the risk of flying with fewer passengers as possible, and thereby safeguarding revenue.

In addition, many airlines in the 1970's began to offer fare products, that is, mixing discount and higher fare passengers on the same flights (McGill & Van Ryzin, 1999). However, no rule existed that could determine the number of seats to reserve for either class because of the complexity involved in determining passenger go-shows which are random events.

Yield management in the airline industry commenced with work by Littlewood in 1972 (McGill & Van Ryzin, 1999). Littlewood proposed that discount fare bookings should be accepted provided that their *revenue value* exceeded the *expected revenue* of full fare

bookings. This *two-fare seat-inventory control* rule became known as Littlewood's rule. Since then research on airline yield management has expanded to comprise the following aspects:

- Forecasting techniques
- single seat-inventory control
- network seat-inventory control with (a) mathematical techniques, (b) bid-price aspects being overviewed here.

An overview of each approach is presented on the following pages.

2.5.1.1 Forecasting Techniques

Forecasting, in the context of airline YM, is critical since the *booking policy* and ultimately, airline revenue are dependent on it (McGill & Van Ryzin). As mentioned before, overbooking and forecasting are two-sides on the same coin, because overbooking is involved with predictions of passenger demand cancellations and no-shows.

Forecasting in the airline industry typically involves models for demand distributions, (customer) arrival processes, *uncensoring* of demand data, and aggregate versus disaggregate forecasting. *Uncensoring* of demand data refers to 'real' demand in the absence of booking or capacity limits as reported by Swan (1990, cited in McGill & Van Ryzin, 1999).

However, disaggregate forecasting for both YM and overbooking is extraordinarily difficult due to the number of variables and customer behaviours (McGill & Van Ryzin, 1999).

2.5.1.2 Single seat-inventory control

The single seat-inventory control solution deals with the allocation of a finite seat inventory to demand that occurs over time and each flight leg is optimised separately (Pak & Piersma, 2002).

The approach involves a trade-off between opportunity costs versus the maximisation of expected future revenues that is incorporated into *booking policy*. This booking policy might be either *static* or *dynamic*. Littlewood's rule is an example of a *static* booking policy that remains valid for a certain period before the departure of a flight; whereas, a *dynamic*

booking policy would adjust the booking policy to changes in actual demand (Pak & Piersma, 2002).

Belobaba (1987a) improved on Littlewood's rule to include multiple nested fare classes and introduced a new term called *expected-marginal-seat revenue* (EMSR) to describe the general case.

Belobaba's method has been termed EMSRa, and produces nested protection levels, that is, these levels are defined to be the number of seats protected for the fare class *and all higher classes*.

2.5.1.3 Network seat-inventory control

In this approach, the objective is to optimise the complete network of flight-legs offered by an airline, *at the same time* (Pak & Piersma, 2002). One approach is to distribute the revenue of an origin-destination itinerary over its flight legs, called *prorating*, and apply single seat inventory control to the individual legs (Pak & Piersma, 2002). Williamson (1992) investigated various *prorating strategies* by considering mileage and the ratio of local fare levels.

Glover *et al* (1982) presented a *mathematical programming* method to solve the network-seat -inventory control problem. The problem was formulated as a minimum cost flow problem. The aim was to find the arc/route/leg that maximised revenue, without exceeding capacity constraints on the legs/arcs/routes *and* the limits of the demand forecasts for the origin-destination-fare combinations.

Bid-price control methods involve assessing the value of an origin-destination fare (ODF) itinerary as the sum of the bid-prices assigned to individual legs in the itinerary. An ODF request is accepted if the fare exceeds the total bid-prices. A *bid-price* is defined to be the net value for an *incremental seat* on a particular flight leg in the airline network (McGill & Van Ryzin, 1999).

2.5.2 Hotel Industry

Yield management in the hotel industry, as mentioned earlier, is the process of allocating the right type of capacity to the right kind of customer at the right price so as to maximise

revenue; or, the number of rooms that should be sold at various rate levels (Kimes,1989). YM in the hotel industry exhibits many of the market or industry characteristics referred to earlier, but there are unique challenges in this industry, as noted by Kimes (1989). Only two of these challenges will briefly be discussed here, namely:

- *multiple-day stays*: hotel guests often do not stay over for one night only; consequently, this poses problems for a hotel in deciding to quote the appropriate rate for customers staying over peak periods when different rates are applied;
- *multiplier effect*: rooms are not the only revenue-earning facets of a hotel; however, there are additional services that could be offered - each presenting associated costs as well.

Orkin (1989) distilled the function of hotel managers to that of *generating revenue from space* and coined a basic "yield statistic" for the hotel industry that was calculated by dividing the *realised revenue* by the *potential revenue* or differently, *occupancy ratio* multiplied by *average rate ratio*.

Weatherford (1995), referred to his previous collaboration on yield management (Weatherford & Bodily, 1992) that was redefined as perishable-asset-revenue-management (PARM), and mentioned that for the hotel industry this would be the trade-off between *average daily rate* and *occupancy* levels.

Baker & Collier (1999) define YM as an intelligent approach to *dynamic pricing* and *reservations control* of a perishable asset across customer types. Furthermore, reservations control is the process by which assets are made available-unavailable to customers. Also, the essence of reservations control is to systematically accept or reject reservation requests to maximise benefits to a hotel. Reservations control becomes necessary when the total room utilisation in the hotel is high.

Baker & Collier (1999) also decompose *reservations control* into (a) allocation, and (b) overbooking. These aspects are summarised below:

a. *allocation*: involves the dynamic reservation limits placed on each customer category. The limits are required to be dynamic, due to the stochastic nature of customer demand (Baker & Collier, 1999)

b. *overbooking*: is the limit on the total amount of rooms in excess of the physical stock that can be sold across all types of customers at a point in time (Baker & Collier, 1999)

Baker & Collier (1999) observed that there was a dearth of research on the YM heuristics for the hotel industry and consequently developed 5 heuristics that were tested against thirty-six realistic, known hotel operating environments. These heuristics were based on work done by Weatherford (1995) and Bitran & Mondschein (1995).

The heuristics were evaluated by means of a simulation that Baker (1994) developed. Several insights were obtained regarding the application of these heuristics in each of the thirty-six operating environments. The main determinant/criterion was the percentage increase in the revenue over a 14-day time-period.

The five heuristics were developed for the hotel industry from work done by Relihan (1989) and Weatherford (1995) and are outlined below:

a. threshold method A: this is basically a first-come-first-served approach (Relihan, 1989)

b. *threshold method B*: the simplest of the five heuristics that does not deny access to the highest paying customer unless the rooms are fully booked (Relihan, 1989).

c. nested by deterministic model shadow-prices (NDSP) method: this decision-rule adds the length-of-stay variable to conventional heuristics that do not account for multiple-day stays.

d. hotel nested network method: similar to the NDSP –method above, except that the linear program solved, permits overbooking (Baker & Collier, 1999).

e. hotel bid-price method: this method accepts or rejects a reservation request based on whether or not the expected revenue exceeds the opportunity cost of removing the room from inventory (Baker & Collier, 1999).

Of the seven conclusions to this research, the most significant was that the simple heuristics performed just as well as the more complex ones across many of the operating

environments (Baker & Collier, 1999). The researchers note that this is critical for hotel managers in that the time and expense in developing and maintaining more complex heuristics is often not justified.

The lessons to be learned from the hotel industry is *how not* to implement yield management, since the problem of 'inverted' pricing practices is similar to railroads – according to Shuman (1991). Hotels had a different view of business travellers compared to the airlines: these were perceived to be individual travellers in groups that represented their companies.

Consequently, the hotels negotiated large discounts with companies to ensure their patronage. Thus, the *customers who were least price sensitive were offered discounted rates* in the effort to generate a base load. In conclusion, the leisure travellers were then charged higher rates than for the business travellers.

2.5.3 Passenger Rail Industry

Queille & Silva (1994) provide an overview of the passenger rail market in Europe by reviewing the transfer of yield management to the passenger rail industry. The stimulus, according to them, was the search for improved profitability from long-distance passenger services with the introduction of a wider range of fares to suit different classes of passenger. Keeping track of all these options is achieved by implementing yield management.

The adoption of yield management is seen as a 'natural progression', since in Europe the high-speed TGV-train services compete directly with the airlines. The French railways, SNCF, adopted yield management in 1993, after Amtrak did the same two years before in 1991. The same service provider, Sabre, installed the first system at SNCF; however, the system had to be modified for rail applications. But, the central functions of *central reservations*, *forecasting* and *pricing* were retained.

The TGV-train sets, like the airlines, have fixed-capacity (*static capacity*), and customers are not allowed to stand in the trains. Additional coaches could not be added to the overall configuration. Consequently, demand forecasting and reservations control became paramount due to the number of routes and reservations that needed to be accounted for. The system was eventually upgraded in terms of computing power and functionality and was

then called Resarail – this became the core of the new *Socrate* system unveiled in the spring of 1993.

Kraft, Srikar & Phillips (2000) have also acknowledged that yield management systems are well established in the passenger rail industry. As mentioned above, the installation of the first *automated railroad revenue management system* at AMTRAK was a milestone for the passenger rail industry.

AMTRAK was able to gain an increase in incremental revenues of 3% to 5%. The *primary objective* of revenue management at AMTRAK was to prevent short-distance, low-revenue passengers from blocking out peak load segments that could be sold to high-revenue riders (Kraft, *et al*, 2000). AMTRAK's revenue management system is based on the expected-marginal-seat revenue (EMSR) model developed by Belobaba (1987a).

2.5.4 Freight Rail Industry

Kraft, Srikar & Phillips (2000) have outlined the nature of revenue management applications in the railroad industry for both the passenger and freight domains. The researchers have covered the following: (1) common characteristics of railroad problems, (2) the major differences between passenger- and freight rail, and (3) price discrimination and traffic mix optimisation, and (4) three distinctive approaches to revenue management.

2.5.4.1 Common Characteristics of Railroad Problems

The common characteristics of railroad (both passenger and freight) problems are the following:

- the railroad revenue management problem tends to be highly *network orientated*;
- the *booking arrival patterns are independent of fare class value*; and
- tend to have *very short booking lead times*. (Kraft et al, 2000:161).

2.5.4.2 Differences between Freight- and Passenger Rail Problems

Kraft *et al* (2000) listed a few critical differences between passenger- and freight rail problems that served to highlight the challenge posed for adopting YM in the freight rail industry; these were:

- freight revenue management focused on the *development of achievable service commitments and improved service reliability* – as opposed to *price discrimination*.

- freight has *no inherent mobility*; that is, it must *always be handled operationally* versus maintaining a strictly sales and marketing relationship as with passenger rail services.
- as mentioned earlier, although booking lead times are short, the traffic retention is quite long; meaning that the delivery or throughput time on rail could be longer than one day.
- a freight rail operation has the ability to displace a lower priority shipment at an intermediate terminal, in favour of a new load.
- passenger-rail businesses have a mass-market approach; whereas, freight railroads serve a relatively small number of *industrial customers*. In this instance, the customers are acutely aware of their- and their competitors' relationship with the freight rail service provider and hence, *price discrimination* might be hampered.
- in freight rail, contracted prices are often negotiated far in advance of the service actually being delivered and these are only adjusted annually.
- freight rail involves service contracts which limit the rejection of demand.
- intermodal (container) business is often characterised by transport brokers which mediate between customer and railroad, thereby minimising control over pricing options (Campbell, 1996).

2.5.4.3 Price Discrimination and Traffic Management

Price discrimination refers to customers who pay different prices for essentially the same service; whereas, *traffic mix optimisation* entails different prices for different categories of services; for example, *short* versus *long* distance traffic. The objective is to find the right 'mix' of short- and long distance traffic to maximise revenue at the available capacity, *or other combinations of service and/or market factors*.

2.5.4.4 Approaches to Railroad Revenue Management

Three approaches to the railroad yield management problem were discussed, namely, (i) *capacity allocation by fare class* (essentially a solution of a mathematical model that generates the required allocation levels by fare class); (ii) *bid-price method* and (iii) *direct price adjustment*. The latter two are both data intensive due to the number of calculations and frequency of updates required.

Kraft *et al* (2000) suggested that the bid-price approach would be suitable for the freight rail YM management problem because of the following:

- this method easily accommodates network traffic management problems due to the simple control mechanism of *not accepting a booking request* if the revenue does not exceed the bid-prices (or opportunity costs) for the legs traversed; and
- bid-price revenue management systems for freight rail would be well suited to the short booking lead times mentioned earlier, since this method could also handle any booking arrival pattern.

2.5.4.5 Contradiction to Freight Rail Revenue Management

In contrast to the industry-wide applications of YM, Van der Meulen (1994) argued that the yield management problem could not be adapted to freight rail due to the following:

i. railway asset scheduling occurs on a probabilistic basis. Consequently, it may be impossible to satisfy customers and at other times there may be a surplus of assets
ii. the offer of deals to manage capacity, as in airlines and the car rental businesses, is not feasible since a railroad is unable to deploy capacity *with sufficient precision* or predictability.

To enable yield management, a business organisation must be able to precisely schedule the use of all its assets. For a railway industry such a concept is complex due to service disruptions and *service redesign issues* that have to be accommodated. In industries, "*where assets are static, this problem is less severe, because there are fewer degrees of freedom"*, *as noted by* Van der Meulen (1994:9).

2.5.4.6 The Nature of the Freight Railroad

Lawless (1990), in his article on the future of railroads, analysed the basic elements of the railway concept according to three aspects, namely:

i. a railway is a fixed guide way running in its own controlled corridor, unimpeded by other forms of traffic found on ordinary highways
ii. because of the low-friction characteristics of steel on steel, a railway is a heavy-duty system, translating into large weights being conveyed in freewheeling units.
iii. these freewheeling units are linked together into a train, which has a carrying capacity many times greater than any single vehicle. The train's power units thus have a very high ratio of carrying capacity to energy expended. Therefore, a railway is inherently a high-volume carrier of heavy trainloads. The reason is that a railway is a high-overhead

carrier that is financially sustaining its own plant and right-of-way (infrastructure). Railways are therefore most economical when they move trainloads over relatively long distances on heavily used lines or dense networks.

2.6 Advantages and Disadvantages of Yield Management

The advantages and disadvantages of yield management are presented below.

2.6.1 Advantages

The advantages of yield management obtained from literature are:

- Strasser (1996) claimed that railroads could improve their yield or bottom-line returns over time by implementing yield management.
- Increase in market share, since more price sensitive customers are now accommodated (Strasser, 1996).
- Better utilisation of spare capacity, since capacity is allocated to the 'correct' market segments (Campbell, 1996).
- Improved market segment (or customer) information, which can be used to improve the service offering (Strasser, 1996).
- "*An indispensable tactical management tool*" to challenge competitors in a firm's operating environment (Shuman, 1991).

2.6.2 Disadvantages

The disadvantages of yield management may be interpreted as challenges as well.

- Lieberman (1993) highlighted the problem of massive investments in computer technology and revenue management software.
- Shuman (1991) noted the perceived reduction in quality and image (by customers) due to price discounts; where discounts were associated with a drop in service levels. Loyal customers may no longer feel 'special'.
- Kimes (1994) investigated the perceived fairness in the pricing strategy or with price discrimination practices, especially if the service differentiation is not obvious or distinct.
- *Customers may resort to opportunistic behaviour*, once the pricing strategy (discount periods) becomes known.
- Shuman (1991) mentioned that historical data might not be complete for demand forecasting purposes.

2.7 Yield Management Assessment Framework

An assessment framework is required in order to establish whether the freight rail industry is 'yield management-friendly'. The basis for this framework was adapted from:

a. The broadly accepted characteristics of yield management or the preconditions of the industry (or market) as referred to earlier.
b. A classification system developed by Weatherford & Bodily (1992), to encompass the range of problems presented by perishable-asset-revenue-management (PARM) will be utilised as well. The taxonomy consists of fourteen elements, the first eleven describing the nature of a possible PARM-problem and the last three relate to the choices made by the decision or researcher framing the problem (Weatherford & Bodily, 1992).

   Each element also has a descriptor associated with it, which are listed from the simplest to more complex assumptions. A table listing the fourteen elements of the classification system and their descriptors is presented here.

Table 1: Comprehensive Taxonomy of PARM Problems

NUMBERING	ELEMENTS	DESCRIPTORS
A	Nature of the Resource	Discrete/Continuous
B	Capacity	Fixed/Non-fixed
C	Prices	Predetermined/ Set optimally/Set jointly
D	Willingness to Pay	Build-up/ Drawn down
E	Discount price Classes	1/2/3/…/I
F	Reservation Demand	Deterministic/Mixed/Random-independent/Random-correlated
G	Show-up of discount-reservations	Certain/Uncertain without cancellation/Uncertain with cancellation
H	Show-up of full-price reservations	Certain/Uncertain without cancellation/Uncertain with cancellation
I	Group reservations	No/Yes
J	Diversion	No/Yes
K	Displacement	No/Yes
L	'Bumping' procedure	None/ Full-price/ Discount/ FCFS/ Auction
M	Asset Control Mechanism	Distinct/ Nested
N	Decision rule	Simple static/ Advanced Static/ Dynamic

Source: Weatherford & Bodily (1992:835)

An example is presented here to demonstrate the utility of the classification system above; namely, for a simple, generic allocation problem, the classification would be [A1-B1-C1-D1-E1-F2-G1-H1-I1-J1-K1-L1-M2-N1].

Or stated differently, using the elements and descriptors: *discrete* resource, *fixed* capacity, *single* fare class, *mixed* demand for reservations, both discount and full-paying customers are expected, *no* group reservations, diversions and displacements, the asset control mechanism is *distinct* and the decision rule is *simple static*.

c. Lastly, the nature and complexity of the freight rail business was analysed to extract the most pertinent attributes that are relevant to the yield management challenge in this field.

2.8 Managerial Challenges

Weatherford & Bodily (1992) cited three managerial problems under the banner of PARM; namely: (1) management objectives; (2) constraints and (3) costs. Several *management objectives* were listed; however, only a few pertinent ones are mentioned and briefly discussed here:

a. *maximise profit (or contribution)*: contribution to fixed cost is defined as revenue minus variable cost, while profit is contribution less the fixed costs and incorporates tax as well.

b. *maximise capacity utlisation*: this goal focuses on selling every available unit of capacity – even possibly to the detriment of the price obtained. Sales personnel might use this approach if measured on the number of units sold.

c. *maximise average revenue per customer*: this objective yields results opposite to the one above; for example, if an airline focused on this goal only it would obtain only one full fare passenger on a 747.

d. *maximise revenue*: in this objective, the cost implications are ignored because these are fixed, negligible or not relevant for the decision at hand.

e. *minimise lost customer goodwill*: a company might decide not to re-open discount fare classes once these have been closed. However, this decision seldom ‘operates’ in isolation.

f. *extract each customer's maximum price*: not generally possible in PARM situations, since this would involve tough *negotiations with every customer*.

Possible *constraints* facing managers in PARM problems were:

a. Operational constraints: two different classes of constraints are presented by Weatherford & Bodily (1992), namely: (i) a fixed capacity of units to allocate, such as the number of hotel rooms, seats on an aircraft or passenger-train and (ii) other operational constraints such as scheduled routes, number of planes and frequency of flights in the case of an airline.

b. Marketing constraints: this is referred to as "the minimum tolerable customer-service levels" and Weatherford & Bodily (1992) state that this can be measured in various ways such as the number of customers denied a reservation or complaints received with regards to inconsistent pricing practices.

c. Strategic constraints: these involve (i) interventions by top management that complicate the company's operating environment and (ii) competitor activity in the same industry or marketplace.

In addition, Weatherford & Bodily (1992) identified two relevant costs to consider in PARM decisions; namely:

- *Variable costs* for the unit of product or service
- *Re-imbursement costs* associated when a customer is denied a reservation or is "bumped". Weatherford & Bodily (1992) claim that this cost is more difficult to measure, since *lost goodwill* cannot be directly observed.

Kimes (1989) outlined key issues for management in the implementation of YM for the hotel sector; these are:

- *Alienating customers*. There is inevitable risk in losing key customers, since yield management might be seen as an unfair practice. Kimes (1989) suggests informing the customers of the organisation's intention to adopt YM concepts in its pricing strategy.

- *Employee-morale problems*. Employees might feel “dis-empowered” in that pricing decisions are now prescribed by a computer system.

- *Incentive and reward systems*. Sales personnel might be affected by the new approach to sales revenue targets, as these would be adjusted more frequently depending on the demand and capacity trade-offs.

- *Employee training*. Knowledge about the new YM system in the company is imperative for success and consistency in application of the YM initiative.

- *Organisation of the yield management function*. Will *decision-making* be centralised or decentralised? And who (multi-disciplinary team or department) will manage the overall project or business process?

- *Commitment of top management*. As with any large-scale implementation in any organisation, the buy-in and support from top-management is crucial to the success of the YM initiative. A proposed YM implementation demands changes and co-operation throughout the organisation.

2.9 Critical Success Factors of Yield Management

Shuman (1991) suggested 6 steps that would determine of the success of YM in the railroad industry; these were:

- *Define both the short- and long-term goals of the revenue enhancement program*: long-term goals of the railroad should be modified as the revenue management capability of the firm improves.

- *Institute a revenue enhancement group in the organisation*: the focus should be on non-conflicting responsibilities, empowerment through senior management support, reporting mechanisms and sufficient funding to meet its objectives. Feedback channels are essential and a review process must be in place to co-ordinate the revenue and (customer) service objectives with performance.

- *Conduct market research to provide the base data on which initial price and service offerings may be designed*: Shuman (1991) suggests that new sources of information be combined with new perspectives to redesign the market segments in lieu of the new approaches to pricing. Also, a competitive monitoring function might be established together with is research exercise.

- *Verify the feasibility of service offerings with a co-coordinated, effort with all role-players*.

- *Design and acquire (decision) support systems*: Shuman (1991) proposes that these systems should be compatible with current databases and use existing hardware – thus minimising the technology investment needs. Secondly, these systems should also be expandable (*scaleable*) to accommodate future enhancements to the revenue management process.

- *Inform the sales personnel and co-ordinate the advertising program with the YM implementation*.

Cross (1997), listed nine steps to guarantee a successful implementation of YM for service industries of which three are different from the factors given above; namely:

- evaluate the organisation and its processes;
- quantify the benefits of YM;
- evaluate the success (or conduct a post implementation review).

Harris & Peacock (1995) borrowed extensively from the airline industry in compiling their ten steps to successful yield management, of which three are valid for service industries in general; these were: (i) determine whether *market segmentation is viable*, (ii) identify service differentiators and (iii) develop a competitor surveillance system.

In conclusion, the following insights have been gained from the literature survey on yield management in the service industries that were covered, namely, that the concept was suited to unknown, small and erratic demand (passengers or hotel patrons) that has no formal relationship with the service provider. This is evident in the airline and hotel industries. Yield management in these industries focused on short-term benefits and involved frequent, repeated and computerised solutions or algorithms.

The equivalent in the freight rail industry would be non-contract, wagonload traffic, the customers of which would have transport options and therefore use rail on an ad hoc basis. That given, and the nature of the rail industry that relies on high traffic volumes (typically unit load traffic) to break-even or turn a profit, having these ad hoc customers is incongruent with the nature of freight rail. Hence, yield management, on the surface, when compared to other service industries, might then apply to this segment or traffic category.

Lastly, the research questions that followed from this literature survey are listed in the following section.

3 RESEARCH QUESTIONS

Given the literature review findings, the following research questions were compiled to explore whether yield management is suitable for the freight rail environment:

- The first research question. What are the current perspectives of railroad management on the adaptation of YM to the freight rail industry?

- The second research question. What approaches to yield management have been developed for the freight rail industry?

- The third research question. Are the service industry characteristics that favour the application of yield management, evident in the freight rail industry?

- The fourth research question. Which market segments (of a railroad's overall customer-base) would conform to these characteristics?

- The fifth research question. Are the functions or activities associated with yield management prevalent in the freight rail industry? (Consider car- and intermodal traffic)

- The sixth research question. What do customers expect from a freight rail service?

- The seventh research question. What are the responsibilities or mandate of the managers of freight railroads?

- The eighth research question. What are some of the (operational) complexities associated with freight rail that may help or hinder YM systems?

- The ninth research question. What, according to management, would be the critical success factors for the implementation or use of YM in freight rail industry?

The consistency *matrix* found in Appendix B indicates the thread of logic between the sub-problems, literature sources and the research questions. The research methodology is outlined in the following section.

4 RESEARCH METHODOLOGY

A justification and overview of the selected method for this research is presented below, together with a brief description of the *nature* of the chosen method, its advantages and potential shortcomings and data analysis method(s) associated with it.

4.1 Qualitative Research Method

The researcher selected the qualitative research method because of the following reasons:

- *few literature sources were available* (Leedy & Ormrod, 2001) on the application of yield (or revenue management) in the freight rail industry;

- the *application of yield management in the freight rail industry is a complex problem* that requires an in-depth investigation by either semi-structured interviews or a questionnaire; or both (Leedy & Ormrod, 2001; Marshall & Rossman, 1989)

- the research is *exploratory in nature* (Marshall & Rossman, 1989; Cooper & Schindler, 1998;Leedy & Ormrod, 2001).

It was envisaged that the qualitative study would obtain the essence of the research problem by *induction* - through the perspectives of the purposive sample.

Miles & Huberman (1994) and Maykut & Morehouse (1994) note that qualitative data is usually in the form of words and not numbers and "are a source of well-grounded, rich descriptions and explanations of processes in *identifiable local contexts*", Miles & Huberman (1994:1). Furthermore, one can preserve chronological flow with qualitative data and "see precisely which events lead to which consequences, and derive fruitful explanations", Miles & Huberman (1994:1).

Also, a good set of qualitative data would likely lead to new findings, integrations and generate or revisit conceptual frameworks. Lastly, Miles & Huberman (1994) claim that the findings emanating from qualitative studies have a characteristic of "*undeniability*". In addition, words are more concrete and meaningful than pages of summarised numbers, according to the authors.

However, a few of the disadvantages of the qualitative research method are the:

- labour intensiveness of data collection;
- data overload;
- potential of *researcher bias*;
- time associated with the processing and coding of data;
- adequacy/sufficiency of data samples when only a few cases have been investigated;
- *generalisability* of the findings and the credibility and quality of the conclusions (Miles & Huberman, 1994).

Conversely, Miles & Huberman (1994) note a few of the strengths of this research method as the following:

- data is collected very close/in proximity to the specific situation;
- the richness and 'holism' of the data and the strong potential for revealing complexity;
- the inherent flexibility of this type of study in that data collection times and methods can be varied as the study unfolds.

Some of the features of qualitative research, as noted by Miles & Huberman (1994), are:

- the researcher tries to capture data on the perceptions of the local actors "from the inside"
- reading through these materials, the researcher may isolate certain themes and expressions

- many interpretations of this material are possible, but some are more compelling for theoretical reasons or on grounds of internal consistency.
- the researcher is the main “measurement device” in the study.

Miles & Huberman (1994) mention three ‘concurrent’ activities that are associated with qualitative data analysis; namely, (a) data reduction (or coding); (b) data display and (c) conclusion drawing or verification. Each of these activities is briefly discussed below.

- *Data Reduction:* refers to the process of selecting, focusing, simplifying, abstracting, and transforming the data as encountered in the written-up fields notes or transcriptions (of interviews). Reduction occurs even before data collection occurs, since the researcher has to decide on the conceptual framework, which research questions and which data collection approaches to select.

  Data reduction is not separate from analysis; it is part of the analysis. The researcher’s decisions are all *analytic choices*. Data reduction is a way of focusing, sharpening, discarding and organising of data to enable the final drawing of conclusions and verifications.

- *Data Display*: Miles & Huberman (1994) regard a display as an organised, *compressed* assembly of information that permits conclusion drawing. Displays facilitate the understanding of the content under investigation and assist the researcher in drawing valid conclusions or in collecting additional information for completeness. As with data reduction, data displays are part of the analysis.

- *Verification*: Miles & Huberman (1994) note that from the start of the investigation the researcher is already deciding on the meanings of statements, is noting patterns, regularities and inconsistencies, causal flows and propositions. They maintain that final conclusions might only appear towards the end of the study; but, already, these conclusions have been *prefigured* - even when the researcher claims to have adopted an *inductive approach*. Conclusions are also verified as the analysis proceeds.

This research investigation might also be regarded as *interpretive*, in that, meaning and conclusions are drawn from the raw data – the interview transcripts. Mason (2002) observed that *interpretivist approaches* regard people, their interpretations, perceptions, meanings,

and understandings as the primary data sources. *Interpretivism* is not dependent on the '*total immersion in a setting*' and could therefore support a study which utilises interviews as the method of data collection – "where the aim is to explore people's collective understandings and reasoning processes", Mason (2002:56).

Maykut & Morehouse (1994) maintain that the *goal* of qualitative research *is to discover patterns* that emerge after close study, careful write-ups and insightful analysis of the research topic. What could be discovered by this method is *not sweeping generalisations but contextual findings*. In summary, the outline of this qualitative research is illustrated in Appendix A.

4.2 Research Population

The population consists of staff members of the senior management cadre, from middle management to chief executive officer of Spoornet, a division of Transnet Limited, South Africa. The population amounted to approximately 160 individuals representing the different functional units, identified for this research, across this railroad.

4.3 Sample Size and Selection

The researcher selected a purposive sample from this research population for the data gathering method in this research. The sample selection and size is outlined below.

This investigation relied on a purposive sample of individuals that are experienced and knowledgeable regarding the freight rail industry in South Africa and the concept of yield management and its possible application in this domain.

The sample included individuals with at least 10 or more years of experience in the freight rail industry and from different backgrounds such as finance, rail operations, marketing (or sales), information technology, and strategic planning (or business strategy). The participants were mainly selected from the Spoornet head quarters' complement where all company-wide decisions are taken.

The individuals from these functional were approached for the in-depth interviews. The objective was to gather different perspectives on the application of yield management and its impact on the organisation.

Seventeen individuals based on their experience and general knowledge and awareness of yield management were approached to participate in the in-depth interviews. Thus the sample was purposive and convenient in nature, given the time and availability of the interviewees and the time-consuming nature of the selected research method.

The final sample size chosen was twelve, due to: (a) poor responses from two participants; (b) having one interview session being dominated by a participant who deviated from the questionnaire completely; and (c) not being able to have a follow-up interview with another candidate to clarify responses. As a result, the researcher in his discretion resorted to replacement sampling. Maykut and Morehouse (1994) state that a sample size of as small as twelve participants is adequate for a qualitative research method based on in-depth interviews as the primary data gathering method.

4.4 Sampling Methodology

The sampling approach above was selected to obtain various perspectives on the yield management concept *within* a railroad entity. The insights from the in-depth interviews might reveal dissimilar ideas, views or concepts on the subject for a freight rail entity – and for the freight rail industry in general.

Criteria for the selection of the sample is presented below:

- selected individuals are familiar with the subject
- participants have at least 10 years or more of railroading experience
- participants possess a thorough understanding of their environment and departmental activities and a general overview of the railroad.

4.4.1 Detail of the Purposive Sample

The researcher chose the purposive sample from a stratum of the top management cadre of Spoornet, a division of Transnet Limited, South Africa. The sample comprised the two lower levels of top management as enclosed by the dotted line in the following organigram.

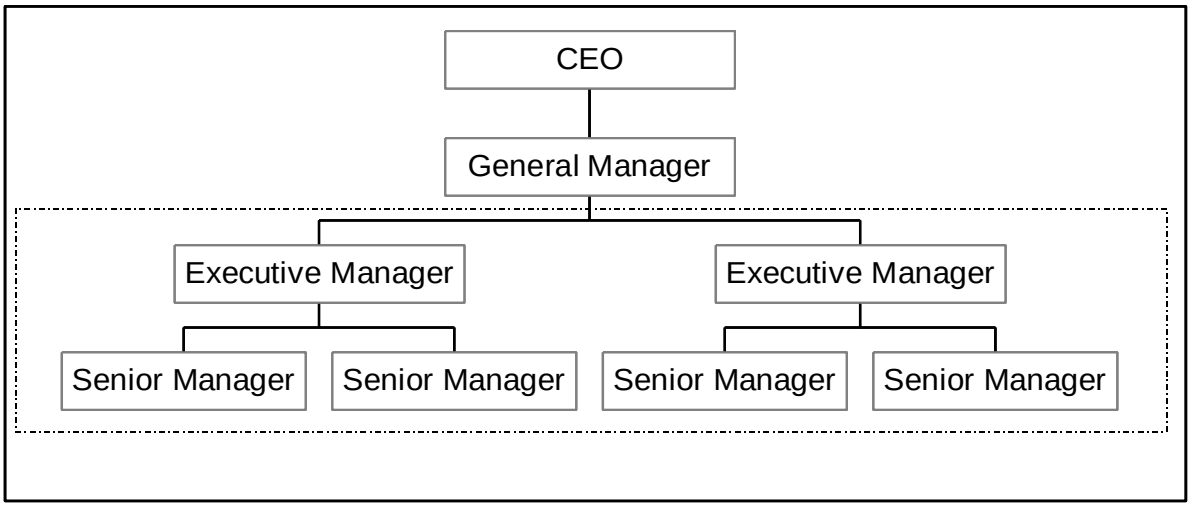

Figure 1: Organigram of Purposive Sample

In addition, the detail of each participant or interviewee is presented in the table below. From the detail in this table, it is evident that the researcher attempted to obtain a representative sample from the functional areas of management as initially intended.

Interviewee ID	Designation	Department
1	Senior Manager	Marketing, Sales & Customer Services: Business Development
2	Portfolio Business Manager	Marketing, Sales & Customer Services: Consolidation
3	Senior Manager	Corporate Affairs: Business Strategy and Performance
4	Portfolio Business Manager	Marketing, Sales & Customer Services: Industrial Mining
5	Executive Manager	National Operations Centre: Business Process, MIS and Technology
6	Senior Manager	Corporate Affairs: International Joint Ventures
7	Executive Manager	Information Management & Business Architecture: Process Enablement
8	Senior Manager	Marketing, Sales & Customer Services: Freight Transport Solutions
9	Executive Manager	Marketing, Sales & Customer Services: Customer Care
10	Senior Manager	National Operations Centre: Train Dynamics and Technology Support
11	Senior Manager	Marketing, Sales & Customer Services: Capacity Planning
12	Executive Manager	Service Delivery Zones: Finance

Table 2: Functional Detail of Purposive Sample

4.5 Data Collection

The researcher used a semi-structured in-depth interview to gather the data. The method was based on the convenience and practicality of obtaining the required data. The interviews were based on a framework represented by the literature survey; therefore no pilot study was required. Justification or rationale for the method was that little research was available on the subject. The interview schedule is found in Appendix C.

4.5.1 In-depth Semi-structured Interview

The semi-structured interview usually revolves around a few central questions (Leedy & Ormrod, 2001). These questions would be aligned with the objectives of the research in order to extract useful information regarding these pivotal themes.

The in-depth interviews were conducted according to the presentation format of the literature review.

4.5.1.1 Overview

The prospective interviewees were contacted via e-mail or telephonically to arrange a briefing session and to obtain permission for the interview. During this first encounter the purpose of the study and a brief overview of the methodology was discussed. The researcher distributed an executive summary to all prospective interviewees that would outline the purpose, objectives, duration and content of the interview and expected results of the research.

The interview framework was organised according to the logic and sequence of the research questions to ensure that the relevant issues were addressed and to fully utilise (economise) the interviewees' time. All information volunteered by participants was used for the analysis, where relevant, unless the participants advised otherwise.

4.5.1.2 Administration

The researcher conducted all the in-depth interviews with seventeen senior staff from Spoornet. The approach to the in-depth interviews was as follows:

- the interviewee was contacted well before the intended session to set aside a minimum of 1 to 1.5 hours;
- interview sessions were conducted at the interviewees' premises/office;
- with permission from the interviewee, the interview was taped;
- notes were taken throughout the interview; and
- the interviews were transcribed verbatim, as soon as possible after the interview, and archived electronically for easy access and review.

- where relevant and required, follow-up sessions were arranged for participants to clarify or elaborate on previous comments and complete questions that were not covered in the time set aside for the first encounter;
- identified participants also provided additional interviewees that could be consulted; however, when approached these individuals admitted that their knowledge of yield management was limited and therefore declined to participate.
- the interviewees declared beforehand that their views were independent of the company, but nevertheless were based on their experiences in this railroad.

4.6 Reliability and Validity

The validity of an instrument is how well it measures what it is supposed to be measuring, while reliability refers to the consistency with which the instrument produces results (Leedy & Ormrod, 2001).

4.6.1 External Validity

Yin (2003) notes that external validity entails the identification of a domain to which a study's findings can be generalised. This research is exploratory in nature and by design, is a qualitative study. Consequently, the sample is purposive, small in number and convenient in nature and the researcher does not intend to generalise the research findings. However, from an analytical or theoretical perspective, the findings may be generalised to known theories about the subject matter.

4.6.2 Internal Validity

The extent to which an instrument measures what it's supposed to measure is called internal validity. The internal validity here is known as content validity, in terms of the questions for the in-depth interviews. In addition to assuring content validity through the literature review, and interview framework, the interview questions were checked by experts in the field of yield (or revenue) management. The panel of experts that were consulted is found in Appendix D.

Leedy & Ormrod (2001) emphasise that in qualitative research the researcher's biases and values would always influence the interpretation of the data. The respondents were approached to verify that the conclusions drawn from the data were appropriate or correct

and the researcher utilised an iterative cycle of analysis moving between the literature survey and interviewees' responses to ensure that inferences and conclusions drawn from the data were plausible or correct. In addition, the 'rival' explanations or opposing ideas were considered.

4.6.3 Reliability

Reliability refers to the consistency in measuring the data and whether the data collection method is repeatable and whether it would yield similar results and conclusions, Leedy & Ormrod (2001). To this end, the researcher conducted all the in-depth interviews using the same questionnaire, thereafter, manually transcribed and re-typed the data into electronic format and then performed the analysis on the data.

4.7 Data Analysis

This section outlines the methods that the researcher used to analyse the qualitative data or the interview transcripts.

4.7.1 Analysis Methods

It is widely known that there is no proven method for research design when a qualitative approach is used. Most researchers claim that the design and *accompanying data analysis* would unfold as the investigation or study progresses; and for this reason, the research design should be flexible and at the discretion of the researcher as more (new) information becomes available during the in-depth interviews and from the responses to the questionnaire (Marshall & Rossman, 1989)

Two methods of data analysis were used in this research exercise; namely, *content analysis* and *induction analysis*. In classical content analysis, the assumption is that the codes under investigation have already been generated and described (Denzin & Lincoln, 2000). In this research study, content analysis refers to pattern coding and not classical content analysis, where frequency tables of recorded information are compiled; rather, the emphasis was on extracting themes and patterns in support of the inductive reasoning. However, the researcher has used frequency tables to record the interviewees' responses against the open-codes that were generated from the interview transcripts.

Analytic induction refers to a method of reasoning that “begins not with a pre-established truth or assumption, but with an observation”, (Leedy & Ormrod, 2001:35). Denzin & Lincoln (2000) define analytic induction to be a formal, non-quantitative method for building up causal explanations of phenomena from a close examination of cases (~interviews). Furthermore, the method is a formal kind of negative case analysis (Denzin & Lincoln, 2000). The editors, describe the method as a set of steps that comprise:

- define a phenomenon that requires an explanation and propose an explanation;
- then examine a case to ascertain whether the explanation is adequate (or fits); if it does, then examine another case. An explanation fits until a new case falsifies it.
- when a case is encountered that falsifies the explanation, under this method, the options are to: (1) change the explanation (incorporate this new case) or (2) redefine the phenomenon (to exclude the new case).
- The process continues until a universal explanation for all known cases of the phenomenon is attained.

Based on the above, it was the researcher’s intent that the transcripts from the in-depth interviews be analysed according to the logic and sequence of the literature review and framework. A brief outline of the manner in which the research questions were answered is provided in the following section

4.7.2 Approach to Analysis

The researcher observed and applied an approach to coding and theme generation for qualitative data, such as interview transcripts, outlined by Creswell (2003). Briefly, the researcher followed the steps below:

- first-pass notes were made for each interviewee while the data was transcribed manually. Initial thoughts and ideas based on the interviewees’ responses were jotted down.
- thereafter, the data, per respondent was scanned to highlight and eliminate any confidential company information
- once this had been completed, a colour-code scheme was utilised to group the relevant response items together, or alternatively, ‘*unitise*’ the data, that is, responses for each interviewee were allocated to the appropriate questions from the interview schedule to

kick-start the analysis. The researcher continually reviewed the tape-recorded interviews to clarify and obtain the gist of the responses to facilitate this exercise.

Unfortunately, the researcher discovered that this exercise was difficult in that the responses for certain interviewees could be used for more than one question and was further complicated because verbatim transcripts were being used. In such cases, the researcher used his discretion to allocate the data.

- the manually transcribed data was then transferred to an electronic format for easy access and retrieval, using word-processing software. The names of the interviewees were removed and replaced with numbers in numerical sequence.

- Note, because of the small sample size, no qualitative analysis computer software was used. The researcher preferred also to do the exercise manually. These unitised elements or condensed responses are found in the Appendix E.

- this new format, in Appendix E, permitted the 'standalone' analysis of each question per interviewee. The format also allowed for, by default, a cross-case comparison of data between respondents.

- the researcher then analysed each interviewee's responses, in this new format, using content and inductive analysis to generate codes and themes.

- using these approaches the raw data was condensed into mind-maps and/or frequency tables that captured the essence of the responses across all twelve interviewees.

- these findings or results were then compared to the literature elements and arguments or propositions were generated in lieu of the major research problem.

An overview of the research questions and method of analysis is presented below:

Analysis for first research question. This question required the interviewees or participants to provide their perspectives on yield management for the railroad industry focusing on their

own experience and insights. The stage for the rest of the interview would then be set up with this introduction.

This research question was satisfied by three questions posed to the participants that covered their understanding of the concept in terms of providing their own definition first; and then translating this for a freight railroad.

Lastly, the interviewees were required to define the capacity unit (for yield) as for the airline and hotel industries that would be the focus of yield management. The first two questions were open-ended questions and the third was a multiple-choice – however, provision was made for responses not listed in the options.

Analysis for second research question. Yield management solutions or approaches for the freight rail industry will be gathered from the feedback to the in-depth interviews. The significance of each of the solutions or approaches adopted by the respondents will also be noted. Two questions formed part of this research question and were both multiple-choice with provision for responses not covered. The one question required an approach or model for yield management in a railroad; whereas the other focused on the interviewees' preference for either the long and/or short-term benefits of yield management in a freight railroad.

Analysis for third research question. The third research question focused on the characteristics of service industries that would facilitate the implementation of yield management in the freight rail industry. The interviewees were required to provide and substantiate, if desired, their responses to simplistic binary options for each item or condition that was listed. Content and induction analysis was used to analyse the interviewees' responses.

Analysis for fourth research question. The fourth research question required respondents to select market segments that would favour the application of or lend themselves to yield management in a freight railroad. The options were posed as opposing constructs that required careful thinking before responding.

Content and induction analyses were used to analyse their responses. Their responses would be used to compile a framework for the implementation of yield management in a freight railroad.

Analysis for fifth research question. The interviewees were required to note which policies or activities associated with the practice of yield management were possible in the freight railroad environment. The interviewees had a binary choice and where desired, substantiated their responses as well.

Analysis for sixth research question. An attempt was made to find a context for the application of yield management in a freight railroad by contrasting the customer expectations with railroad management's responsibility. However, no rail customers were interviewed, rather the interviewees were requested to list what customers would expect from a railroad. This was an open-ended question and the role of rail management was presented as a list of options or multiple-choice question. Content and induction analysis was used to analyse their responses.

Analysis for seventh research question. The interviewees were required to provide operational and or other issues that would (either help or) hinder the application of YM in the freight rail industry. The information was obtained by means of categorised responses with an option to include information not presented in the list of responses. Content and induction analysis was used to analyse the responses.

Analysis for eighth research question. This research question comprised three questions that covered the advantages; disadvantages and critical success factors for yield management in a freight railroad. These three questions provided categorised responses with an option to list additional information not listed.

In addition, a specific question that related to the ownership of the freight railroad and the latitude to practice yield management, was included. This question was placed at the end to not influence the responses to the preceding questions, that is, to observe neutrality, in that the focus was on freight railroads in general. The specific issue of the type of ownership presented a unique impact on the ability to practice yield management in a freight railroad.

An open-ended question was used to invite individual insights, views and opinions for this question. Content and induction analysis was used to analyse and collate the responses.

In conclusion, this chapter covered the data analysis methods and briefly outlined the method of analysis for each research question and its corresponding interview items. The results of the semi-structured in-depth interviews are presented in the following section.

5 PRESENTATION OF RESULTS

This chapter focuses on the results or findings of the in-depth, semi-structured interviews that were conducted for the purposive sample of twelve participants. The results are presented according to the sequence of the research questions and questionnaire items. This approach provided a sound framework to present the data logically.

Each research question is presented with its corresponding interview questions as per the consistency matrix in Appendix B. In Addition, the research questions are linked to the six sub problems as identified for the main research problem.

The raw data, that is, the relevant extracts of the transcripts to the interview tape recordings are included in Appendix E. The participants are represented numerically for reasons of confidentiality with their responses retained verbatim.

5.1 First Research Question

This research question comprised three questionnaire items to clarify what a select sample of railroad managers understood about yield management, its adaptation to and how it could be approached or implemented for a freight railroad.

The responses were unique to the questions and content analysis was used to extract and distil the main patterns and themes. Question three was presented to the interviewees in the form of a checklist or options-list to select whichever was applicable in their opinion. The results to this first research question are presented below for the three interview items.

The results to the first question regarding the participants' understanding of the yield or revenue management concept are presented in the figure that illustrates the various aspects (or components) that were given.

From Figure 2, two aspects emerged that the respondents focused on; namely, a value component and an effort or operational component. The participants did not explicitly state or use these two categories; rather, the researcher combined the twelve responses into these two components.

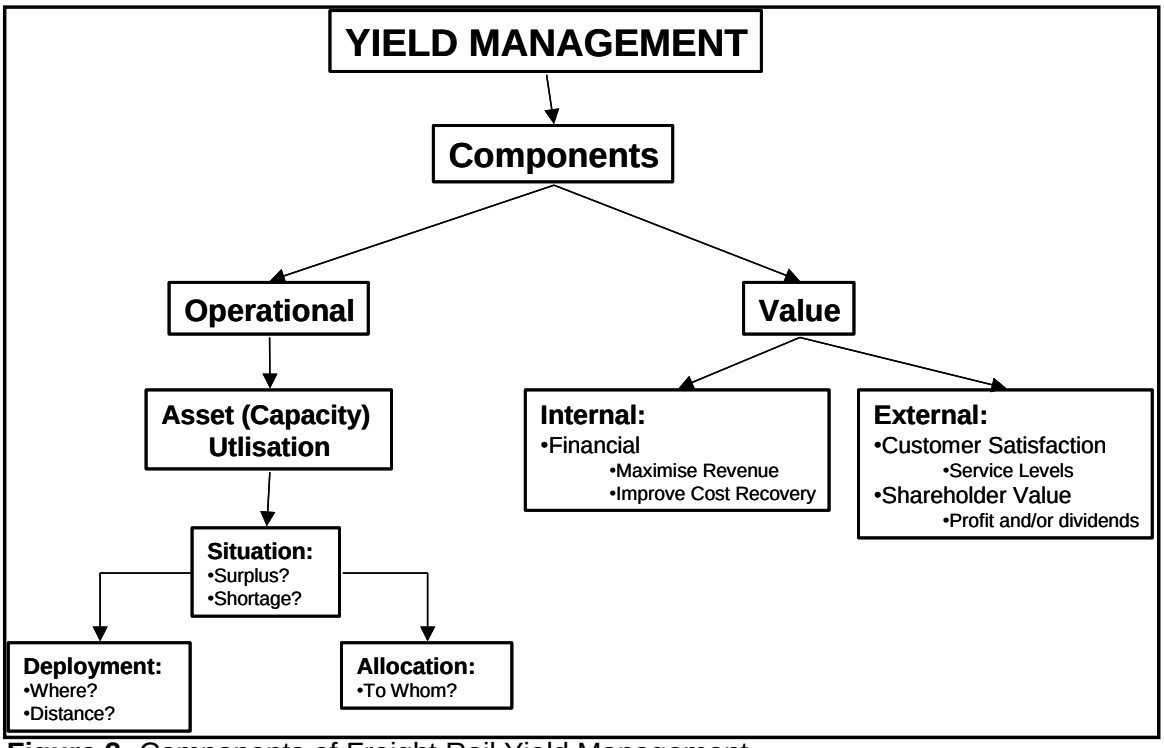

Figure 2: Components of Freight Rail Yield Management

The value component addressed internal and external facets; the internal being the direct value to the freight railroad in terms of return on assets or investment, increased revenues and improved bottom-line – referred to as the financial aspect. The external part focused on shareholder and customer value. The value component was noted as not solely reflecting the revenue or income component as per the definition given in the literature review.
However, the addition of customer and shareholder value were "additions" to the accepted definition of yield in the concept yield management. Customer value entailed customer service or satisfaction, and shareholder value represented the accepted notions of net income or dividend that is due to them.

The operational or 'effort' component was used to describe the activity that has to be incurred to realise this value. As one respondent noted later in his interview and in response to another question, that yield management does not happen by itself, rather, "one has to manage, plan for it and structure for it". This operational component involves *asset (or capacity) utilisation* and *deployment*. Productivity and efficiency related-issues were associated with these two operational aspects. The operational component dealt with the management of the freight railroad's assets.

The components of value and effort relate to the central theme of yield management, which is *maximising the income per production, or unit of capacity*. Now, this objective can be achieved through either of these two components; namely it can be realised through price (financial means) only, and/or operational means by resorting to productivity and efficiency efforts. In both cases, the income per capacity unit or production unit is increased.

However, these two are not pursued at the expense of the other, but are pursued simultaneously, which gives rise to the optimisation aspect of yield management or differently, a trade-off or compromise position. Therefore, one's assets would be deployed (and used) in return for a reward, which balances this effort.

Asset deployment and utilisation are present in both instances of surpluses and shortages of capacity (assets).

In short, yield management for the freight railroad under discussion involves increasing or maximising value at the least operational cost to the service provider. Either increasing prices and/or operational efficiencies (customer satisfaction through operational excellence) could achieve this goal.

The second interview schedule item required participants to adapt this yield management definition to the freight rail industry. This might seem as superfluous or trivial, but this question leads into the approach or focus of a possible approach to yield management implementation for a freight railroad. The researcher was not aiming for convergence in the responses, but wanted to elicit all the possible perspectives. These are outlined below.

Participant one noted that a railroad has an *installed capacity* for which it can and should obtain a maximum return for deploying that capacity.

The second participant highlighted all the other assets, besides the rolling stock, that should also be included in the goal to optimise revenue or return. Therefore, he regarded yield management as a contribution to fixed costs as well.

The third participant noted that yield management in the freight rail environment is different to the both the airline or hotel industries in that, it does not create market demand, but

rather, is a response to market demand. Also, yield management is more complex in the freight rail environment, in that it seeks to obtain a return from available resources, given the capacity constraints that exist. Citing one example that was given: if the wagon were the limiting factor, then according to yield management the goal would be to select the product(s) at price(s) that would provide the optimum return per wagon per day.

The fourth participant cited yield management in a freight rail environment is the *combination of traffic flows* that would yield the best revenue or income for the railroad.

Participant five regarded yield management to be the utilisation of installed capacity, for which the unit cost of transport would be reduced, and thereby reducing overall transport cost, which in turn, would yield a higher return for the railroad. He notes that the railway is not just high-cost fixed capacity, but that it is also “perishable”. Therefore, the participant believes that higher levels of asset utilisation satisfy both these aspects.

The sixth participant drew attention to the fact that airline yield management is about short-term decision-making, and tends to forget the base load at a high rate that affords it the ability to use discounted airfares. Similarly, for a freight railroad, the presence of a base load of traffic at a high tariff is necessary to practice yield management in the short-term.

Participant seven viewed freight rail yield management as the matching of demand to the railroad’s unique set of capabilities, a systemic capability, for which the best return is obtained in this matching of traffic to capability. The optimisation or trade-off decision between revenue and/or profit and cost is inherent in this matching exercise. However, it was noted that freight rail yield management is different from the airline industry.

The eighth participant viewed yield management as the ability to extract value out of the supply-chain by design. This value is to be found either in the volume or tonnage that is moved, the customer satisfaction and the financial return.

Participant nine regarded yield management as the deployment of ‘scarce’ assets or capacity in limited supply, to areas where the best returns would be obtained. The difficulty with freight rail yield management is best dealt with via the auctioning of available capacity.

The tenth participant viewed freight-rail yield management simply as the maximisation of income per production unit. In his view, the production unit was the train.

Participant eleven regarded yield management as the profit that is obtained through the volumes that are transported by rail and the efficiency of the assets that are used to convey this volume. In addition, it depended on the ability to build or have sufficient capacity to shift these volumes.

The twelfth participant simply said that it is optimising the transport leg of the business, that is, to optimise the revenue earned per wagon in any given direction of movement. In essence, to optimise the revenue and utilisation of the wagon fleet simultaneously. In the case where demand outstripped the supply of capacity, this was an ideal situation in which to practice yield management.

In conclusion, two central themes emerge from the descriptive outline of the participants' responses, namely: (1) *internal* and (2) *external* factors that govern freight rail yield management. The internal factor refers to the composition of the railroad's asset-base and how it is utilised (deployment and/or allocation) and the external factor refers to the market demand that may contain *rail-friendly* or potential rail-bound traffic.

The third item of this research question dealt with the unit of capacity that would be the focus of yield management efforts within the freight railroad ("the management of perishable assets"). The researcher constructed the figure below to illustrate or incorporate all responses from the participants and to indicate the interrelationship between the various capacity elements of a freight railroad.

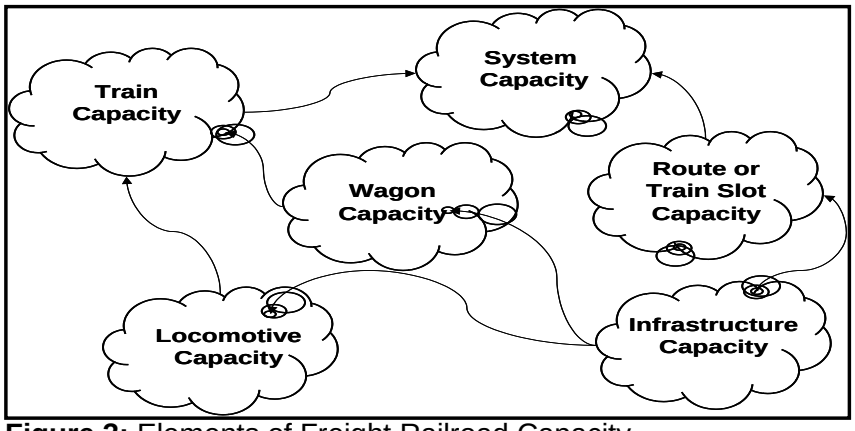

Figure 3: Elements of Freight Railroad Capacity

The figure depicts six capacity elements that the participants mentioned as their notion of railroad capacity. From Figure 3 these are locomotive-, wagon-, train-, train slot or infrastructure capacity and a system-wide capability. The table below tallies the number of responses against each capacity unit as provided by the participants:

Capacity Element or Unit	**No. of Responses**
Wagons	2
Locomotives	3
Trains	4
Train Slot	2
System-wide capability	1
TOTAL	12

Table 2: Response Tallies for Freight Rail Capacity

Furthermore, the participants outlined their reasons for their particular selection of freight rail capacity, and these reasons are presented below according to the table above.

Wagons were selected as the unit of capacity, since this was regarded as the *primary revenue generator* for a freight railroad. In this instance, locomotives, as a standalone unit of capacity, did not have this attribute.

However, for the participants who selected *locomotives* as the unit of capacity, the reasons given were:

- from a capacity constraining perspective, that is, when locomotives are in short supply or if the fleet size was inadequate, it limits the ability to deliver an acceptable service level and generate additional revenue for the railroad.
- locomotives were regarded as the primary production unit of the railroad, and all service delivery decisions would have to revolve around this unit of capacity.
- Locomotives were regarded as the most expensive resource of a freight railroad and would have to be managed (or deployed) circumspectly.

Trains were cited as the unit of capacity and was substantiated as follows:

- it was the means whereby a railroad generated net-ton-kilometres , its primary output, and for which it was remunerated by its clients

- a freight railroad was *in the business of selling trains* – not locomotives or wagons, but trains - and without this combination of locomotives and wagons, a freight railroad has nothing.

The *train slot* was mentioned by two participants the element of capacity since it provided the route capacity for the trains and also, interestingly, as the capacity unit that applied to unit load traffic only. That is, unit load traffic defined as a single train-consist transporting one commodity between a single origin-destination pair was governed by the availability of train slots (infrastructure capacity) to increase capacity or throughput.

Whereas, for single wagonload traffic, the unit of capacity to be considered was the available *wagon-space* on a general goods or *manifest train*, that is, a train that consists of various wagon-types, transporting different commodities from different origins to different en route destinations.

The participant who mentioned a *system-wide capability* tried to accommodate the complexity inherent in the question by referring to the interrelationship of all these capacity elements. The main focus was the interrelationship between these capacity elements and the manner in which these were configured for a freight railroads' particular asset-base.

To clarify, *the system-wide capability*, depended on the combination of these unique types of capacity such as type or class of locomotive, wagon-types, and infrastructure design and train configurations. Other resource-types such as personnel were also mentioned here, as part of this unique combination, but this was discarded, since the focus was on physical, inanimate objects.

Two other thoughts that emerged from the responses were the following:

- the constraint (or limiting factor) defines the capacity. From the diagram above, and based on the discussion above, a freight railroad's capability would be limited or restricted to whatever asset is in short-supply.
- The most valuable asset, given a particular scenario or environment, for a freight railroad, should be the primary unit of capacity. As one participant mentioned, that for an environment where there are multiple-freight rail operators, the allocation of train slots by

the regulator or infrastructure-owner to the various players should be regarded as the most valuable asset or unit of capacity.

To summarise, as two of the participants noted, *freight rail capacity* is complex and *has many more components* than either the airline or hotel industries as far as yield management is concerned.

5.2 Second Research Question

The second research question focused on the approach that rail executives would adopt when attempting to implement yield management. The researcher also explored the time aspect or perspective of the yield management benefits, since this influenced the assumptions taken for the particular approach and the method itself.

The researcher observed during the interviews that there could be an overlap with interview question two, which required participants to adapt the yield management concept to the freight rail industry. The adaptation of the concept to the freight rail industry might also be regarded as the approach a participant would take to implement yield management.

The researcher attempted to gather as many approaches to freight rail yield management as the participants could provide and did search for specific patterns or themes in this set of data. The approaches to freight rail yield management are outlined in Table 3 on the following page.

The participants' responses were condensed into five broad categories of approaches to yield management, with three approaches having subcategories. The five main categories are (a) *modal advantage*; (b) *operational focus*, (c) *capacity utilisation*; (d) *traffic mix* and (e) *opportunities beyond the railhead*.

Modal advantage refers to rail's competitive advantage in conveying bulk products in long trains with no en route shunting. The objective is to pursue business for which long trains, heavier loads and distances equal to or greater than the average haul length applies. In the short term, commodities or different demands would be traded off against each other, since certain commodities have inherent value and therefore would provide solid revenue streams for the freight railroad.

Table 3: Approaches to Freight Rail Yield Management

ELEMENTS / METHOD	Method Sub-categories	Timing/ Timelines	Modus Operandi	Assumptions	Objectives
Modal Advantage	None	Short-term	Trade-off demands against each other	Asset-base mix is fixed	Maximise revenue
	None	Long-term	Match traffic to rail's competitive advantage of bulk movements Long-term contracts supported by pricing strategy	Low cost structure and new asset-base mix	Maximise revenue
Operational Focus	Optimise scheduling	Long-term	Remove available train capacity by design – *right size* capacity to demand	Demand is stable or uniform	Minimise cost
	Ongoing service improvements	Short-term or continuously	Mini-projects to review and optimise current unit load service offerings	Unknown inefficiencies in current services not addressed yet	Minimise cost and maximise yield
Capacity Utilisation	Fill-up empty-legs	Short-term	Marginal pricing based on marginal costing	Opportunity cost of unutilised capacity is untenable	Minimise instances of opportunity cost
	Sales-volume approach	Long-term	Discounted tariffs based on level of capacity utilisation	Operating plan is stable, and hence costs	Maximise revenue
Traffic Mix	None	Short-term	Select best profitable demand mix, given railroad's capabilities	Operating costs are stable and cost structure is fixed	Maximise revenue and minimise operating cost
	None	Long-term	Same as above, but permanent – new target market. Divest from unprofitable business and lose this traffic to competitors	Cost structure can be changed. Can exit from unprofitable with minimum risk Using price as a lever to deter unwanted traffic.	Cost structure is adjusted for new target market – invariably bulk traffic. Converges to rail's competitive advantage
Future beyond railhead	High proportion of baseload to overall demand. Plus, beyond railhead services with intermodal collaboration between modes	Long-term	Intermodal collaborations using multi-purpose assets capable of on/of-rail services	Current revenue streams are stable and predictable year-on-year. Few opportunities with rail-bound wagonload traffic	Maximise revenue

In the long-term, the freight railroad would configure or equip itself to move only bulk products or commodities that satisfy this competitive advantage – the complexity of wagonload traffic is removed resulting in a low cost efficient transport solution.

Operational focus includes optimising the train schedule to remove spare or available train capacity – not necessarily train slots or line, network or route capacity. Therefore the train operation is streamlined, efficient with supply (train capacity) equal to demand. This situation affords the revenue and capacity utilisation benefits.

Capacity utilisation entails the filling-up or attraction of demand to spare or available capacity on trains. Two approaches are listed under this category, namely, utilising *empty-leg movements* and a *sales-volume approach*. The first is based on marginal pricing, since the variable cost of filling-up additional train capacity is low; and the sales-volume approach is retrospective in offering a tariff discount once a published level of capacity utilisation is achieved. This approach attempts to deter opportunistic behaviour by customers.

The *traffic mix* option involves the *static choice* of a demand mix before the commencement of a business cycle – typically a new budgeting period, The assumption here is that the resource-base is fixed and the best match or fit is looked-for given the asset-base mix. Another variant of this option is to divest from unprofitable market segments, thereby changing the traffic mix. This could occur on a continuous basis.

Opportunities for increased revenue growth are also to be found in *services beyond the railhead*, that is, in conjunction with other transport modes to provide intermodal solutions. As one participant noted in response to another question that a freight railroad should *strive for a symbiotic relationship* with road hauliers to improve it yield management decisions. The combination of modes eliminates the disadvantages of either mode and enhances the overall service offering

The option of either long- or short-term benefits could be interpreted as the either long-term yield management (or yield management over the long-term) and short-term yield management respectively. The participants' choices are tabled below:

Option	No. of Responses
Short-term benefits (only)	1
Long-term benefits (only)	3
Both	8
TOTAL	**12**

Table 4: Benefits of Yield Management

From the table above, one participant chose the short-term option only, three participants focused on long-term benefits only, and eight participants chose both, that is, they would focus on both the long- and short-term benefits of yield management. The participants' choices are discussed below.

The singular focus on the short-term benefits is regarded as the classical case of yield management and a practice that is pursued in the short-term or over short-time horizons. This is characteristic of an opportunistic approach that seeks to maximise value, based on different pricing mechanisms and/or capacity utilisation or allocation plans. The approach is ad hoc or inconsistent and the benefits are short-lived.

The underlying reasons for the three responses favouring the long-term focus are the following:

- The nature of the freight rail industry is such that it is more of a long-term fixed industry and not necessarily a spot industry. It needs to have a long-term forward planning perspective and therefore the nature of yield management is more abut options and choices in support of this.
- The assets of a freight railroad have long life cycles and therefore dictate the traffic moved and would be prudent to match the asset life-cycle with that of the customer life cycle. Also, there is little scope for short-term benefits in light of the above and the *inherent inflexibility* of rail transport, since the resources would obviously be committed to a specific customer over this asset life cycle. This is one approach to hedge the risk of high-fixed cost capacity or resources. Short-term yield management also requires more administration.
- A freight railroad, besides turning a profit for profit's sake, also has to replace its assets at the end of the asset life cycle; therefore a railroad cannot plan or maximise yield in the short-term. This requires a long-term yield management perspective; else the assets might never be replaced.

For the participants who selected both options, their reasons are tabled below. They acknowledged the long-term nature of the railroad industry but identified opportunities for short-term benefits as well. The reasons are discussed below.

In support of the long-term approach, the following perspective summarises the responses that were given:

- A freight railroad ought to satisfy its long-term contractual customers first, before meting the demands of ad hoc customers with available or spare capacity. However, the basis for this decision is governed by survival of the freight railroad in satisfying customers that moving bulk traffic.

The choice for short-term benefits as well, revolved around:

- exploiting market opportunities that arise when the freight railroad has spare capacity that would satisfy this demand.
- the assumption that in the short-term all costs are fixed so move as much volume or tons as possible;
- management's ability to change operating practices or perform asset modifications in the short-term to improve yield.

5.3 Third Research Question

This research question focused on establishing whether or not the characteristics of industries where yield management is practised, were exhibited by the freight rail industry. The characteristics were gleaned from the literature survey, but only seven of the ten were included in this questionnaire item. The remaining three conditions or characteristics that were excluded are (a) demand should be direct and not derived; (b) businesses should have a profit motive, and (c) the unit of capacity could be re-used for different types of demand.

The reasons for excluding these are discussed in the data interpretation section. The table below indicates the support for a characteristic that is either present or not in the freight rail industry. Results that did not have a definite outcome or participant bias are briefly discussed.

SERVICE INDUSTRY CHARACTERISTIC	YES	NO	TOTAL
'Perishable' capacity (revenue-earning opportunities decrease with time)	12	0	12
Fixed-capacity (assuming that extra capacity is expensive to acquire/add in short-term)	12	0	12
Capacity can be reserved in advance	11	1	12
Visible market segmentation (pricing based on service levels)	12	0	12
Low variable costs	11	1	12
Variable demand and seasonality	12	0	12
Direct relationship/contact with customers (no intermediary)	11	1	12

Table 5: Service Industry Characteristics of Yield Management

One participant cited the ability to reserve capacity in advance as not the preferred option in his market segment since he would rather have little spare capacity and push the operating envelope. The participant understood the question to mean reserve capacity as in additional capacity and not the ability to allocate capacity to customers in advance. However, despite this interpretation, the participant's sector is mainly concerned with the movement of single wagonload consignments and in this environment reserving capacity is counter-intuitive to the opportunistic approach in managing the asset base.

Low variable costs as a percentage of total cost was not a given in a freight railroad when the asset-base is near the end of its life cycle. Participant eleven drew attention to this in that variable costs in the form of maintenance costs could erode the advantage of low marginal costs. In this case, it is prudent to let the assets stand idle.

Participant two mentioned that a direct relationship with customers is not always possible as in the single wagonload consignment industry, since intermediaries are required to perform the non-core functions of rail such as order and account management services – especially in this industry with ad hoc users of rail transport.

5.4 Fourth Research Question

The fourth research question focused on generic rail market segments that favoured or lent themselves to the application of yield management in the freight rail industry. Participants' options are presented in the table below, as well as an overview of the reasons for their choices.

Category	MARKET SEGMENTS (generic descriptions)			
Consignment Size	Unit load traffic (~ bulk consignments)	7	Carload traffic (~ small consignments)	10
	Container/Intermodal traffic (large, repetitive consignments)	5	Container/Intermodal traffic (small, once-off consignments)	9
Customer Relationship	Contractual traffic	6	Non-contractual/Spot traffic	10
Price sensitivity	Price elastic segments	10	Price inelastic segments	4
Demand Variability	Seasonal traffic	9	Non-seasonal traffic	5
Portfolio Scope/Commodity Mix	All commodities in business portfolio	4	Selected commodities in business portfolio	8

Table 6: Market Segments amenable to Yield Management

The frequency per classification was recorded for this question. Support for a category was based on the number of responses for that category. From the above table, the generic market segments that favour (*short-term*) yield management, according to the participants are: (a) single railcar- or wagonload consignments, (b) small, once-off container consignments, (c) non-contractual or spot traffic, (d) price elastic segments, and seasonal traffic or variable demand. Lastly, freight rail yield management is applicable to a select range of commodities in the railroad's portfolio. The participants' choices are briefly discussed below.

The support for *single, wagonload consignments* (*both freight and intermodal or containerised*) as the market segment that would favour yield management comprised the following:

- the single, wagonload consignment market is a source of additional revenue to the guaranteed, 'flat-line' revenue streams, the "bread and butter" for railroads, of bulk customers.
- the characteristics or attributes of unit load traffic or megaRAIL (defined earlier) were regarded as the "antithesis" of the market segments that favour short-term yield management. These characteristics of megaRAIL were, "conveyor-belt type traffic, *baseload*, optimum utilisation of capacity, resources fully allocated or committed to one customer and long-term contracts".

The case for *non-contractual traffic* lending itself to yield management was supported in the following manner:

- these customers are not rail-dependent – are ad hoc users of rail with other transport options and have not committed themselves to rail by investing for rail transport. These are opportunistic customers who are searching for the cheapest tariff from any mode: "*these customers are speculating, so you speculate with them*".
- Non-contractual or ad hoc users could be used to fill-up available spare capacity at a fair price.
- Ideal segment for the auctioning of capacity

The option regarding price sensitivities shifted towards the *price elastic* segment since:

- yield management is for price sensitive customers
- it would be immoral to exploit a rail-dependent (*price inelastic*) customer, since one could exploit the industry out of existence.
- The price sensitive customers tend to make yield management easier in that one can price oneself out of certain market segments, while attracting others.

Seasonal traffic or highly fluctuating demand-type traffic garnered support for the following reasons:

- A freight railroad finds it difficult to match supply to demand in these situations, so would attempt to extract maximum revenue in these instances
- Seasonal traffic presents a short time period in which to gain a maximum return for your assets being deployed

Yield management was seen as a *selective practice for a few commodities* or products in a railroad's portfolio because:

- only a few products or commodities behaved according to or exhibited the characteristics mentioned such as single-wagonload consignments, fluctuating and seasonal demand, price elastic and spot-markets
- FMCG (fast moving consumer goods), intermodal or containerised traffic, grain and cement were specific markets that were quoted as being amenable or susceptible to *short-term* yield management practices.

The table above also indicates that other categories received support as well and therefore need to be discussed. The categories with the lower response frequencies are: (a) unit load consignments, (b) unit load container or intermodal consignments, (c) contractual traffic, (d)

price inelastic segments, (e) non-seasonal traffic and all commodities in the railroad's business portfolio.

The reasons for selecting *unit load traffic* are:

- a better opportunity to obtain a return with a train (wagons and locomotives) than a few wagons – for the same effort. Unit load traffic is "easy pickings". This applies both to freight and containerised cargo.
- the complexity in offering a single, wagonload consignment service – it is a challenge for railroads to satisfy many customers between many origins and many destinations.

The *price inelastic* customers are rail-dependent and therefore would opt for a long-term contract that would curtail the railroad's price increases. However, under these circumstances, it is an opportunity to improve productivity and efficiencies with these loyal customers through collaborative projects that would increase yield for both parties. Similar reasons were presented for contractual traffic.

Non-seasonal traffic was regarded as typical unit-load or regular, predictable traffic that allowed the railroad to fully optimise its asset deployment and improve capacity utilisation. Maximising yield in this scenario means to minimise cost by running more efficient operations.

In summary, this question highlighted the difficulty in selecting the market segments that favoured yield management because participants portrayed different interpretations or understandings of yield management. Their responses could be traced to their initial definitions of yield management.

It became apparent at this stage of the research that there is a distinction to be observed between the long and short-term aspect of yield management. As one participant mentioned that when yield management is discussed or debated it is often forgotten that it means *short-term, dynamic yield management* of which the airline industry is the prime example.

The participants therefore *correctly* identified the rail market segments that would favour this *short-term, dynamic yield management* as found in other industries where it is practised. But

noted, too, are other perspectives and insights that identified a longer-term type of yield management and the market segments that were suited to it.

5.5 Fifth Research Question

The fifth research question focused on the policies, functions or activities associated with yield management and sort to establish whether these were possible in the freight rail environment. The participants' responses are recorded in the table below, with the highest tallies per function being regarded as possible or not in the freight rail industry. Where the outcome was not definitive, the participants' reasons were probed to fully understand the situation.

Yield Management Policy	YES	NO	TOTAL
Employ price discounting (to manage demand)	11	1	12
Overbooking of capacity	2	10	12
Able to withhold capacity (deny access) in order to obtain higher yield	9	3	12
Forecasting of demand	11	1	12
Use of penalties to manage/change customer behaviour	12	0	12
Auctioning of capacity (bid-price approach)	10	2	12
First-come-first-served (FCFS) allocation of capacity rule	5	7	12
Computerized revenue management system	11	1	12

Table 7: Yield Management Policies

The table above indicates that *overbooking of capacity* is not possible within a railroad for the following reasons:

- it could be a sign of poor contracting by the railroad;
- the risk of upsetting the loyal, contractual customers;
- overbooking is usually applied to the airline industry due to customer behaviour in the form of "no-shows"; this is not possible in the railroad environment since the wagons or railcars have to be delivered to and collected from the customer by the railroad. A railroad would suffer a degradation of its service if it did the same.

The *first-come-first-served* (FCFS) capacity allocation rule did not have a definitive outcome for either option, therefore the participants' responses are outlined first, *for* the allocation rule, and then *against* it. The reasons in favour of the FCFS allocation were:

- a method to fill-up available capacity on trains. A freight railroad would resort to this to attract additional tonnage or volume. In other words, a case of '*satisfising*', which is, meeting rail's demand for tonnage or volume to ensure its survival.
- It is applied in the single, wagonload consignment market to fill-up spare train capacity very quickly because of the low opportunity cost associated with empty-return movements.

Arguments against the first-come-first-served (FCFS) capacity allocation rule were:

- integrity, since the participant preferred to negotiate for a contract. The participant understood FCFS to be an ad hoc arrangement between the railroad and every customer.
- the risk involved of attracting the 'wrong' customer or encouraging *rail-unfriendly* business
- the freight railroad might be short-changing itself in terms of maximising its yield.

In conclusion, the researcher considered that the following yield management functions seemed to be implementable in a freight railroad: (a) price discounting; (b) withholding capacity in order to obtain a better yield elsewhere; (c) forecasting of demand; (d) penalties to manage customer behaviour; (e) auctioning of capacity and (f) the use of a computerised revenue management system.

5.6 Sixth Research Question

This research question explored customers' demands of a freight rail service. and exploring the duties and responsibilities of rail executives. The question about customer demands was an open-ended question to the participants and not the customers of the freight railroad concerned. The researcher noted and recorded the common answers across all participants and grouped these into new categories. Only responses of two or more per identified category were recorded. The results for the customer demands are tabled below.

Customer Specification or Demands	**No. of Responses**
Acceptable Pricing	10
Predictability and Reliability of Service	9
Safety of Goods	4
Good condition of rolling-stock	4
Flexibility of Rail Service	2

Table 8: Customer Specifications

The categories above are not arranged according to importance, significance or priority, but rather represent the number of participant responses that were identified as being valid elements or constituents of a category. However, from the table above, pricing was prominent across nine of the twelve respondents, followed by predictability and reliability of the service. The safety of customers and their goods was the third most cited specification, followed by the condition of rolling stock and degree of flexibility of the rail service. Six customer specifications were identified as opposed to the five that were requested.

5.7 Seventh Research Question

For the question on rail management's responsibilities, the researcher provided a checklist of responses, but certain participants preferred to respond independently of this list. The table below depicts the participant responses for the responsibilities of overall business performance of the freight railroad. The researcher employed a similar approach as for the previous question by creating new categories from the participant responses.

Management/Executive Responsibility	No. of responses
Shareholder value	5
Profit	8
Customer Service	5
Capacity Utilisation	6
Safety	3

Table 9: Responsibilities of Rail Executives

Five categories were identified, namely: (a) shareholder value, (b) profit, (c) customer service, (d) capacity utilisation and (e) safety. The responsibility towards the shareholder and the responsibility to increase profits are linked. Shareholder value can only be increased through increased profits via improved revenue streams and/or minimised operating costs.

Customer service entails the predictability, reliability, and cost efficiency of the rail service offering. Maximising capacity utilisation was one of the listed options and as custodians of the railroad assets, management should deploy the assets where utilisation is increased and in so doing reduce the unit cost of rail transport, and hence the rail service offering.

The reduced cost of transport also refers to operational efficiency, which in turn benefits the railroad's bottom-line. Safety includes the protection of customer's cargo, the freight rail's

assets and human life. Compromised safety in operations affects all these and creates unwanted (operational) costs in the system and impacts railroad profitability as well.

5.8 Eighth Research Question

The eighth research question revolved around challenges that could scupper a potential yield management application or implementation for a freight railroad.

The challenges to freight railroads were explored using a list of categorised responses obtained from the literature review; however, few respondents utilised this list. Their responses, according to categories created by the researcher, are tabled as follows:

Categories of Challenges	**No. of Responses**
Social Imperatives/Legacy Roles(non-profit roles)	2
Yield Management Processes and Systems	3
Understanding Elements of Yield Management	3
Managing Demand Variability	2
Service Reliability and Predictability	5
Pricing challenges	2
Operational challenges	5
Efficacy of Rolling stock	4
Railroad cost drivers	2
Customer Relationship challenges	4

Table 10: Freight Rail Challenges for Yield Management

The researcher identified ten different categories of challenges, as opposed to the five that were requested, with two or more valid underlying or constituent responses from the participants. An overview of these is presented for each of the ten challenges, based on the experience and knowledge of the participants.

Social imperatives or *legacy roles* refer to the era before deregulation when the freight railroad that employed these participants was regarded as a *common carrier*. This created a perception in the market of a *utility service* that catered for everyone and refused no one. Therefore, in this situation, the *element of choice* associated with yield management is non-existent.

Now in a deregulated transport market, long-standing, undesirable customers are difficult to turn away from rail, due to this mindset, and hence, the railroad has to retain them. However, the railroad itself might be suffering from this mindset in that it *cannot relinquish* these *undesirable or rail-unfriendly market segments*.

A company's *internal processes* might not be designed or set up for yield management. The transparency or '*audit ability*' of these processes for YM decisions is a fundamental requirement. In addition to this is the design and *operationalising* of decision support systems for yield management.

The *understanding of the elements* of YM encompassed the basis of the trade-off decisions or criteria to be used when trading-off demands against each other. Peoples' understanding of yield management was also crucial to its implementation, and often the major challenge. A lack of understanding of YM also contributed to poor decision-making and measures were required to highlight this as well.

Demand variability for a freight railroad would also be problematic, since railroads preferred to have predictable, stable or uniform demand patterns that matched its operating rhythm. The challenge was to reduce the amount of variability in the system.

Service reliability and predictability are the corner stones of operational excellence and without it, a freight railroad's pricing strategy might be jeopardised. Reliability and stability, or consistency of service is required to create the stability that freight railroads need.

Pricing challenges were cited in the case of *supply-chain competitiveness* that limited the ability to price for a profit and the *perception problem* with railroad tariffs in that customers have the notion that the tariff would be lower for a smaller/lighter consignment and a relatively short transport distance. This is contrary to railroad economics.

Operational challenges involved the deployment of assets which is difficult for a railroad in that wagons have to be delivered to and collected from customers – the demand, as in the case of the airline or hotel industries, does not come to the railroad. Hence, *empty wagon distribution* is a challenge in the reduction of wagon cycle time – especially idle time. The

ability to deploy locomotives to demand points over short time horizons was cited as another challenge for railroads

The *efficacy* of rolling stock comprised the problem of a surplus of the wrong type of capacity – a *legacy* from the common carrier era. *Non-standardisation of the asset-base,* referred to the problem of too many variants of locomotives and wagon-types across the rail network.

As one participant responded elsewhere that a railroad might also have the *location of capacity* as a limiting factor. In this case, locomotives and wagons might be restricted to certain parts of the rail network. The ability to redress these legacy problems might prove challenging from an asset replacement perspective.

Determining *cost drivers* or apportioning of costs for a railroad is difficult in that one cannot trace a particular cost to an individual asset or activity. And this inability to apportion costs correctly could affect a railroad's pricing strategy or ability to price for a profit. Furthermore, a railroad has to account for total cost or full absorption costing, which severely limits its market pricing options.

Customer relationship challenges involve the prioritising of customer services, in that, strategic or contractual customers should be served before ad hoc users or according to a customer segmentation hierarchy. Also, customers might challenge the railroad's segmentation by using its buying power to negotiate better tariffs for its rail services. Maintaining customer satisfaction under a resource-constrained environment is daunting for a railroad as one participant noted. Customers might even prescribe the rules for the freight railroad's yield management initiatives.

5.9 Ninth Research Question

This research question probed the critical success factors, advantages and disadvantages (or risks) of YM for freight railroads and whether state-owned freight railroads would be permitted to practise yield management. The participants' responses to these four aspects are briefly discussed below.

Critical success factors were viewed differently to the operational challenges, although one participant noted the temptation to repeat the answers from the previous question. The researcher also identified this subtlety in the two questions at the time the interview schedule was constructed, but retained the question to elicit more perspectives and insights from the participants.

From the responses that were given, the researcher identified the following critical success factors for yield management in a freight railroad:

Critical Success Factor	**No. of Underlying Responses**
Operational Excellence	11
Market Intelligence	7
Knowledge of Costs	4
Awareness of railroad capability	4
Decision Support Systems (DSS)	4
Forecasting ability	2
Customer Relationship Management	2
Modelling or Simulation capability	2
Corporate Governance	2

Table 11: Critical Success Factors for Freight Rail Yield Management

Operational excellence comprised the following participant responses:

- the "demonstration of the ability to run a *tight ship*".
- a fixed-train schedule to instil discipline and stability leading to a consistent service. System variability would then be reduced in this manner.

Participant responses that gave rise to the *market intelligence* category were the establishment of a proper research function to generate information knowledge about the broader rail environment ("understanding the playing field"), potential *rail-friendly* customers and to identify market opportunities to exploit using rail.

Knowledge of rail costs was another critical success factor that could undermine a railroad's ability to price correctly for all services – irrespective of whether cost-plus or market-based pricing strategies are pursued. Marginal costing was cited as a foundation for marginal pricing and impacted the options or opportunities in the wagonload business. However, the problem here is not pricing but rather, an issue with consistent service delivery.

Participants have cited the *awareness of the railroad's capability* ("know what you can and cannot do") throughout the interview as a building block of yield management. In addition, this entails knowledge about market position and the asset-base in terms of what could be achieved. This awareness of capability included the knowledge of available capacity at any given moment.

The *ability to forecast* future customer intent, especially in the single wagonload consignment arena, was central to achieving the stability and reliability that freight railroads wanted; and, to have sufficient time to deploy and match capacity to demand.

Customer relationship management was central to dealing with irate or dissatisfied customers as a result of yield management practices. One participant referred to this as a "*high-level of customer care"*.

Decision support systems (DSS's) were central to the yield management initiative in that trade-off decisions would be automated and the criteria for these trade-off decisions are then consistently applied. The *modelling and simulation capability* is linked to these DSS's because it affords the ability to conduct "what-if" analyses to enhance yield management decisions.

Corporate governance keeps everyone honest when practising yield management and would form part of the customer relationship management function to identify possible internal company policy breaches that might have damaged the customer relationship.

From this table of critical success factors, the five most cited are operational excellence, market intelligence, awareness of railroad capability, knowledge of rail costs and the need for decision support systems.

The advantages of yield management were grouped in to the categories of the table below:

Advantages	No. of Underlying Responses
Improved financial performance	12
Sustainability	3
Improved customer service	7
Improved competitive position	3
Increased asset utilisation	4

Table 12: Advantages of Yield Management to Freight Railroads

Responses for improved financial performance included an increase in the bottom-line or profit and an improved return on investment or ROI. However, these two measures are linked.

Sustainability referred to the long-run going concern position of the railroad or its viability in the long-term.

Improved customer service was an indirect advantage since the railroad, in applying yield management, has to provide a better quality of service to justify its tariffs. A freight railroad could *improve* its *competitive position* since yield management practises would improve its market research activities, the monitoring of important variables such as available capacity and marginal costs.

Increased asset utilisation would be achieved through prudent allocation and deployment of capacity to profitable business and better operating plans.

The disadvantages were similarly grouped as follows:

Disadvantages	No. of Underlying Responses
Customer relationship problems	11
Pricing approaches	4
Complexity	2
Company image	3
Shareholder or Social Imperatives	2
Rationalisation of workforce	2

Table 13: Disadvantages of Yield Management to Freight Railroads

Customer relationship problems involve upsetting the loyal, contracted customer-base in terms of tariffs that are offered to non-contractual customers to attract their demand to the freight railroad's spare or available capacity. This problem surfaces due to pricing differentials related to customer segmentation. The freight railroad's competition might also take up customers that either abandoned rail transport or those have been discarded by the railroad because of its yield management practices. Customers could feel insecure about fluctuating rail transport tariffs and the railroad would have to continually defend its YM practices. There could also be possible customer behaviour and demand pattern changes due the pricing strategies that go with segmentation of the market.

Customers might be dissatisfied with the freight railroad's *approaches to pricing* and would resist unacceptable increases for the same quality of service. Price discounts could lead to future problems when these have to be escalated ("the easiest thing in the world is to drop your prices…more difficult to up your prices"). Price differentials in small captured market could expose the freight railroad to competition law, since it could be undermining competitors in the same industry. The continued use of marginal pricing could eventually distort the market and undermine existing business.

Complexity was identified in evaluating competing demands simultaneously and in continually having to perform system-wide trade-off decisions.

A freight railroad's *image* would suffer due to its yield management practices that seemingly *marginalise* certain customers and *favour* others. Also, long-standing loyal customers that are discarded due to YM practices might expose the freight railroad in the media. The freight railroad could also be accused of monopolistic behaviour by/in the exploitation of rail-dependent customers. As one participant noted: yield management may be at odds or in conflict with a *shareholder's social imperatives*". Another referred to the freight railroad as "not meeting the shareholder's expectations" – assumed to be a *development role* for the freight railroad.

Another disadvantage of yield management was the *rationalising of the workforce*. This was peculiar in that yield management is generally concerned with the revenue streams of a business, not the costs. However, for the participants that noted this, it could be traced to their definition of yield management: maximising the difference between revenue and costs.

Participants' responses to the question of whether a state-owned freight railroad (or parastatal) would be allowed to practise yield management lead the researcher to develop three categories, namely, (a) *would be permitted*, (b) *conditional approval* and (c) *unsure of stakeholder reaction*.

The results of these three categories are presented as follows:

Response Categories	**No. of Underlying Responses**
Would be permitted	3
Conditional Approval	5
Uncertain ("*shades of grey*")	4

Table 14: Yield Management in State-owned Freight Railroads

The participants who noted that the state-owned freight railroad *would be permitted* to practise yield management had the following reasons:

- from an *asset efficiency* perspective, this is a given. So yield management in this case is achieved through the increased and prudent utilisation of the freight rail's assets. Note that the pricing component of yield management is not mentioned. Shareholder value would be achieved through cost reduction or minimisation of costs, rather than the maximisation of revenue.
- Profitability, according to participant six, is linked to service and not to pricing only. And customers would reward the freight railroad for its quality of service by accepting the corresponding tariff.
- it would be the only way to replace the freight railroad's assets. However, this is not achieved through asset utilisation only, but justifiable rail transport tariffs greater than the cost of providing the service.
- yield management is the means to make the freight railroad a sustainable, self-funded entity. This would be achieved through cost reductions and profit maximisation

Conditional approval would be provided if:

there was sufficient competition to the freight railroad in targeted markets;

- depended on the orientation or mindset of the government (or shareholder) at a certain point in time. Also, the current shareholder has a social democratic mindset which implies the its state-owned enterprises would have to entertain a delicate balance between social and commercial objectives – profits, by all means, but not *super-profits*.
- Not applying the YM practices to large industries that sustained the local economy.

Unclear shareholder guidelines of the criteria by which to discriminate between social and commercial freight rail services created a climate of *uncertainty* that influenced management's decision-making and autonomy. This uncertainty was expressed as follows:

- A public enterprise is an oxymoron. These entities always have a *mixed-view* or *bifocal mission* as laid down by the shareholder (government). Therefore the *business definition* in terms of which markets to serve for a profit is difficult to articulate.
- There are no clear guidelines to distinguish social or developmental freight rail services from commercial services and management's business choices or options therefore seem limited. Freedom to price for yield (or sustainability) may be restricted too.
- Participant twelve described the operating environment as a "*catch-twenty-two*" situation. This is a colloquialism that typifies a situation in which "*the victim cannot escape an insurmountable obstacle*", South African Pocket Oxford Dictionary (1993: 115).

This research question, on the critical success factors of yield management for the freight rail industry, uncovered key insights from the participants. Among the critical success factors, operational excellence emerged as the most important cited. One could link this critical success factor to the main advantages and disadvantages of improved financial performance (cost containment through operational discipline) and customer relationship problems (possible dissatisfaction with inferior service or operations), respectively. Lastly, the responses to the question of state-owned freight railroads being allowed to practice yield management cited *operational excellence* again as the criterion by which it would be permitted.

In conclusion, the participants' provided different perspectives to the nine research questions that probed whether yield management was suitable for the freight rail industry. Their responses to these questions are discussed in the following section using the literature review as a basis for the arguments.

6 DISCUSSION OF RESULTS

The purpose of this exploratory research was to obtain the perspectives of a select sample of railroad managers or executives on whether the concept of yield management is suited to the freight rail industry. The results of the in-depth semi-structured interviews are discussed according to the framework of the interview schedule and contrasted with the literature review findings. All literature review information has been used.

6.1 First Research Question

The participants have identified two components in their definition of yield management for a freight railroad, namely, an operational component and a value component. Weatherford and Bodily (1992) attempted to satisfy all industries in their definition called PARM or "*perishable-asset-revenue-management*" which meant the *management* of perishable assets *through price segmentation*.

The *operational component* referred to asset or capacity utilisation through deployment and/ or allocation. Productivity and efficiency measures were pursued to improve asset utilisation and the reduction in operating cost or service delivery costs.

The *value component* referred to the benefits of yield management for the freight railroad and its stakeholders – the customers and the shareholders. These benefits comprised financial and customer service components. This value component amongst other items listed also includes the revenue focus of yield management.

With these two components the researcher attempted to contrast the definition given by Weatherford & Bodily (1992), namely PARM, with that which the participants provided. Their focus was on using price as the primary or sole means by which *perishable assets* (capacity) would be managed; whereas, in the freight rail environment, price is not the only lever, but requires some effort from the railroad in deploying/allocating or distributing this capacity. Therefore, there are two options or approaches to managing yield in a freight railroad.

The researcher argues that this insight is fundamental to the understanding of yield management in the freight rail environment. This aspect is explored further in the implementation approaches to freight rail yield management, the capacity unit as the basis for freight rail yield management solutions, and the challenges that the freight rail environment presents to the yield management problem.

The adaptation of this definition to the freight rail environment therefore reflected these two aspects as the participants have indicated in their responses. The adaptations of the concept involved the following:

- a *return for* the freight railroad's *installed capacity* that consists of all the elements outlined further in this discussion. In short, a return on the assets or, in essence, the concept of business as one participant coined it.
- a match between the demand and the railroad's systemic capability to obtain the best yield
- best traffic mix or flows to realise maximum yield
- a service design perspective that seeks to maximise throughput and hence value for all partners in a supply-chain
- the allocation of scarce assets to where the best returns are obtained.

Similarly, as encountered in the literature survey for other service industries, there are many perspectives on what constitutes yield management for the freight rail environment. This might suggest that yield management has become an outdated concept that needs to be revised or explicitly defined for specific industries as opposed to the universal concept and definition given by Weatherford & Bodily (1992).

Reed (1998:4) defined yield management as "a system or method of analysing a business, with many elements that may be applied differently in different businesses". Lieberman (1993) viewed yield management as a process, a way of conducting business.

In conclusion, yield management for the freight rail industry, as the participants have indicated in their responses, has different interpretations.

Furthermore, the perspectives differed on the unit of capacity that would qualify as the "*perishable asset*" to be managed under YM. Participants expressed their views on the matter as depicted in Figure 3.. This illustrates the inherent complexity of the freight rail environment and how this would influence the yield management problem for this domain.

The diagram indicates that freight rail capacity could be viewed as separate elements, as well as holistically, because of the interrelationships as was identified by the participants. "…it is a difficult *thing*!", as one participant expressed during his interview.

In conclusion, for the *unit of capacity* for freight rail, the researcher believes that this aspect of the freight rail environment is another problem towards defining and understanding yield management for this industry.

6.2 Second Research Question

This research question required participants to outline their yield management solutions or implementation approaches for a freight railroad. The researcher identified five broad categories for their responses, namely, *modal advantage*, *operational focus*, *capacity utilisation*, *traffic mix* and *opportunities beyond the railhead*.

The objective across these solutions was to maximise yield expressed as revenue, return or profit as well as cost minimisation, due to the operational element of freight railroads. One participant noted that freight rail yield management was centred on *choices versus* the *selling of a product* as in the airline or hotel industries; hence, the focus on price in the YM solutions for these industries. Kraft et al (2000) hinted at *price discrimination* and *traffic management* options for yield management in freight railroads.

Noted too, were the time frames suggested for their solutions or implementation approaches. The long-term approaches seemed to coincide with the rhythm of freight rail operations in that is it is not renowned for speed or flexibility, but prefers repeatable, stable and predictable flows approaching the *behaviour* of a conveyor-belt system. The short-term referred to *opportunistic methods to improve yield*, *given* a *railroad's immediate circumstances*.

The YM solutions for a freight railroad were further explored in the question that requested participants to select the benefits that appealed to them, namely, the long- or short-term benefits of yield management. The choice of either long- or short-term benefits relates to the speed at which yield management decisions should occur as well as acting on them.

According to Kimes (1989) the characteristic of the yield management problem was that it needed to be solved repeatedly and therefore required a fast, accurate and inexpensive solution. Furthermore, optimality was not as important as being able to provide this fast solution.

In conclusion, the researcher argues that the *long-term* benefits are more suited to freight rail because of the long traffic retention periods (Kraft *et al*, 2000).

6.3 Third Research Question

This research question covered seven of the ten conditions or characteristics in service industries where yield management is practised. The omitted three were: (a) “demand for the service ought to be direct and not derived”, Marmorstein, Rosomme & Sarel (2003:162); (b) the “same unit of capacity can be used to deliver many different products or services”, Netessine & Shumsky (2002:4); (c) and *producers have a profit motive* and have broad freedom to act (Netessine & Shumsky, 2002). The reasons for the exclusions are as follows:

- the issue of *derived demand* is a common feature of all modes of transport. That is, derived demand is defined as demand for a service that is otherwise not produced or performed for its own sake. Alternatively, what the authors intended to illustrate is that demand is not lodged or an intent is not communicated on behalf of someone or something else; that is, in the freight rail sense the customers’ *goods* and not the *customers* need to be transported.

  A freight railroad, according to both definitions, exhibits this characteristic of derived demand and NOT direct demand. Therefore it was not deemed fitting for the interview schedule. Also, as one participant noted that “*a freight railroad does not create demand*”.

- the feature of a *multi-purpose or versatile unit of capacity* is rare within a freight railroad where different commodities are transported – depending though, on the business scope defined for the freight railroad. A specific commodity has a corresponding specific unit of

capacity designed for it to be transported by rail. Hence liquids would be conveyed in tanker-cars or wagons and mining ores in open-top wagons or railcars. Therefore, a freight railroad might have a fleet of rolling stock as diverse as its business scope.

However, there are instances for which wagons or railcars are capable of conveying more than one type of product, but for which the handling characteristics or requirements are similar.
Alternatively, in a railroad context, and with reference to an earlier question on the *definitive capacity unit* for a railroad, only two of the capacity elements in Figure 3 might possess this *multi-purpose or versatility attribute*, namely, the rail network and locomotive. The researcher however, prefers to hold the first idea that a freight railroad has few examples of assets or capacity that are truly multi-purpose or versatile.

- A profit motive in any commercial situation is a given – even for a *state-owned entity*, such as the freight railroad in this research exercise. Therefore, the researcher omitted a *rhetorical question* from the interview schedule.

The results obtained, indicated that all characteristics listed were *identifiable* in a freight railroad. *Perishable capacity* in the freight rail sense, stemmed from the opportunity cost of not utilising idle capacity; that is, once an opportunity to use the capacity today has elapsed, it cannot be recovered in the future or stored for future use. This is true of service industries in general and for transportation as participant four highlighted in the first question on the definition for yield management.

Fixed capacity, in this sense, was meant to probe the characteristic of *limited capacity* or a *fixed amount* of capacity (Kimes, 1989) and not *static capacity* (Van Der Meulen, 1994). *Static capacity* as reviewed in the literature referred to *fixed configurations* such as onboard seating in aircraft, a set number of hotel rooms or passenger seating on TGV-trains. Hence static capacity in terms of fixed configuration is not a feature in a freight railroad, since train size (or capacity) is not a fixed configuration.
However, the participants noted that the *amount of capacity* is a feature present in a freight railroad in the sense that *rolling stock fleets*, both wagon or locomotive fleets, *are difficult to increase without considerable time delay*.

Reservation or *allocation of capacity* in advance was possible or even being practised in the freight railroad for this research exercise. There was also *visible market segmentation* in the three traffic categories or services as defined earlier in this document. However, apart from this segmentation variable, others such as commodity (an obvious segmentation variable for a freight railroad) and customer were others.

Low variable costs in relation to the high-fixed cost of the assets were another feature that was recognised in the freight railroad. Although one participant noted that a freight railroad with an ageing asset base might have considerably higher variable costs (*compared to net book value or salvageable or scrap value*) than if the asset base were relatively new.

The participants also identified *variable demand and seasonality* as a feature of the market segments that a railroad served. Direct relationships with customers was the preferred option for all participants, except one, who indicated that the intermediary performed certain non-core rail functions for a specific portfolio of the freight railroad's business.

However, in general, the participants concurred that intermediaries are undesirable for the freight railroad because they are "*an encumbrance in terms of strategy and market position*" and dilute a railroad's revenue stream. In addition, intermediaries might negatively impact a supply-chain's competitiveness in terms of transport cost. One participant noted however, that a railroad could channel/justify tariff escalations through an intermediary.

In conclusion for this research question, it has been established that the freight railroad in this research exercise does exhibit the characteristics associated with service industries where yield management could be practised as identified by Kimes (1989), Weatherford (1991), Weatherford & Bodily (1992), Lieberman (1993) Cross (1997), Netessine & Shumsky (2002) and Marmorstein, Rosomme & Sarel (2003).

6.4 Fourth Research Question

Shuman (1991) noted that yield management is applicable in industries where there are combinations of *bulk* and *spot customers* who *compete for capacity*. In a railroad this could happen on *many levels of capacity* as outlined earlier in this document. In lieu of this statement by Shuman (1991), the question was posed to participants to identify the generic market segments where yield management could be applied.

The participants identified the following generic market segments that favoured yield management, re-arranged in the table below to illustrate another aspect that emerged from this question.

CATEGORY	MARKET SEGMENTS (generic descriptions)	
Consignment Size	Unit load traffic (~ bulk consignments)	Carload traffic (~ small consignments)
	Container/Intermodal traffic (large, repetitive consignments)	Container/Intermodal traffic (small, once-off consignments)
Customer Relationship	Contractual traffic	Non-contractual/Spot traffic
Price sensitivity	Price inelastic segments	Price elastic segments
Demand Variability	Non-seasonal traffic	Seasonal traffic
Commodity Mix	All commodities in business portfolio	Selected commodities in business portfolio
Time Horizon	**Long-term**	**Short-term**

Table 15: Re-arrangement of Market Segments amenable to Yield Management

From Table 15 above, the participants selected the market segments from both the long-and short-term time horizons that favoured the application of yield management. This was not a definitive result as the researcher expected.

The overall category that received the highest or most support was the short-term category that comprised the small once-off consignment sizes, spot or non-contractual traffic, price elastic, seasonal and a selected group of commodities that exhibited this behaviour.

These generic market segments, grouped under the short-term time horizon category, are consistent with that identified in literature as outlined by Shuman (1991). Furthermore, these responses suggest that a *short-term, dynamic yield management* approach, such as in the airline industry, is more applicable to this segment.

The generic market segments grouped under the long-term time horizon category suggest that there is a *different type of yield management approach* that is warranted. As one participant remarked:

> "megaRAIL or unit load traffic does not lend itself to the characteristics of yield management. Characteristics of megaRAIL are conveyor-belt type traffic, baseload, optimum utilisation of resources, fully committed (to one customer), long term contracts, which is the *antithesis* of the characteristics that make up (*short-term*) yield management".

Participants who supported this option, under the overall long-term time horizon category had the following reasons:

- A high proportion of baseload traffic that conforms or matches rail's competitive advantage in moving large unit load consignments over large distances. This was a freight railroad's "bread-n-butter" traffic or the reason for its existence. This was regarded as "easy-pickings" for a railroad and one option that afforded more benefit in moving a full train consignment, versus pursuing single wagonloads for additional revenue.

- In terms of *contractual traffic*, this favours both the customer and the freight railroad. Firstly, for the freight railroad, this long-term customer relationship satisfies its baseload or "bread-n-butter" requirements. In addition, this long-term *collaborative* relationship, as another participant noted elsewhere, is the foundation for freight rail yield management from an asset efficiency and productivity perspective.

  The reason being that, unlike in other service industries such as the airlines and hotels, where there is mainly a sales and marketing relationship with the customer, *freight is inherently immobile* and has to be handled operationally (Kraft *et al*, 2000). Consequently, the customer and the freight railroad are responsible for *asset sweating and reduced asset cycle times*.

  Secondly, participants noted that contractual customers are usually strategic or key entities for the freight railroad and carry the risk of having invested extensively for rail transport (as in rapid loading and unloading equipment) towards improving asset efficiency. These customers therefore will only be *satisfied with a corresponding high level of service* – another *interpretation of yield* in yield management.

- *Price inelastic* customers are generally rail-dependent customers and those with long-term contracts with freight railroads. As another participant mentioned that a contract would be negotiated to curtail the exposure to high price hikes because of this dependency on rail. The contract therefore *minimises the risk of*, or *guards against exploitation* or *monopolistic behaviour* from the freight railroad (Kraft *et al*, 2000). Apart from a co-responsibility to improve operational efficiencies, a freight railroad would then

negotiate for a better return or yield in these types of contracts with an effective pricing strategy or an initial contract price with annual escalations.

- A participant noted that a freight railroad is *better off* a with predictable stable demand pattern, which satisfies a railroad's *operating rhythm* or *conveyor-belt type operation*. This is true of unit load or megaRAIL traffic. This *non-seasonal segment* then provides the baseload and associated optimum capacity utilisation levels compared to that for spot traffic.

In conclusion, participant eleven observed what the researcher had realised while reviewing the interview transcripts that there are *different tactics or approaches* to managing yield. And, therefore *two types of freight rail yield management*, namely, one that has a *long-term orientation* versus the accepted *short-term, dynamic yield management* referred to in the literature survey.

The *long-term type of yield management focuses more on asset efficiency* (operational concerns) and less on pricing, since the transported products are mainly bulk commodities with low intrinsic value that require a low-cost transport solution. The short-term, dynamic yield management is suited to the spot market, for which demand is ad hoc, once-off, that is, time spent on rail does not allow for operational improvements, hence the focus on pricing to achieve the highest return very quickly.

6.5 Fifth Research Question

The results for the fifth research indicated that there were two activities or functions not possible within the freight railroad, namely, *overbooking of capacity* and a *first-com-first-served* capacity allocation rule. Overbooking of capacity was not preferred, since this would result in a compromise of the service levels and dissatisfied customers. *First-come-first-served* (or FCFS) was a risk in terms of reduced revenue potential and contrary to essence of yield management where the best returns are sought.

However, the FCFS rule was acceptable in situations where available wagon-space on trains or train capacity needed to be utilised. Here the opportunity cost of waiting for some other profitable single-wagonload consignment to materialise is not tolerable. Therefore, a "*satisfising*" approach would be adopted. The result for the FCFS allocation rule was not

clear-cut and the researcher believes that whether it is *intrinsically* possible or not depends on the situation and railroad policy.

In conclusion, this research question identified, from the participants, the yield management activities that could be applied or that are already being applied within the environment of this freight railroad. Overbooking, forecasting and an asset control mechanism (denying capacity) are the basic solution elements to yield management problems (Weatherford & Bodily, 1992). In this case, the participants have indicated their preferred policies to be employed in the practising of freight rail yield management.

6.6 Sixth Research Question

The sixth research question probed the participants' views on customers' expectations of the freight railroad. The results of this and the seventh question are used to argue a context for the application of yield management in the freight rail environment. The results for this question indicate that participants cited *acceptable pricing*, *predictability and reliability of service*, *safety of goods*, *good condition of rolling stock* and a *reasonable amount of flexibility* in the service as important customer specifications.

Acceptable pricing and the predictability and reliability of the rail service are inseparable, as participants have also noted elsewhere. Customers would not be amenable to tariffs that do not reflect an acceptable level of service. Therefore, the tariffs should correspond to an acceptable service level or be indicative of a differentiated service. Because freight is inherently immobile (Kraft *et al*, 2000) and has to be handled operationally or be on rail for a considerable amount of time, the *safety of goods* is paramount.

The condition of the rolling stock was regarded as an important customer specification, since it is part of the rail service offering. However, the researcher observed that *customers are co-responsible for maintaining the condition of the assets* and that a freight railroad should ideally monitor any customer-abuse of its assets.

6.7 Seventh Research Question

This research question required the participants to list the main responsibilities of rail executives regarding overall business performance of the railroad. Common items were

grouped and categorised as *shareholder value*, *profit*, *customer service*, *capacity utilisation*, and *safety*.

Of the five listed here, the first four seem valid responsibilities that could be satisfied using yield management approaches. Safety in general, not just of customers' goods, but human-life as well is costly in many ways and should be a non-negotiable requirement in a rail service. However, as part of the overall service and specification, this might affect the customers' perception of the quality of the service offering and hence the *perceived value* in the pricing of the rail service.

Increased *shareholder value* was mentioned as one of the outputs of yield management or '*yield*' interpreted differently. In terms of overall return on investment or increased revenue streams, this could be realised by increased revenues from customers through increased pricing and/or improved capacity utilisation. *Profit*, linked to this shareholder value, indicates a *motive to create value* by the participants, and would be satisfied in the same manner.

Increased *capacity utilisation* was mentioned because of the high-fixed cost attached to the freight rail asset-base. The participants regarded "asset-sweating" as important in that financial measures of business performance focus on asset turnover ratios or activity metrics to gauge the value of acquiring and applying the resources. Weatherford and Bodily (1992) caution that increased capacity utilisation could be pursued to the detriment of the price obtained per capacity unit. This is not the rationale governing yield management; rather, a *balance between* shareholder value or *profit and increased capacity utilisation*.

In conclusion, therefore, the management responsibilities as listed by the participants could be pursued and satisfied by employing yield management principles. The most popular customer specifications of *acceptable price* and a *predictable and reliable service*, together with the management responsibilities noted here, are two sides of the same *yield management coin*, and therefore the context for yield management in this industry.

6.8 Eighth Research Question

The eighth research question explored the operational challenges that could affect the implementation of yield management in the freight rail environment. The participants did not however, limit their challenges to operational issues only. The researcher identified ten

separate categories of challenges of which the items with the highest frequency of scores are discussed.

Understanding of the elements of yield management, *YM processes and systems*, *service reliability and predictability, operational challenges, efficacy of rolling stock* and *customer relationship challenges* were the issues that received the most responses from the overall list of ten hurdles for the freight railroad.

Understanding of the elements of YM and the *processes and systems to support it* are interdependent. The YM initiative could be hampered if there is not consensus or thorough comprehension of the concept across the organisation or amongst a selected group of individuals earmarked to drive the implementation, as demonstrated by the purposive sample chosen for this research study. In addition, these two challenges are relevant given the operational complexity of a freight railroad.

The researcher contends that *operational challenges*, which included asset deployment and efficiency measures, efficacy of rolling stock and service predictability and reliability, are interdependent. These form the basis of satisfising the customer requirements. Kraft *et al* (2000) outlined the nature of freight rail yield problems as the following:

- freight rail YM focuses on the *development of service commitments and improved service reliability*, as opposed to price discrimination
- freight has *no inherent mobility*, it must always be handled operationally, hence the challenge of asset deployment which Van Der Meulen (1994) claimed freight railroads were not capable of doing with precision. In addition, he notes that *service disruptions* and *service redesign* issues exacerbate the problem.
- traffic or freight retention is lengthy, that is, the delivery or throughput time on rail could be longer than one day.
- furthermore, the *efficacy of rolling stock* contributes to these service delivery challenges in that poor levels of asset reliability give rise to service disruptions.

Customer relationship challenges would be encountered when the freight railroad has to consistently deny capacity to certain customers because of other priorities (obligations to contract customers) or other revenue-earning opportunities. Kraft *et al* (2000) noted that a freight railroad would have a *captured market* that consists of a relatively small number of

industrial customers that are acutely aware of their and their competitors' relationship with the freight railroad. In this situation, *price discrimination* might be hampered too.

In summary, it has been established that the participants, based on their experience and insight, have identified challenges that are mainly operational and technical in nature. These challenges highlight the *intrinsic complexity of freight rail operations*, which add another dimension of complexity to the yield management problem for this industry.

6.9 Ninth Research Question

This research question encompassed four aspects that the researcher viewed as facets relating to the critical success factors (CSF's) of freight rail yield management. These facets were the CSF's, the advantages and disadvantages of yield management in the freight rail environment and whether a state-owned freight railroad would be permitted to practise yield management.

The most cited critical success factors were *operational excellence, market intelligence, knowledge of costs, awareness of the railroad's capability,* and to *operationalise decision support systems.* From the literature review, the participants have identified two of the critical success factors mentioned by Shuman (1991), namely, *market intelligence* or *research* and *decision support systems*.

However, another CSF listed here approximates the verification of feasible service offerings (Shuman, 1991), that is, the awareness of a freight railroad's capability. In terms of the feasibility of service offerings and given the participants' perspectives on this matter, the knowledge or awareness of the railroad's strengths and weaknesses is a fundamental requirement for the freight-rail yield management.

Operational excellence and the *knowledge of costs* are related, since operational excellence implies a reduced unit cost of transport. The awareness of the railroad's capability then, could be generated from market intelligence information and the modelling or simulation capability that are combined to produce "what-if" scenarios of potential yield outcomes.

Note, a freight railroad's capability is dependent on the demand or traffic mix (*derived demand*) that it has contracted or agreed to transport. Therefore, under different traffic mix or demand scenarios, a freight railroad could determine the best possible match between its

capability and what the market demands – a yield management decision. A forecasting ability then is required to enhance this decision-making process or decision support system. This approach would coincide with what Cross (1997) suggested that an *organisation and its processes should be evaluated*.

Kimes (1989) and Shuman (1991) noted that corporate governance is related to the *organisation of the yield management function*. Customer relationship management would be linked to this corporate yield management group, in that, this group would compile customer service objectives and the corresponding performance measures. These in turn could be used for resolving customer disputes regarding the rail service offering.

The *advantages of yield management* were *improved financial performance*, *long-run sustainability* of the freight railroad, *improved customer service and competitive position* and *increased asset utilisation*.

Improved financial performance, as claimed by Strasser (1996), was the *de facto* reason why the participants would consider implementing yield management in a freight rail environment. The improved financial performance translated into the long-run *sustainability* of the freight railroad, in terms of asset replacement, or the ability to pay its way (Lawless, 1990).

Improved customer service is a secondary benefit arising out of improved segmentation (Strasser, 1996), in that the freight railroad does not approach the rail service as a “one-size-fits-all” transport offering. *Segmentation variables or criteria* for a freight railroad are difficult to identify though, as one participant acknowledged. Market segmentation for a freight railroad could encompass customer, freight or commodities and type of equipment or rolling stock used; however, the essence of segmentation is to highlight visible differentiation, which the researcher believes is an elusive goal for a freight railroad.

An *improved competitive position* (Shuman, 1991) arises out of the knowledge that is obtained in implementing yield management. As one participant noted, the freight railroad becomes more aware of its service delivery system and understands its cost drivers. This knowledge or awareness affords the freight railroad the ability to compete responsibly by not discounting prices to such an extent that undermines its current business.

Increased asset utilisation is obtained by allocating the right capacity to the right customer or market segments (Campbell, 1996). As noted earlier, *yield management is a trade-off* between maximum revenue and an acceptable level of asset utilisation. These two objectives cannot be pursued separately or at the expense of the other.

The *disadvantages associated with* of yield management are *customer relationship problems*, *dissatisfaction with pricing approaches*, *company image issues*, *complexity*, *alignment with shareholder requirements* and the *rationalisation of the workforce*.

Dissatisfaction with pricing approaches and *customer relationship problems* were investigated by Kimes (1994) in her study of the *perceived fairness of yield management*. Customer discontent surfaced when there was no distinct or obvious differentiation underlying it. The researcher maintains that differentiation or segmentation is difficult in a freight rail environment.

Company image problems follow from this customer discontent with the price discriminating practices as one participant noted that irate customers could discredit the freight railroad in the media. Participant twelve observed that *yield management was a selective practice* and conflicted with a customer service strategy that normally has good intentions. In addition, as Kraft et al (2000) noted, a freight railroad has a small market of industrial customers. Given this fact, it would be a challenge to satisfy every customer and maintain good customer relations in such a situation.

Complexity was regarded as a disadvantage because it was required to *evaluate* several competing *demands* for rail transport *simultaneously*. This was the case for the single, wagonload consignment market, as one participant remarked that it would be "*difficult to satisfy thirty customers with thirty consignments moving between thirty origin-destination pairs*".

The researcher found *rationalising of the workforce* a peculiar item within the context of the yield management discussion thus far. However, the participants who raised this point, approached the question from an operational efficiency perspective which implied the reduction of costs. As noted earlier, there is an operational component to freight rail yield management that focused on the productivity and efficiency measures needed to improve

yield. These participants regarded yield to be revenue minus the costs to serve. Hence, the reduction of the workforce was deemed a disadvantage or negative result of yield management in a freight railroad environment.

Weatherford and Bodily (1992) defined *strategic constraints* that might hamper the yield management effort. These strategic constraints were interventions by top management (or shareholders) that complicated a firm's operating environment and competitor activity in the market place. One such strategic constraint could be the shareholder requirements that are imposed on the railroad management. The participants were requested to respond to the question of whether a state-owned freight railroad would be permitted to practice yield management.

Their responses ranged from (a) would be permitted, (b) conditional approval and to (c) uncertain/. The participants who remarked that a freight railroad would be permitted to practise yield management based their arguments on the *capacity utilisation or operational efficiency aspect* of freight rail yield management. The shareholder, in their view, would welcome these efforts, since it indicated that railroad management was a *responsible custodian of the assets*.

The situation for *conditional approval* related to the competitiveness in an industry as a prerequisite for yield management. As long as the shareholder (government) believed that customers had transport options, would YM be permitted, falling short of being accused of monopolistic behaviour?

Uncertainties surrounding the latitude to practice yield management, *revolved around the choices* that a freight railroad could exercise regarding pricing strategies and traffic mix. It was noted that a state-owned entity or public enterprise, irrespective of the industry, generally has a 'bifocal' (or "mixed-view") mission comprising social (developmental) and commercial goals.

Participants acknowledged that the exercise of selecting profitable traffic and being socially responsible at the same time was compounded by the fact that it was difficult to distinguish between either social or commercial type services. The proportion of social (developmental)

and commercial type services that a state-owned freight railroad should assume could be regarded as a yield management decision as well.

In conclusion, the critical success factors, advantages and disadvantages of yield management in the freight railroad environment have been outlined. *Operational* and *customer relationship issues* are pervasive in all these aspects of yield management for a freight railroad. Even the question of whether state-owned railroads would be permitted to practise yield management contains operational and customer issues.

Operational aspects in the sense that this was regarded as the manner in which yield management should be pursued in a state-owned freight railroad, namely, operational efficiencies as opposed to price discrimination or pricing options only. The customer relationship aspect is in the *choices that a state-owned freight railroad has in selecting whom to serve*.

Lastly, the following section presents concluding remarks to the question of whether yield management is suited to the freight rail industry.

7 CONCLUSIONS

7.1 Summary

This research has established that yield management is seen as implementable in the freight rail environment. The participants noting that the characteristics of yield management were evident and identifying the market segments to which it applied, confirmed this. Also, yield management policies were listed that could be employed in the freight rail environment.

However, yield management has many definitions as remarked by Reed (1998) that yield management is easier to define in terms of its objectives than to define what it really is. As Reed (1998) stated, “the outcomes are easier to understand than the process”. Weatherford & Bodily (1992) also state that yield management has not been properly defined yet, and therefore attempted to provide a universally applicable definition for all industries as the “*management of perishable assets through price segmentation*”, or, “*perishable asset revenue management*” (PARM).

The participants in this research however, have highlighted another aspect to the general notion of yield or revenue management that does not focus on price only, but for the freight rail environment, includes an *operational element* or *component*. So, freight rail yield management *cannot be the management of perishable assets through price segmentation exclusively*, as is the case for the airline, hotel and other fixed (or static) capacity industries. In these industries only the pricing lever is used to manage capacity and is usually implemented via computerized algorithms that focus on the dynamic allocation of capacity and the price sensitivities of demand.

In addition, the demand is mobile (airline or rail passengers present themselves where the capacity is located) as opposed to freight that is immobile – railroads have to both deliver and collect their capacity units. As one participant noted that the airlines carry no risk; rather, the risk is borne by the passengers in terms of their behaviour. Also, Van der Meulen stated that yield management is easier applied in industries where there is *static capacity* or *fewer degrees of freedom (of movement)*.

The *operational component* of yield management for freight railroads results in a two-pronged approach to improve yield as Kimes (1999) noted that the *objectives of yield management are to improve the yield or revenue per unit of capacity*. Both pricing and operational efficiency (or increased asset utilisation) then, achieves this objective for the freight railroad

Furthermore, in terms of the capacity unit as the focal point of yield management efforts, the participants selected different units of capacity, even a system-wide notion of capacity was mentioned. The researcher endeavoured to incorporate their responses in one diagram to illustrate that all capacity units that were listed, formed part of an overall system-wide capacity or capability (see Figure 3). Hence, yield management initiatives could be pursued in either element or simultaneously for all capacity elements.

However, participant seven remarked that basing the yield management initiative and decision-making on one or two variables only would be disregarding the essence and complexity of what constitutes a freight railroad. In addition, another interviewee observed that *for freight railroads there is no singular unit of capacity*, but rather a capacity that is effected through the wagon mainly, in concert with other capacity elements.

The researcher argues that this has resulted in a level of complexity that complicates the yield management for freight railroads to the point that it is impractical. Therefore, yield management in the freight rail environment is best approached intuitively (Oberwetter, 2001) versus implementation using more of the established revenue management solution techniques.

Two types of and corresponding approaches to yield management in the freight rail environment were identified, namely, a long-term and short-term approach. The long-term approach arose of out freight rail's competitive advantage in conveying mainly bulk consignments supported through long-term customer contracts or relationships. This approach assured freight rail's continued sustainability and survival. The other type and approach is consistent with the short-term, dynamic yield management associated with the service industries from the literature review.

Due to the complexity and challenges that freight rail presents to the yield management problem, the researcher argues that freight rail yield management should focus on satisfying rail's competitive advantage or stated differently, that short-term dynamic yield management is beyond the capabilities of freight rail.

7.2 Suggestions for Further Research

This research exercise has established that yield management in a freight railroad is complex and presents more challenges than that found in the other service industries encountered in the literature survey. More research is required to unravel this complexity. The researcher therefore proposes the following aspects that could be further explored with regards to yield management in the freight rail industry.

The perspectives of rail executives of other commercial and state-owned freight railroads should be explored to gain more insight regarding the freight rail yield management problem. This research focused on a select, purposive sample for convenience and the nature of the topic. The researcher was looking for depth in this exploratory research. Perhaps the corporate initiatives of other freight railroads could be researched to facilitate understanding of the freight yield management problem.

Reed (1998) has mentioned that yield management is better understood in terms of the outcomes than the process. The investigator suggests that research be undertaken to determine the metrics or measurements of yield management in the freight rail environment, thereby shedding light on the approaches for maximising yield in freight railroads.

Future research is required to determine whether the existing yield management models of the airline and other service industries could be adapted for freight railroads.

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