How the Application of Management Information System (MIS) Affects Business Value (BV) in the Airline Industry

Jerzy A. Kisielnicki, Warsaw University, Szturmowa str.3, Warsaw, 02-678, Poland; E-mail: kis@mail.wz.uw.edu.pl, kis@wspiz.edu.pl
Ewa Gwiazda, PM Consulting Inc., Canada; E-mail: Ewa.Gwiazda@worksafber.com

ABSTRACT

This article is based on the utilization of the MIS and Decision Support Systems (DSS) as significant factors influencing the BV of an airline. Authors state that a contemporary airline company needs to increase its investments in IT, specifically MIS and DSS applications. This hypothesis is based on the analysis of business needs of passenger airline pricing for such airlines as British Airlines, KLM, LOT (Polish Airlines), Svet Aero as well as on the research carried out with airline executives and their clients. The included examples illustrate that the payback period for investments in MIS/DSS – even during unfavorable economic environment - is less than a year.

INTRODUCTION

This article is based on a utilization of the MIS and DSS as significant factors influencing the BV of an airline. There is a significant difference between N.G. Carr [2004] and P.A. Strassmann [2004] in this regard. Carr states that the industries are saturated with IT applications, incremental investments in IT do not give an enterprise a strategic advantage, and strategic importance of IT has significantly decreased in recent years. Strassmann, who also advocates reduction in investments in IT, states in his book Squandered Computer [2004] that the differentiator is in *how* the IT investments are spent. Strassmann's position, rather than Carr's, is closer to ours.

Based on our research in pricing of passenger airfares, we state that today's enterprise needs constant development of the IT, MIS, and DSS applications. This development in turn drives up the enterprise's BV: both tangible and intangible assets of an enterprise. Our results can be extrapolated to the tourist, transit, and telecommunication sectors.

SCOPE AND HYPOTHESIS

In this article, we prove that the role of IT has not diminished. On the contrary, its strategic importance has changed from automation of repetitive processes to process management and management control. Based on our research, enterprises dealing with services distribution – specifically airlines – experience the growth of their IT role and along with it, the growth of their BV. The growing role of IT is caused by the volume and complexity of creating and distributing passengers' airfares. These factors drive the need of using a special class of MIS systems called the IV Generation systems.

In this article we use the following research approach:

- The first part includes the results of heuristic decision support procedures analysis
- The second part includes a CASE study of a practical example of the Generation IV MIS and the corresponding BV calculation

Since airlines do not release their operational effectiveness "hard data", we were not able to provide detailed research on BV calculation methods. However, we managed to apply our BV calculation method to the real production data.

Any airline, to be competitive, needs to implement coherent strategies to lower its costs and operating risks. The key element of operating risks is maintaining effective pricing strategy (prices too high will deter potential customers while prices too low will unnecessarily lower the profit margin). These simple on the surface requirements need a lot of data, complex transactions, and effective distribution to satisfy both the airlines and their customers. Consequently, the IT solutions need to be more sophisticated that the ones currently dominating the airline pricing market.

This article also includes the implementation procedures and IT roles in this implementation. It is based on our experience and research in analysis, design and implementation of IT solution in organizations like BA (British Airways), KLM (Royal Dutch Airlines), LOT (Polish Airlines), Malev (Hungarian airlines) and SvietAero (Ukrainian Airlines). Within the scope of our research, we issued questionnaires to:

- Airline managers and executives; to seek their opinions about the pricing decision support systems
- Clients; to seek their opinions about their experiences buying airline tickets

The research is based on the requirements of effective pricing strategy and its implementation evaluated from the pricing analyst (PA) point of view. The PA's role within an organization is to prepare and justify pricing decisions for pricing managers (PM). Based on PA's recommendations, PMs decide on price changes. The key criterion for this decision is profit optimization; the key success factor is a flexible pricing strategy.

In this article, we will prove the following two hypotheses:

H.1 The complexity of airfare pricing and distribution systems requires the use of IV Generation MIS systems.

H.2 The use of IV Generation of MIS system increases airlines' BV.

The hypothesis H1 is proved based on the research of pricing procedures in presented airlines. Hypothesis H2 will be illustrated by a specific example of a BV calculation in the context of Generation IV MIS.

In summary, we can say that the main thrust of this article is the analysis of decision-making processes and their control in the airline pricing industry as well as the role of MIS. As mentioned earlier, these findings can be applied to a wide spectrum of service distribution and their pricing strategies.

SELECTED THEORETICAL FOUNDATIONS OF MIS USED FOR DECISION-MAKING PROCESS IN AIRLINE PRICING

In order to achieve significant benefits from this class of systems, the design has to support flexible pricing strategy: pricing analysts need to have the capacity to easily access relevant information, have tools that support their analysis and

decision making processes, and allow for effective distribution of price changes through many sales channels. This implies that the MIS system needs to provide a complex set of tools and techniques ranging from typical transactional applications to simulation models and DSS functionality.

We can categorize the various MIS application based on their complexity using the concept of the MIS generation [D. J. Power - 2002]. The industry uses various methods to classify MIS; the most common are classifications presented by: E. Turban, J.E. Aronson, Ting-Peng Liang [2004], and K.C Loundan J. Loundan, [2006].

To classify MIS systems used to support the implementation of pricing strategy in airline industry, we applied a classification method that includes both hardware and software criteria and well as business functions [J.Kisielnicki, -2005].

Generation I – A database-supported transactional system used for reservations, sale of airline tickets, and inventory management.

Generation II – A database-supported on-line transactional system used for reservations, airline tickets sales, and inventory management. Also includes sales monitoring functionality and revenue management for each individual flight in a given time period.

Generation III –A Generation II system that also includes modules allowing for benchmarking an airline against the competition. This system would include a statistical modeling tool allowing for trend analysis, forecasting, etc.

Generation IV –A Generation III system that also includes modules allowing for the implementation of a pricing strategy based on probability, knowledge database, and heuristic methods to obtain an optimal profit from each sale.

Recommended MIS is a Generation IV system that includes the following elements:

Data warehouse, as an element of Generation IV MIS system, would incorporate historical, current, and future airfare information such as price, rules, flight information, fare class, where the sale originates, etc.

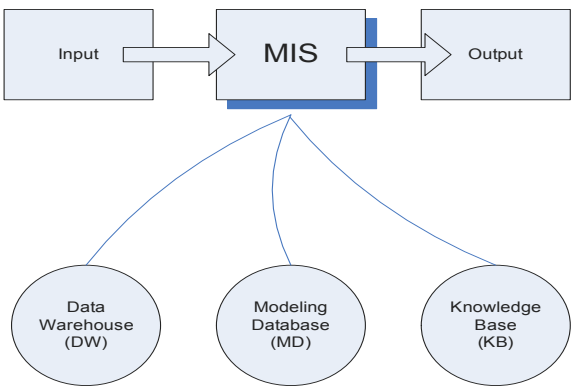
Modeling database would include yield management algorithms helping with the following decisions:

1. What price should be set for the next sold ticket; using marginal calculus models
2. What combination of prices will bring an optimal profit/revenue for each flight; using optimization and simulation models

In addition, the models would include the elements of risk assessment (for example: how many group tickets could be sold on each flight; the probability of groups returning their tickets; could the returned tickets be resold, etc.).

Knowledge base would include information about the competition, financial results of earlier promotions, etc.

Figure 1. Elements of generation IV MIS system used for pricing decision support in an airline industry



Source: Personal research

MIS itself uses all price changes as in input, and converts them – using all three supporting elements (DW, MD, and KB) – into new airfares.

Where a sophisticated MIS does not support pricing decisions, airlines are not able to establish a competitive price. Thus:

1. The airline is loosing revenue if its price is higher than the competition; plane flies empty
2. The airline is loosing profit if its prices are too low

A well-designed MIS allows for fast access to relevant data, correct pricing decisions, and effective distribution of pricing changes to travel agents, web sites, local airline offices, etc. All three elements are critical to a successful pricing strategy and its implementation.

Our hypothesis that the Generation IV MIS are required for the effective management of pricing policy was confirmed by the results of 20 interviews carried out amongst managers and executives (of airline companies) who attended the MBA program at Warsaw University. 16 interviewees, when asked for the characteristics of the adequate pricing decision support MIS, described the Generation IV MIS. Two of them described the Generation III and two described the Generation II.

Also of interest are customers' opinions about the quality of information available from the airlines. The questionnaire issued to the research sample of 80 graduate MBA students[1] of Warsaw University and the University of Trade and Law in Warsaw indicated that 80% were unsatisfied with the service provided by the travel agents and airline local sales offices. The key reasons were partial and unconvincing information about the tariffs and all associated rules (cancellation, changing dates, upgrades, etc.). While not all the blame can be put on the IT, airlines with complete and trustworthy information about their flights available through all sales channels will have better financial results than their competition. Without sophisticated calculations, we further state that this would lead to an increased BV.

ROLE OF A PRICING ANALYST AND MIS IN AIRFARE PRICING PROCESS

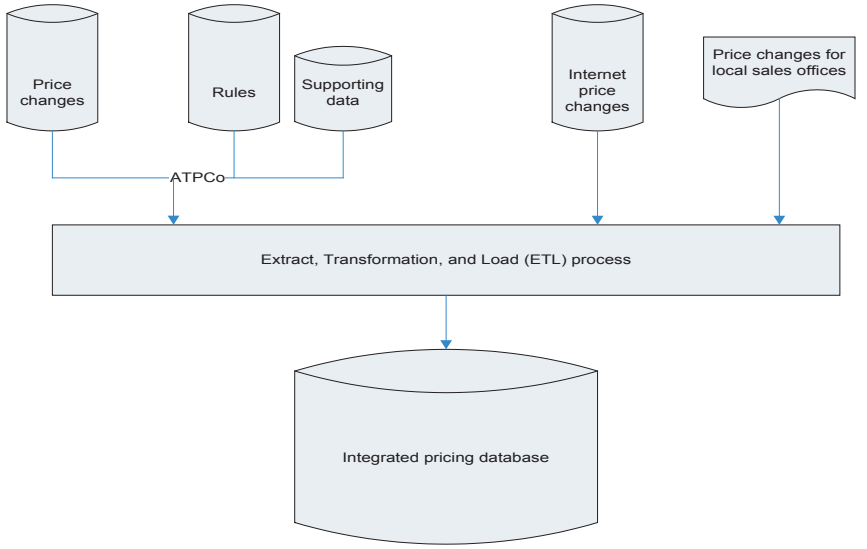
Pricing information in the airfare pricing process is both an input and an output. The output decides if an airline's pricing strategy is effective.

Is my price competitive? This is the key question that pricing managers as well as airline executives ask themselves every day. The Internet created a price transparency unheard of in the past. Every client, even if he buys his ticket from a travel agent in the end, checks the Internet first. Moreover, the competition is only a mouse-click away. This environment punishes uncompetitive airlines very quickly. In our context, uncompetitive airlines are those that do not react (i.e., analyze changes, decide on pricing changes, distribute the new price) to market changes quickly and accurately. Without a decision support system airlines would have to employ a high number of pricing analysts at a high cost and without a guarantee that they would find all the relevant pricing changes, recommend the right decision, and distribute price changes to all sales channels. Effectively, most airlines accept a compromise between costs and benefits; they employ fewer pricing analysts and in return have delayed and imperfect reactions to the competitors' pricing changes.

Generally, it is understood that designing a pricing strategy (for both products and services) requires creativity. Changes in consumer market trends, macroeconomic changes, market segmentation, airline revenue, and profit force pricing analysts to constantly monitor the effectiveness of current pricing strategy and make (timely) adjustments. Consistent maintenance of effective pricing strategy is not a simple task – the most common trap is a straight pricing competition that not only hurts the individual airline but the industry as a whole.

In addition, pricing analysts need to review several hundred daily price changes using very primitive transactional applications just to find out what is happening on the market. Currently, applications available in the researched airlines do not have mechanisms to tailor all price changes to the needs of individual analysts, do not provide decision support functionality, and are not connected to the price changes distribution systems. Hence, the necessity of employing an army of pricing analysts who sift daily price changes, make decisions (or recommendations) based on their own knowledge and experience, and pass it to another department for distribution. To mitigate the costs, airlines outsource data entry tasks (required for distribution) to countries like India where salaries are much lower, almost

Figure 2. Key element of the IV generation MIS specialized in pricing changes analysis



Legend:

ATPCo – Airline Tariff Publishing Company is the key source of market changes; it distributes all airline tariffs to all companies that buy their subscription. ATPCo distributes prices, rules, and various supporting data (code tables for countries, cities, airports etc.) ATPCo sends all changes five times a day during a week and twice a day during weekends.

The Internet price changes can be automated using screen-scraping techniques. Most airlines however are still using manual processes to monitor the Internet price changes.

Price changes originating from local sales offices (LSO) can also be automated using the workflow management process techniques. Most airlines however are still using manual processes to submit price change proposals and issue approvals.

The ETL process accesses source data, formats them, and updates the integrated database used by pricing analysts to monitor changes.

Source: Personal research

everybody speaks English, and the relatively high percentage of workforce has been educated in the UK. The time difference is also an advantage to European airlines: when their working day comes to a close and all their pricing changes are ready for distribution, staff in India begin their working day and initiate the distribution process.

In most airlines the entire process is supported by IT, but only on a transactional level (Generation I and II). To provide fast sometimes instantaneous - reactions to the market changes, airlines need a Generation IV MIS. The application of MIS would significantly help with pricing analysis, decision making, and distribution, allowing for a precise and fast response to pricing changes. MIS would integrate all sources of price changes; tailor the price changes to pricing analyst markets, and aid in decision-making processes. Figure 2 presents the key elements of such a subsystem.

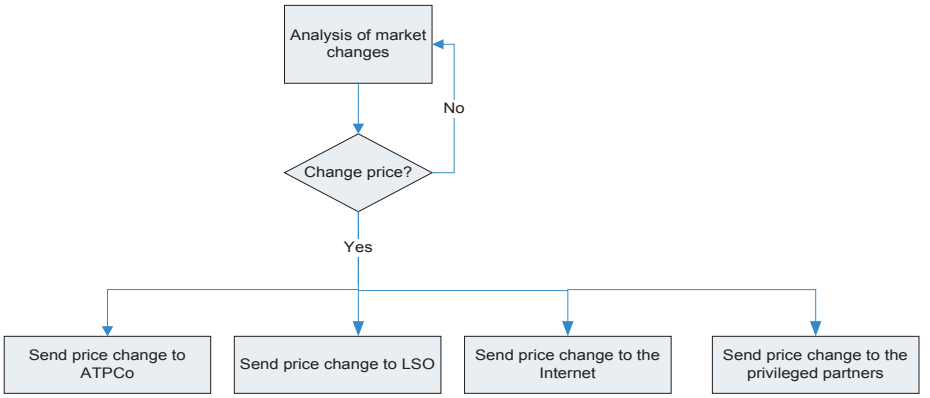
One of the key reasons to use the Generation IV MIS is the sheer volume of fares stored in the integrated database. Our research indicates that in any given moment there are approximately 200 million tariffs (this includes ATPCo distribution and SITA distribution directly to the Global Distribution Systems). Loew [2004]. The number of changes made each year is estimated at 1 billion. Loew [2004].

In addition to airfare price changes, there are also airfare rule changes that influence customers' buying decisions: ticket return policy, length of stay, travel dates and travel dates changes, etc. The number of rule changes is estimated at 1.5 million a year.

The decision making and distribution of the Generation IV MIS supporting the pricing management in airline industry is presented below:

To illustrate the challenges facing airlines, a hypothetical airline company MyAir will be used (the need to use a hypothetical airline is due to the fact that the researched company did not agree to release its data as it would provide a competition insight into its operations). Let us assume that MyAir owns 50 aircrafts, has an annual revenue of $1 billion, and operates on 10 000 markets (where a market is defined as an individual flight, for example London-NYC; the flight NYC-London would be a separate market). Let us further assume that MyAir makes approximately 1 million price changes a year and analyses approximately 5 million price changes issued by other airlines. This translates into reviewing 13 700 prices and rule changes every day (assuming normal distribution). Every delay in MyAir response would mean either revenue loss (if prices are too high) or profit loss (if prices are too low) Loew [2004].

Figure 3. Decision support and distribution of price changes processes in generation IV MIS



Source: Personal research

Table 1. Sample set of prices and rules associated with a booking class. This information is sent for each airline, market, travel date, purchase place etc.

Class	Price	Rules
Business Class	pP-(1) P-(N)	R1 Rs
Economy Class	P (N+1) RmP (M)	R1 Rw
Economy Plus	P(M+!) Rk P(K)	R1 Rp

Legend:

P – price of a ticket in a given booking class

R – rules associated with a booking class and ticket price

Source: Personal research

Every airline can change prices and rules five times a day for every market and any future dates. Additionally, normal distribution does not really happen: airlines can change 30% of their prices in a single filing, make only minor adjustments for quite some time or suddenly make drastic changes. Since there is no legislation on how far in advance the price or rule changes can occur, there is no way to predict when the high volume of these changes might arise.

It is also important to understand that not all price changes are equally important. It is estimated that each airline has 90% of revenue from 1% of its markets. Therefore prioritizing markets and price changes is critical to the effectiveness and efficiency of price changes monitoring.

An additional challenge that airlines face is monitoring rule changes. Every airfare is a combination of its price and associated rules. Table 1 presents the illustration of airfares and relationships between prices and rules.

The pricing process is completed in four stages:

Stage 1: Monitoring Competitors' Pricing

The monitoring of competitor's pricing is an ongoing task. Pricing analysts have to check the price changes of competing airlines at least twice a day on each market. They use the integrated pricing databases presented in Figure 2. While market changes could trigger a potential price change, the evaluation of current pricing does not happen in isolation of internal influences. Every price change needs to go through analysis in three internal systems:

1. Revenue accounting
2. Reservation system
3. Yield Management

Stage 2: Monitoring Competitors' Airfare Rules

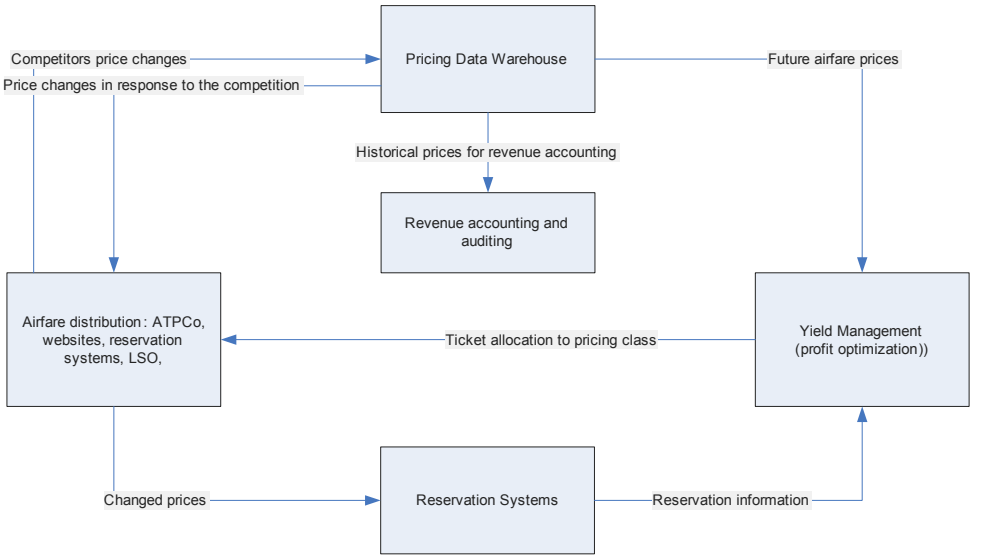
Since airfare pricing is influenced not only by the dollar amount but by rules as well, every pricing analyst has to review the changes in rules. The relationship between airfare and rules is complex: each airfare has multiple rules and each rule is linked to multiple airfares. The analysis of this relationship is not straightforward. As an example, let us use an airfare from London to NYC offered for $1,050 with a condition that a passenger will not stay in NYC on Saturday. The same airfare from London to NYC is offered for $850 with a condition that a passenger will stay in NYC on Saturday. At a first glance, this pricing difference does not seem logical; after all, the cost of the flight is the same regardless where a passenger will be on Saturday. However, this particular rule has been used for market segmentation: most business travelers want to come home before the weekend, while people who go for vacation typically want to spend a weekend at their destination. Therefore, a change in a rule saying that airfare from London to NYC is the same regardless of the length of stay in NYC means that the price for business travels has dropped by $300. Since the rule might affect more that one market, pricing analyst needs to carefully review all rule changes, associate them with all airfares, and then review the impact of the changes.

Changes in rules are as important as changes in prices; with one rule change such as in the example given above, competitors can change thousands of airfares in one filing. Table 1 presents that the relationship between airfares, prices, and rules is further augmented by the risk assessment as well as revenue/profit simulation to predict financial results of price changes.

Stage 3: Pricing Decision

An airline typically has many pricing managers, each responsible for a set of markets or market segments. The pricing manager receives recommendations for all of them on a daily basis, assesses each change in tactical and strategic context, and approves or rejects the change.

Figure 4. Data flow between internal systems using current and proposed prices



Source: Personal research

Stage 4: Price Change Distribution

Once a new set of prices is approved, it has to be distributed to all sales channels. Each airline has several distribution channels (refer to Figure 3): ATPCO or SITA (the main ones), LSOs, airlines' websites, travel agencies throughout the world, their websites, various privileged partners, etc. The importance of sales through an airline's own web site grows since the overall cost of such sale is much lower: there are no intermediate costs and all tickets sold by the Internet are e-tickets (less expensive than traditional paper tickets).

Worldwide distribution adds extra complexity to airfare pricing: the price is different depending on where the sale is taking place. For example, the return ticket Johannesburg-NYC-Johannesburg bought in Johannesburg will be less expensive than the same return ticket NYC-Johannesburg-NYC bought in NYC, because tickets bought through the Internet are priced based on the place of departure. In addition to the base price, pricing analysts need to take into account local taxes, airport fees, agents' commissions, etc. Moreover, all price changes have to reach all sales channels at the same time.

Price changes to the LSO are typically distributed via email, fax, or a telephone. While it is a fast and effective solution it is a short-term one. In the long term, airlines struggle with controlling this process and ensuring that price changes requested by the LSO are properly analyzed, evaluated, and decided upon.

Theoretically, yield management can mitigate pricing errors. Let us use the MyAir example: MyAir has a plane with 100 seats and these seats are divided into five pricing classes: very expensive, expensive, average, cheap, very cheap. Each of these pricing classes has allocated 20% of all seats. The yield manager monitors daily reservations and depending on the progress and various risk factors changes the seat allocation in each class. If very expensive airfares are selling well, the yield manager will increase the allocation in this class to 25% and will decrease the allocations in other pricing classes. If the very cheap tickets are selling fast, the yield manager might close this class altogether and allocate remaining tickets to the other classes. One of the risk factors that the yield manager also takes into account is group tickets: these should be less expensive if it was not for the risk of return. Typically, yield managers do not advise to have more that one group in each flight. Regardless of how well yield managers optimize the pricing of remaining seats, they act after the sales/reservations have been made – the lost revenue and lost profit due to inadequate original pricing cannot be recovered. It can only be adjusted for the future.

Yield managers rely heavily on IT support; to arrive at the best balance of prices in each class, they use a combination of marginal economical models, simulation, and optimization techniques.

An example of a costly pricing error made by a low-cost carrier was setting a promotional price for Warsaw-London market at Euro 1. The intent was to start at a very low price and then raise it. At the same time, BA started its promotion and was selling its tickets at a price lower than the low-cost carrier. The low-cost carrier was not able to recover the losses incurred during the Euro 1 promotion and effectively could not compete with BA. As a result, during the July-August vacation season, the low cost carrier lost Euro 100K in this market alone.

THE INFLUENCE OF PRICING DECISION SUPPORT SYSTEMS ON COMPANY'S BV

There are many different approaches in evaluating BV: how each department contributes to the company BV, what the reasons of growth or decline of BV are, etc. In this section we will present how IT, and specifically Generation IV MIS, influences BV. Even though our research indicated that IT significantly influences the BV, we can not derive precise and scientific function that defines this dependency. Therefore this part of the article is a CASE study; we will identify the influence of the Generation IV MIS on the passenger airline company's BV. The term BV, as mentioned earlier, represents both tangible and intangible assets of a company. It is also an important indicator of its market value. Since the assessment of a BV is complex, there are many methods of defining and calculating it E. Brynjolfesson, L.M. Hitt, [2003], Remenyi, D., A. H. Money, et al. [2000] P.A.Strassmann, [1990, 1999]. In literature, in addition to the BV, the use of "goodwill" of a company quite common G. Jones, N.J. Morgan, [1994] A.H. Millichamp, [1997]. Generally, we understand the BV of a company is a difference between the company's assets and its liabilities. The analysis and evaluation of different approaches to defining and calculating BV is not in scope of this article.

The results of using Generation IV MIS and its effect on a company's BV are presented in the Figure 5. The relationships between the investment in such MIS and BV benefits is defined based on the analysis of the Generation IV MIS for our hypothetical airline company MyAir.

Let us assume that MyAir has annual sales of $140 million (daily sales of approximately 4 million). The investment in IT in 2004-2005 was approximately 25 million (infrastructure and operational costs are not included). 80% (16-18 million) of this cost was spent on the new Generation IV MIS.

In this article, we used the estimates of future revenues as an indicator of BV. From this potential revenue we subtract labor costs (including professional development of pricing analysts), marketing, research and development costs required to maintain competitive edge in IT, and higher taxes incurred as a results of increased sales. We state that a company can generate additional sales due to effective and efficient IT including the Generation IV MIS.

The influence of Generation IV MIS is calculated according to the following formula:

$$BV = (P\text{-}aP) – W.$$

Where:

- BV – annual increase of company's value due to the use of IV Generation MIS ($).
- P – annual increase of company's revenue achieved due the improved pricing processes (S).
- a – indicator of the effectiveness of pricing analysts using lower generation MIS.
- W –implementation costs of IV Generation MIS ($).

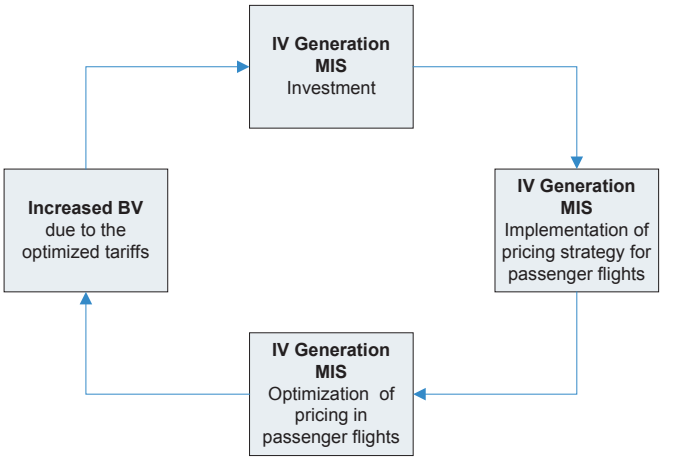
Let us assume that MyAir looses approximately $100 000 daily ($30 million annually) due to an ineffective pricing policy. In addition, MyAir looses between 2%-5% revenue ($20-50 million) due to the late responses to competitors' price changes. Using the above equation, we have:

- P=$50-80 million annually
- a is estimated at 0.7 –0.8
- W = $16-18 million

Year 1: BV is between 0 to 6 million; Generation IV MIS will pay for itself.
Year 2: BV is between $16-25 million

Based on the estimated cost of MIS and revenue, we see that the costs of the IV generation MIS will be paid off during the first year of its operations.

Figure 5. Dependency between the investment in MIS and BV



Source: Personal research

AMR research estimates that airline companies that consider pricing management as a key element of its strategy have 10% increase of revenue [Scott 2003]. Based on our research, the revenue increase depends 70% on the qualification of pricing analysts and 30% on the IV Generation MIS.

CONCLUSION

In this article we presented the complexity of airfare pricing and pricing distribution, included estimated volume of transactions and data, and indicated how investment on IV Generation MIS increases airline BV. We estimated that at any given moment, there are approximately 200 million airfares and the annual number of price changes is 1 billion. Therefore, in order to maintain effective, efficient, and flexible pricing strategy, airlines need to use sophisticated IT solutions. Based on our research (questionnaires, interviews, analysis of several airlines, and literature), we state that the Generation IV MIS meets these requirements. In addition, the Generation IV MIS directly influences airline BV, and even the significant cost of the IV generation MIS implementation is returned within one year. Paraphrasing Mark Twain, we can say that Carr's forecasting of the diminishing role of IT is highly exaggerated and certainly does not apply to the passenger airline industry.

BIBLIOGRAPHY

E. Brynjolfesson, L.M. Hitt, [2003], Computing Productivity: Firm – Level Evidence, MIT Sloan Working Paper No.4210-01 (June)

Carr, N. G. [2004], Does IT matter? : Information technology and the corrosion of, competitive advantage. Boston, Harvard Business School Press.

G. Jones, N.J. Morgan,[1994] Adding Value, Routledge, London - New York, p.. 80

J.Kisielnicki, H.Sroka, [2005], Business Information Systems, Placet, Warsaw

J. Loew [2004], Draining the Fare Swamp, Journal of Revenue, and Pricing Management Special issue IATA Revenue Management and pricing conference. Vol. 3, April p.5

K. J. Loundon, J.P. Loundon [2006], Management Information Systems- Managing the Digital Firm, Pearson Prentice Hall, New Jersey

A.H. Millichamp, [1997], Finance for Non-Financial Managers, Letts Educational Aldine Place, London, p. 195

D. J. Power ed. [2002], Decision Support Systems: Concepts and Resources for Managers, Quorum Books division Greenwood Publishing

Remenyi, D., A. H. Money, et al. [2000. The effective measurement and management of IT costs and benefits. Computer weekly professional series. Oxford; Boston, Butterworth-Heinemann

K. Scott [2003], Driving demand profitable with, pricing, AMR research

P.A.Strassmann, [1990], The Business Value of Computers, Pub. Strassmann, Inc.

P.A.Strassmann, [1999], Information Productivity, Pub. Strassmann, Inc.

P.A.Strassmann, [2004]. Squandered Computer, Pub. Strassmann, Inc.

E.Turban, J.E.Aronson, Ting-Peng Liang [2004], Decision Support Systems and Intelligent Systems, Prentice Hall,

Van Grembergen W. [2004], Strategies for Information technology Governance, IDEA Group Publishing,

K. Scott, [2003] Driving Demand Profitably with Pricing, AMR Research

ENDNOTE

[1] 25% of the sample had more than 5 flights in a year, 60% has between 3 to flights in a year, and 15% had 1 or 2 flights in a year.