



# Biometrics: the next frontier in service excellence, productivity and security in the service sector

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## Abstract

**Purpose** – To explore the potential role of biometric technologies in driving service excellence, productivity and security in the service sector, and their role in fostering sustainable competitive advantage.

**Design/methodology/approach** – This paper used a case study approach involving 16 in-depth interviews with executives at Singapore Airlines and the Civil Aviation Authority of Singapore on their use of biometrics technologies with focus on the Fully Automated Seamless Travel project.

**Findings** – The potential for innovative technologies to foster sustainable competitive advantage can be assessed in terms of their potential impact on customer experience, as well as the extent to which their implementation involves significant business process reconfigurations that are hard to imitate by competitors.

**Research limitations/implications** – With regard to limitations, this research is based on an in-depth study of a single case of biometrics implementation. More cases need to be examined to enhance the validity of the findings. Research implications relate to evaluation of new technologies from the perspective of achieving competitive advantage, outline of dimensions of strategic alignment, and discussion of competencies and processes fostering strategic innovation.

**Practical implications** – The findings provide a new framework for evaluating innovative technologies in terms of their potential for enabling an integrative strategy of differentiation and cost leadership; highlight the importance of strategic alignment; and outline competencies fostering strategic innovation.

**Originality/value** – This paper is one of the first exploring the role of biometric technologies in service delivery; addresses the strategic implications of implementation; and concludes in terms of broader strategic principles.

**Keywords** Strategic alignment, Service delivery, Airlines, Singapore

**Paper type** Research paper

## The emergence of biometrics

Intense competitive pressures and razor-thin margins in the airline industry, as in many other industries, do not allow firms the luxury of freely expending resources to improve levels of service. Rather, the trick is to constantly seek ways to simultaneously achieve leaps in service quality as well as efficiency. Internet technology has in the last few years allowed many firms to do just that, and has redefined several service-oriented industries such as retail financial services, insurance, book and music retailing, and travel agencies. Biometrics may be the next major technology after



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the internet enabling further value and productivity enhancements for those firms that know how to harness its power (Wirtz and Heracleous, 2005).

Biometrics is the authentication or the identification[1] of individuals based on a physical characteristic or trait. Physical characteristics include fingerprints, facial recognition, hand geometry or iris configuration; and traits include signature formation, keystroke patterns or voice recognition. Biometrics, as something you are, is both more convenient and more secure than something you know (passwords or pieces of personal information) or something you have (card keys, smart cards or tokens). There is no risk of forgetting, losing, copying, loaning, or getting your biometrics stolen, especially if a multi-biometric approach is used for authentication. Dominant security-enhancement technologies leave a lot to be desired. In addition to security risks, has been estimated that between half to a third of calls to IT help desks are password related, and that managing multiple passwords and password resetting costs can range between \$200 (Forrester Research estimate) to \$340 (Gartner estimate) per employee per year (www.Forrester.com (2005); www.Gartner.com (2005)).

Biometrics can offer significant security enhancements as well as other value-added applications. Potential applications of biometric technologies range from controlling physical access to facilities (used by Disneyworld to provide access to season pass holders), enabling voice recognition at call-centers (used by the Home Shopping Network and Charles Schwab to enable hassle-free client authentication), controlling time and attendance of employees (used by McDonalds), providing self-service access to safe deposit vaults at banks (used by the Bank of Hawaii and First Tennessee Bank), or cashing checks in supermarkets (used by Kroger, Food 4 Less and BI-LO).

Security concerns and higher levels of fraud, such as the rising incidence of identity theft, combined with advancements in biometric technologies and reducing costs of the technologies involved, have provided an impetus for greater diffusion and highlighted biometrics' immense potential. In 2003, while industry revenues were US\$719 million, the estimate for 2004 is US\$1.2 billion. This is expected to rise to US\$4.6 billion in 2008. Currently the lion's share of biometric technologies is accounted for by fingerprint biometrics at 48 percent, followed by face recognition at 12 percent and hand geometry at 11 percent. Iris recognition, by far the most secure method, has just 9 percent market share, since it costs a lot more to implement and there is a lower level of customer acceptance (International Biometrics Group, 2005).

However, the overwhelming majority of current biometrics applications are focused on simply improving security rather than being led by a clear mandate of providing quantum leaps to customer service while simultaneously raising efficiency as well as security. We believe that the winners of tomorrow will be firms that manage to harness the power of biometrics to achieve this essential combination (Wirtz and Heracleous, 2005). We illustrate this through a discussion of the use of biometrics by Singapore Airlines, one of the key service leaders and strategic innovators in the airline industry.

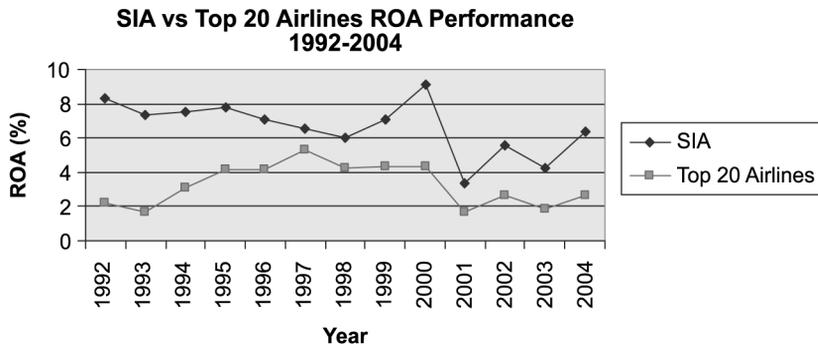
### **Singapore Airlines – outperforming through service excellence**

The strategies of focusing on value-added differentiation through premium quality on the one hand, or focusing on system-wide efficiency and aiming for cost leadership on the other, have been seen as incompatible strategies since they usually entail mutually contradictory actions and investments at the operational level. It has been argued that any such attempt to combine incompatible generic strategies would at best be

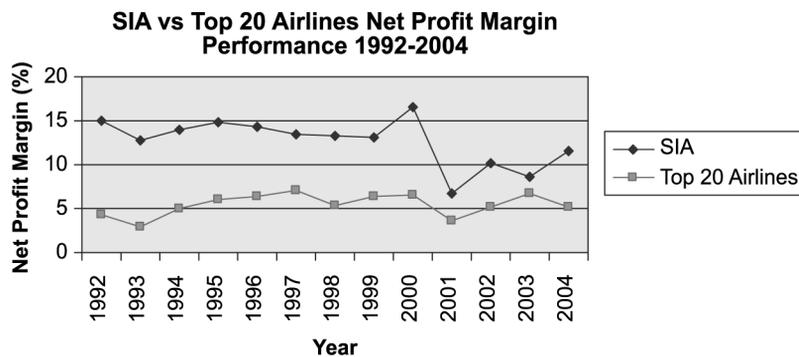
temporarily successful. Companies attempting it would risk being stuck in the middle, achieving neither high levels of differentiation nor sustainable low cost (Porter, 1980). In spite of arguments to the contrary (Hill, 1988), successfully achieving a combination of differentiation as well as lower cost than competitors in the same strategic group has been rare.

One organization that has consistently achieved this is Singapore Airlines, arguably one of the most successful service leaders and innovators in its industry (Heracleous *et al.*, 2004; forthcoming, a). Our studies have shown that SIA has combined premium levels of quality and innovation, while at the same time having lower costs than its peer group, for decades. This has enabled SIA to consistently outperform the airline industry (never in its history posting an annual loss), a key measure of robust sustainable competitive advantage (Heracleous *et al.*, forthcoming, b). The airlines industry is extremely tough to compete in, given its disastrous business cycles, overcapacity, difficulty of differentiation, high risk profile and structural unattractiveness (Costa *et al.*, 2002). Figures 1 and 2 show performance comparisons of Singapore Airlines relative to the top 20 airlines (by market capitalization, weighted average) for the period 1992-2004.

Singapore Airlines and the Civil Aviation Authority of Singapore (CAAS), the operator of Changi Airport, arguably the best airport in the world ([www.traveldailynews.com](http://www.traveldailynews.com), 2004), have given us access to their current thinking on biometric technologies, and how they are employing them to offer every traveler's



**Figure 1.**  
Return on assets (ROA)  
comparison



**Figure 2.**  
Net profit margin  
performance comparison

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dream when it comes to airport procedures: the ability to breeze through airline check-in, security checks as well as immigration checks in less than one minute, all within a context of enhanced travel security. In line with technological trends and international developments, SIA and CAAS believe that in the not too distant future most international travelers will be carrying a passport, visa or smartcard which will contain selected biometric information of its owner. In response to this opportunity, a task force in SIA has identified an astounding 113 potential biometrics applications in a recent retreat, and is currently exploring which ones would provide simultaneous strategic differentiation through service excellence, while improving productivity and cost effectiveness, as well as security.

For many “full service” airlines, delivering excellent service comes at a premium cost to the airline. Singapore Airlines on the other hand, appears to have managed to create cost-effective service excellence in an industry where both pricing pressures and customers’ expectations have been continually rising. How does SIA manage to do so? In common with many other organisations with a reputation for providing excellent service, SIA displays the characteristics of world-class service companies including top management commitment, customer-focused staff and systems, and a customer-oriented culture. According to Dr Cheong Choong Kong, former CEO of SIA, “Our passengers . . . are our *raison d’être*. If SIA is successful, it is largely because we have never allowed ourselves to forget that important fact.” However, what distinguishes SIA’s customer-oriented and cost-conscious culture, is that these are not just abstract, motherhood statements. The values of cost-effective service excellence are enshrined in processes and practices that make the values real for all employees, enacted in their every decision and action (Heracleous, Wirtz and Pangarkar, forthcoming).

### **The advent of fully automated seamless travel at Singapore Airlines and Changi Airport**

A significant application of biometric technologies currently being developed at SIA’s hub at Changi Airport in Singapore is the FAST (Fully Automated Seamless Travel) process. In November 2004, a six-month pilot test of FAST has been initiated based on a biometrics technology that integrates three processes: airline check-in, pre-immigration security checks, and immigration clearance. Most other biometrics-based trials elsewhere primarily focus on improving security, are limited to specific processes or aspects of customers’ experience such as controlling access to secure areas, airline check-in or immigration checks; and at implementation level apply mostly to airport staff or a limited number of selected frequent flyers rather than a broad spectrum of passengers. This initiative at Changi Airport is a world’s first of integrating these processes with the clear objective of driving service excellence at airport operations and SIA’s ground services, while at the same time driving efficiency and improving security. FAST is expected to be rolled out in the future to all passengers who carry biometric cards, and all airlines operating through Changi Airport. In addition to improved security, a key aim is to enhance competitive differentiation through delivering great customer service and convenience as well as reducing airline and airport costs by simplifying procedures, reducing error, and making efficient use of self-service technology.

The pilot phase involves 9,000 of SIA's frequent flyers who are Singapore citizens, and is being implemented at terminal 2 at Changi Airport. Participants have signed up first at an enrolment station of the Immigration and Checkpoints Authority, where their biometric information (fingerprints and facial features) have been captured on a smart card called SVIP (Smart Visa for Identification with Passport). When traveling, these registered users can simply walk through a separate gateway at immigration, where they can do a self-service check-in at a computerized service station. Here, they tap their card onto a reader, have their fingerprint scanned, and use a touch screen to check in while their face is being scanned by a camera. The system identifies the card holder, clears security checks and immigration, at the same time recommends a seat based on the known preferences of the traveler, and upon acceptance by the traveler, prints a boarding pass. If the traveler is happy with the suggested seat, the entire process takes less than 60 seconds, from a current average of (already highly efficient) eight to fifteen minutes. If the passenger wishes to change their seat three times (the cabin seating with available seats is displayed on the self-service check-in screen), the time needed for the entire process could rise to three minutes. The pilot test does not handle passengers with check-in baggage, but a separate process, the "baggage drop-off" concept, is being considered for that. Hand luggage is taken on board as usual.

The FAST pilot technology is integrated with a number of existing systems. First, SIA's booking system for seating preferences and real-time seat allocation and confirmation. Second, Singapore's current IACS (Immigration Automated Clearance System), used for speedy immigration processes at the border between Singapore and Malaysia to facilitate travel for tens of thousands of daily commuters to and from Malaysia who live in one of the two countries and work in the other. IACS monitors entry and exit from Singapore and checks traveler details against immigration databases. Third, the SVIP card, which is an initiative by the Ministry of Home Affairs to meet US immigration requirements.

This process looks simple from the customer's perspective, as it should, but it is in fact highly complex from a legal, security, technological and organizational perspective, which makes it extremely difficult to imitate by competing airlines and airports. The development and pilot of FAST requires close co-operation among five organizations, each with their own priorities, concerns, and systems. The organizations involved are Singapore Airlines, Civil Aviation Authority of Singapore, Immigration and Checkpoints Authority, the Singapore Police Force, and the Ministry of Home Affairs. The pilot uses a multi-biometric approach, combining facial recognition, preferred by the EU, and fingerprinting, preferred by Singapore's authorities and currently employed in the Immigration Automated Clearance System at the Singapore-Malaysian border. One consideration in developing the system was the aim of meeting the requirements of the US Enhanced Border Security & Visa Entry Reform Act of 2002.

Besides harmonizing with EU and US standards, this approach helps to minimize the key two error indicators of biometric identification systems. The False Rejection Rate refers to the right person being rejected and would lead to inconvenience for that person until their identity is established; whereas the more critical one for security purposes is the False Acceptance Rate, which would mean that the wrong person is identified as a legitimate card or visa holder and allowed to travel. To align with EU

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privacy laws, no biometric data is being stored at the airport or elsewhere. Rather, all data is stored on passengers' own smart cards. In the event of loss, it would be virtually impossible for any unauthorized alteration of data stored on that card since it is protected by a complex algorithm and the keys are kept by Singapore's Immigration and Checkpoints Authority.

Different service processes have different security needs. For example, a 99 percent accuracy of a voice-recognition application may be a quantum leap of improvement for caller-identification in a call center that is currently identifying customers calling from stored telephone numbers. For immigration processes however, accuracy levels cannot be compromised and 99 percent accuracy would be unacceptably low. In such cases, multi-biometric systems that deliver almost 100 percent accuracy can be used, as in FAST or in the US-VISIT program.

A complementary use of biometrics currently in development is the "Baggage drop-off" concept. Currently, all passengers with check-in baggage have to undergo the inconvenience of carrying their bags to the check-in counter after they arrive at the airport. SIA wants to eliminate this inconvenience by allowing passengers to drop off their baggage outside the building as soon as they come out of their vehicle, so that they can then just breeze in the airport and avail of the seamless travel facilities offered. This baggage drop-off idea clearly complements the biometrics-based check-in process, which in its current form can only handle passengers with hand-luggage.

The above service innovations are taking place in the context of Singapore's strategic objective of maintaining and improving its hub status in the region, given the importance of hub status for the country's sustained economic growth and its reputation as a paragon of efficiency. Other relevant organizations such as the Singapore Tourism Board are currently considering how to employ the card in commercial applications to enhance travelers' experience when in Singapore. SIA and CAAS will be carefully monitoring customer satisfaction, system reliability, and efficiency during the trial and will take detailed measures to fine-tune and improve the system before it is rolled out to all travelers and airlines. While SIA had the inspiration for this project, and as the hub airline will benefit most from the increased convenience and efficiency of ground services at the airport, this process is technically owned by CAAS and is intended to be rolled out to all terminals and airlines after the trial phase.

### **Managerial implications: building and sustaining competitive advantage**

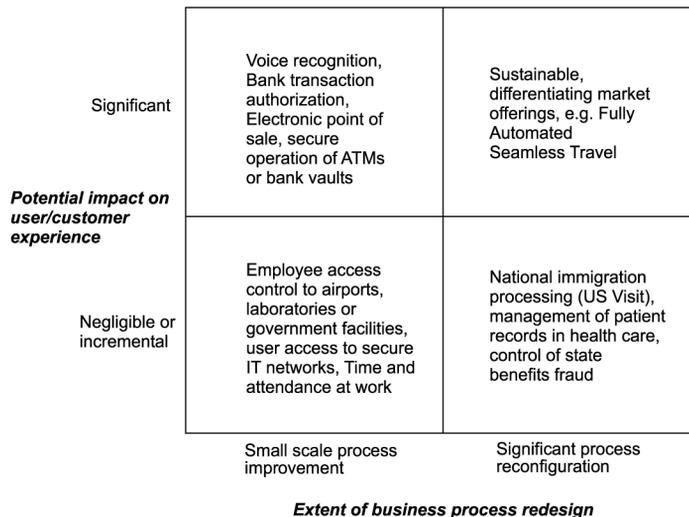
Our study has significant implications for companies that wish to achieve service excellence and sustainable competitive advantage. The first implication relates to strategic thinking with regard to new technologies; simply employing new technologies for their sake or just to cut costs cannot afford competitive advantage. Such advantage can be achieved only if new technologies are employed in accordance with a customer-centric mindset, that adds value to the customer, combined with seamless implementation. The second implication is the importance of strategic alignment; the consistency and coherence of strategy, core competencies, organizational configurations, and demands of the market. Such alignment would make a company's operational system, and the strategy it supports, hard to imitate by competitors. Lastly, the third implication relates to strategic innovation. To be a service leader, a company has to keep innovating through such processes as ideas brokering, effective use of inter-organizational networks, deep understanding of the

customer, and developing an internal culture that supports innovation, continuous learning and change.

The first key implication of our study is that employing the latest technology does not necessarily afford competitive advantage to companies. Rather, new technology has to be employed within a mindset aiming to deliver service excellence (rather than jumping on the competitive bandwagon), and secondly the implementation has to create barriers to imitation through significant process re-configuration, as discussed below. If the new technology also enables cost reduction, a service-oriented company can be in the enviable position of being able to achieve an integrated differentiation/low cost strategy. SIA is one of a select group of companies that have achieved and sustained this strategy, together with companies such as Dell and Intel. In each case, the precise elements of implementation have varied, but the result is the same: an unbeatable strategic combination.

Considering the specific case of biometric technologies, the challenge is to move beyond incremental applications of biometrics focusing simply on security, but to consciously design applications that aim towards combining service excellence with higher efficiency, where higher security is a by-product of this process rather than the *raison d'être*. This entails thinking both about how to enhance customer experience, as well as designing and implementing significant process reconfigurations, as shown in Figure 3.

The lower left hand side quadrant includes examples of biometric applications that neither involve significant business process redesign, nor present the potential for value added customer or user experience. The lower right hand side quadrant shows examples involving significant process reconfigurations, but still without the potential for substantial value added to customers or users. These two quadrants primarily focus on control; for example access, attendance or entry control. The higher left hand side quadrant offers the potential for improvements to customer experience, but can easily be copied by competitors because these improvements do not involve significant business process reconfiguration. As a result, these applications have either become, or



**Figure 3.** Achieving sustainable advantage through biometric technologies

are on the way to becoming, necessary as tickets to compete. They are hygiene factors rather than differentiating ones.

Locating oneself in the top right-hand quadrant on the other hand can provide sustainable advantage, since the innovations offered, and the related customer experience, are supported by unique and internally coherent operational configurations that have a long lead time, involve specialist knowledge, presuppose tight interwoven systems, and require deep co-ordination among the employees and other stakeholders involved in the process. As Porter (1996) has argued, such internal configurations are exceedingly difficult to imitate and provide the potential for sustainable differentiation.

We could not locate another example in other industries of harnessing biometric technologies to this extent in pursuit of service excellence, higher efficiency, as well as increased security, and we estimate that it will be several years before something similar is offered in the aviation industry itself. Our research at SIA and CAAS has convinced us that one of the forthcoming quantum leaps in differentiation via service innovation in the airline industry is the full-fledged integration of biometrics with several customer service, security and immigration processes to provide a seamless, hassle free, safe and convenient travel experience. This is not simply an application new technology to make existing processes faster, but to radically re-engineering these processes. This is only the beginning for SIA and CAAS. Other implementation ideas that may be realized and integrated in the near future include access control to airport lounges, issuing and payment of tickets, loyalty program service processes, and voice recognition at call centers. Some of these applications could be copied by competitors on a stand-alone basis, but their overall and mutually reinforcing effects cannot.

The unique constellation of Singapore Airlines and Changi Airport as innovation-driven service leaders in the context of a forward-looking, efficient and competitively-oriented country (often referred to as “Singapore Inc.”) allows us to catch a glimpse of the potential biometrics can offer to service firms more broadly. We are convinced that it is only a matter of time before several imaginative applications follow in other industries, enabled by more people around the world carrying smart cards (which could be for example integrated into credit cards) or biometrically enabled identification documents such as passports, identity cards or driving licenses. The field is open for companies to claim the high ground and sustainable success by effectively using the emerging technologies of biometrics.

Technology advances combined with creative minds in many service organizations don't allow us to predict accurately which biometric service applications will eventually become the 'killer applications' and how, but it appears certain that it is only a matter of time before biometric technologies revolutionize service delivery and allow many firms to realize significant gains in service quality, customer convenience, safety and productivity, all at the same time.

Our study brings to the fore the important lesson of strategic alignment, the second implication as noted above. From a vertical perspective, strategic alignment is the consistency among four elements: firstly the strategy, secondly the core competencies, thirdly the organizational features or functional strategies that implement or operationalize the strategy; and fourthly all of these should in turn be consistent with what the market wants, and what would make customers choose the company's product or service over competitive offerings. The strategy of Singapore Airlines is to achieve high profitability through the successful integration of differentiation (through

excellent service and continuous innovation); and higher efficiency compared to its peer group. The core competency of the company, supporting this strategy, is cost effective service excellence, enshrined in the company's practices, processes, and values. Use of biometrics technologies is one way of operationalizing this core competency of cost effective service excellence, and in turn supports the overall strategy. We have observed several other such organizational processes, for example how SIA people are developed, how new services are rigorously designed and implemented, how innovation is fostered in both centralized and decentralized modes, how cultural values are role-modeled and diffused, and how the organizational structure supports both differentiation and low cost (Heracleous *et al.*, forthcoming, b).

In the final piece of the puzzle of alignment, SIA's strategy, core competencies, and organizational arrangements, are in turn in line with what the market wants: high levels of quality at competitive prices (that are enabled by the lower costs at SIA in relation to its peer group). These elements lead to a highly aligned company, that at the same time can look at itself critically and if necessary re-align its processes and practices, thus escaping the ever-present danger of inertia. This ability of SIA to look at itself critically and question its current practices and processes is enabled by its customer-oriented values that continuously remind everyone that at the end of the day if the customer is unhappy, yesterday's alignment can turn into an expensive sunk cost that can lead to terminal decline.

The third key implication of our study is the importance of strategic innovation. The development of Fully Automated Seamless Travel (FAST) at SIA aptly illustrates various processes that can foster strategic innovation. Firstly, the process of "ideas brokering", identifying and using existing ideas or technologies in new ways that contribute to service excellence and add value to the customer. Biometrics technologies which enable FAST already exist in other domains. What SIA did was to identify and effectively apply these ideas to the aviation industry, as well as to integrate them with capabilities already present in the company (e.g., SIA's system for real time seat allocation and confirmation). A related process for fostering innovation is to draw from inter-organizational networks, forming strategic alliances to access ideas and resources to develop new internal processes and offerings. FAST illustrates this well, since at its core it is a collaborative effort of SIA, Civil Aviation Authority of Singapore, Immigration and Checkpoint Authorities, Singapore Police force, and the Ministry of Home Affairs, drawing on the relevant technical knowledge of the government computer labs.

Another way to foster innovation is to develop or discover novel ideas through a deep understanding of the customer. SIA spends considerable amounts of time and energy trying to get into the shoes and minds of its customers to understand their lifestyle trends, wants and needs, so that its new offerings reflect and capitalize on these understandings (e.g., Krisflyer entertainment system, Dolby sound, broadband internet in the air). SIA also conducts extensive preparation and testing to ensure that implementation of innovative processes and offerings is up to SIA's usual high standards. Finally, innovation is fostered by an internal culture and structure that supports continuous customer orientation, learning and change. There has to be a clear call from leadership about the importance of innovation; role modeling by the most senior levels of the organization; reward and evaluation systems that monitor and reward innovation; dedicated roles for innovation-related activities such as ideas

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brokering or network engagement; and dedicated spaces or events for ideas exchange and cross-pollination. All of these have been pursued by SIA in various ways, with the aim of creating a learning organization with a flexible and adaptive culture and structure and open mindset, that encourages continuous change and development (Heracleous *et al.*, forthcoming, b).

#### Note

1. Authentication is a one to one comparison, essentially answering the question “are you who you say you are?”; identification is a more complex process of a one to  $n$  comparison, answering the question “who are you?”

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#### Appendix. Outline of methodology

This research is based on in-depth interviews of executives at Singapore Airlines and the Civil Aviation Authority of Singapore focused on their use of biometrics technologies and more specifically on the Fully Automated Seamless Travel project. This research is part of a broader research project which started in 2001, examining Singapore Airlines’ strategy and competitiveness over the years, in particular its competencies of service excellence, efficiency and innovation. We have conducted both secondary and primary data gathering on these themes. In addition to library and database research on the airline industry and on Singapore Airlines, we have up to now conducted a total of 16 interviews with 12 executives, each lasting from 45 minutes to 90 minutes. We have recorded, transcribed and analysed most of these

interviews (and where we were not allowed to record, we took extensive field notes) with a view to gaining a deeper appreciation of how Singapore Airlines has managed to achieve sustainable competitive advantage and outperform all other airlines in its peer group for decades. The findings from this project will be presented in a forthcoming book (Heracleous, Wirtz and Pangarkar, forthcoming).

The performance comparisons shown in Figures 1 and 2 compare Singapore Airlines' performance in terms of net profit margin and return on assets against the weighted average for the top 20 airlines by market capitalization (as at 15 May 2004), for the period 1992-2004. The 20 airlines are Southwest Airlines, Singapore Airlines, Cathay Pacific, Japan Airlines, Lufthansa, British Airways, All Nippon Airways, Quantas, Air France, Ryanair, JetBlue Airways, China Southern Airlines (A shares), China Eastern Airlines (A shares), Thai Airways, American Airlines, Malaysian Airlines, SAS AB, China Airlines, WestJet Airlines, and Alitalia.

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