A CUSTOMER CENTRIC APPROACH TO FRONT-END BUSINESS INTELLIGENCE DEPLOYMENT

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ABSTRACT: The integration of business intelligence systems into existing business systems requires the mapping and engaging with electronic data storages. Such appropriately targeted and devices business intelligence systems may then be deployed into these electronic data storages. They may then be combined to deliver new front-end business intelligence solutions, which may add value to the modern e-business environment. Business intelligence software agents and approaches may be appropriately targeted to existing business areas – like the travel services industry, and can be wisely deployed to help generate desired business intelligence solutions.

Key words: Business intelligence, travel industry, services, customer targeting.

INTRODUCTION

Luhn (1958) groups business intelligence (BI) into a broad category of applications and technologies that: gather, store, analyse and provide access to data suitable to assist enterprise users in their business decisions and deliberations. BI typically includes: decision support systems, data queries and reporting, on-line analytical processing, statistical analysis, forecasting and data mining. BI systems often tap data warehouse information, and link this data with historical, current and predictive views of various business operations. Developed software systems often assist in the extraction, analysis and reporting of such information - delivering sales, production, financial and many other performance related business data management solutions. BI information also assists companies in their comparative positioning by benchmarking comparable companies (Luhn, 1958). BI also sifts and simplifies both information discovery and analysis by making it possible for '*decision makers at all levels of an organisation to more easily access, understand, analyse, collaborate and act on information, anytime and anywhere' (*Microsoft Technet, 2008a).

BUSINESS INTELLIGENCE DEVELOPMENT

The Australian Commonwealth Serum and Industrial Research Organization (CSIRO), 2008 suggests that by using available data intelligently a business may increase competitive advantage. It suggests this process occurs in five consecutive key stages: **(**1) data sourcing, **(**2) data analysis, (3) situation awareness, (4) risk assessment, and (5) decision support.

Data sourcing

Data sourcing involves the extraction of information from sources including: (1) text documentation like memos, reports or email messages, (2) photography, images, audio files, and formatted tables, and (3) web pages, or other URL linked sources. Such data collection is generally electronic, or can be converted into electronic form via interconnected data input tools and deliverable systems like: scanners, digital cameras, external database queries, global web searches and full computer file access, collation and analysis. Such data once compiled may often be sorted and analysed to some extent using existing basic software tools.

Data analysis

Beck and Michael (1995) suggest the synthesises of useful knowledge from broad collections of business data may identify and deliver: (1) new and current trends, (2) new information from previously disparate sources, (3) new validations and further understandings of business models, (4) missing information, and/or (5) possible future trends and scenarios. Such processes are termed 'data mining'. This knowledge discovery' sometimes solves business understanding problems utilizing: (1) probability theories (like classification, clustering, and Bayesian networks), (2) statistical methods (like regression, factor and cluster analysis, and customer demands), (3) operations research tools (like queuing, scheduling, and logistics), (4) artificial intelligence

systems (like neural networks, and fuzzy logic) (CSIRO, 2008). However such data capture requires meaningful and intelligent linkages into both the business situation and its outcomes.

Situation awareness
Integrating outcomes focused data analysis into the business situation may help to deliver key information that better engages the business and its environment with its end-user demands or requests. Here, information linked to prevailing or projected market trends is outputted in relevant terms, and may aid in decision-making processes. Thus, situation awareness may deliver information pertinent to understanding and delivering smart output solutions. Situational awareness algorithms typically provide automatic syntheses, and may also be programmed to offer degrees risk assessment.

Risk assessment
BI may help determine plausible solutions and appropriate actions. In this mode, mapping current and future risks against procedures like cost-benefit analysis or against competitive forces analyses may deliver outputs that enable further business assessment of capabilities. Such assessments are typically point-in-time measures, and apply to a set of monitored or measured circumstances. Here, appropriate risk solutions are selectively and intelligently drawn from the business's array of interconnected database and decision support systems.

Decision support
BI systems, working within decision support frameworks, may be used in knowledge discovery. Here new knowledge outputs must be wisely sourced and used. Key situations like share price manipulations, external economic changes, business and supplier performance, customer perception, and market sentiment once flagged, may be intelligently engaged to enhance sales, customer-delivered quality, customer servicing and customer satisfaction. In the travel tourism industry such decisions need to be generated on a timely manner, and may be monitored by: (1) real-time metrics monitoring of tourist bookings, (2) viewing graphical representations of data like room usage, and meals, (3) predicting financial performance like meeting profit targets, (4) drilling across performances at different levels of staffing, materials, and logistics,(5) responsive decision making built from BI tabulations of the business situation, and (6) improved BI software program integrations, solution executions, and business value-based solutions.

BUSINESS INTELLIGENCE
BI may deliver the necessary business insight to better enable decision making. It also may allow a company to respond rapidly to changing market conditions, and possibly to deploy a range of intelligent approaches that assist in delivering 'optimal business outcomes. For example, Avanco (2008) builds BI solutions by deploying three toolkits: (1) performance management (2) enterprise reporting, and (3) datamining of remaining business databases. These BI solutions systems help Avanco transform and then load new combined intelligent solutions including: (1) metrics outcomes to track data, (2) digital dashboards to effectively communicate and predict performance results,(3) web centric tools to better view and share dynamic reports containing 'drill-down' details, query responses, and deliverables (like understanding key forces positively driving the business). Avanco specifically deploys BI solutions to assist in keeping all business units on task, goal focused and aligned with the determined strategic direction.

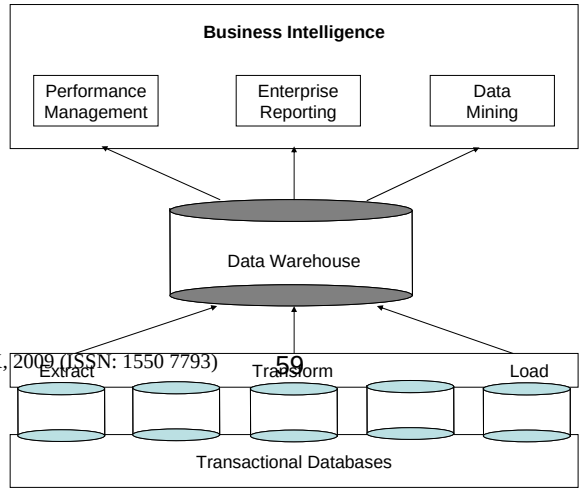

Figure 1. The Avanco Approach, Source: www.avanco.com, (2008)

The Avanco approach builds BI applications and solution capabilities into existing data warehouses. These BI solutions then effectively data mine resulting in improved decision making capabilities and better information dissemination capacities within the business. IBM business solutions target such decisions based solutions (IBM 2003a). They seek to grow and maintain strategic competence front-end business users may directly engage with these in-depth BI analysis pathways. IBM solutions may also investigate BI-packaged solutions of numbers, facts and scenarios and use these as pathways to improve key bottom-line performance parameters (http://www.ibs.net/au/solutions/business-intelligence/). Such IBM BI systems deliver enhanced: (1) supply chain performance, (2) data configuration (as sourceble fact packets), (3) instant solutions (that build scalable and growing data stores or warehouses), and (4) analysis toolkits (that assist in staff decision making processes). Hence, many approaches to building BI solutions exist.

BI APPROACHES

Today, many BI solutions typically fit into a number of approaches including:

1. Agent Based BI Systems (Jenkins, Norman & Faratin, 1998; Schleiffer, 2005; Weng & Tran, 2007)
2. Web-Based and Fuzzy Logic BI Systems (Weir, 2000; Jensen, & Shen,. 2004)
3. End-to-End BI Models (Kalakota & Robinson, 1999)
4. Intelligent Agent-Based BI (Bobek & Perko, 2006; Tarokh & Soroor, 2006)
5. Multi-Agent BI Frameworks (Wickramasinghe, Amarasisi & Alahakoon, 2004; Hamilton & Selen, 2008))
6. 3D - Self Organising BI Maps (Kohonen, 1982; Shirazi & Soroor, 2007)
7. Smart BI Gateways White, 2005; Hamilton, 2009).

Agent based BI systems

These systems pursue problem specific solutions in a similar manner to artificial intelligence sorting systems. An agent is a computer or information system, positioned within a constrained environment. It is also capable of delivering autonomous action(s) in response to its designed targets. Ideally, agents are capable of: controlling actions across multiple technologies, communicating with other agents, quickly reacting to change and position, taking initiative based on weighted parameter settings, and possessing degrees of intelligence (Schleiffer, 2005; Weng and Tran, 2007).

Web-based BI frameworks

Businesses may deploy BI across their web presence to access, analyse, publish and distribute relevant information to end users. This point-and-click information accession has been greatly simplified by the inclusion of technologies that engage with high performance repositories such as data-marts and/or data warehouses (Gupta, 2008). Many businesses focus on BI systems to reduce costs, to find new revenue streams, or to change company processes to better meet new challenges (Ritacco & Carver, 2004). Jensen and Shen (2004) link fuzzy logic and rough set theories to greatly reduce of data redundancy and information loss. Others use BI as a Web 2.0 toolkit enabler (O'Reilly, 2007). Thus, from a BI perspective, web technologies are still evolving, and web related BI manipulation toolkits are still being enhanced – especially in the security, scalability and data extraction areas!

Web servers deliver web pages, but they must also respond to multiple users, and their web server access requests. Here, secondary data processing is often required, thereby slowing business responses. Another response slowing factor is the need to include web servers. Web

servers, to some extent, interrupt the continuous connection between the user, the business applications, and desired data source components.
Web-Based BI Frameworks typically engage:

1. A BI Server – to house the business offered BI solutions and to readily respond to connected and data seeking users. (IBM, 2003a).
2. A Session Management Service – to control the web user's access to the server and information and to intelligently track activities (Ollman, 2001).
3. A File Management System, - to capture directory and file sourcing permissions, and to maintain these materials (OS data, 2008).
4. The Scheduling, Distribution and Notification Services – to allow web users to schedule reports, build queries and seek information refreshes when required or when specified (Microsoft Technet, 2008b).
5. Load Balancing Services – to cater for multiple users accessing the server (or its supporting offload servers), and deploying two or more systems to basically act as a single unit (IBM, 2003a).
6. An Application Server - to maintain parts of the system and build web browsers into powerful, front-end query / analysis tools (IBM, 2003b).
7. Supporting Technologies such as Cobra, Hop, Java and Xml – to improve web servicing options (Popov, 2000).

Thus, across their overall solution design Web-Based BI Frameworks typically network across standard technologies and engage in BI interconnectivity and in systems integration systems.

End-to-end BI models

Another approach to BI is the end-to-end approach. Here, data elements built into robust, scalable and flexible platforms are combined, converted into useful and intelligent forms, and deduced into final business outcomes that are often linked to transaction solutions (Kalakota and Robinson 2001). End-to-end BI platforms typically act as an integrated five-step process:

1. integration of customer-related information
2. analysis and segmentation of: 'data mining' segments, users, customers specific products and cross-selling options
3. triggers to indicate product personalisation requirements
4. performance indicators determining best ways to action a user request
5. point of sale information to best capture end users.

Thus, end-to-end solutions, as shown in Figure 2, typically link business units into overall solutions.

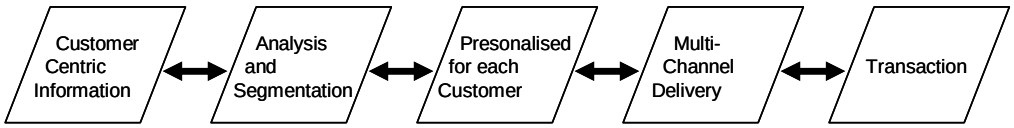

Figure 2. A Five-Step Process for Delivering a BI Platform
Source: Kalakota and Robinson, 2001

Intelligent Agent-Based BI

Intelligent agents are software data capture program entities that quickly perceive and proactively respond to user-generated changes. Intelligent agents aim to satisfy business design objectives, and user requests. They generate smart business solution components (Wickramasinghe, Amarasisi, Alahakoon, 2004). They also engage and interact with other agents to best meet business design requirements, and they are capable of self analysis – where they seek to explain actions, and detect both errors and successes.
Intelligent agents can:

1. collect internal or sources unstructured data, recognise information in semi-structured forms and then organise retained data along with additionally related information
2. create business-relevant prediction and simulation models
3. delivery selected information to the appropriate user over the right channel

Thus intelligent agents add reasoning capabilities to the BI equation

Multi-Agent Approach

Intelligent multi-agent systems further enhance intelligent agents approaches (Wickramasinghe, Amarasisi, Alahakoon, 2004). Intelligent multi-agents act within constrained environments and deploy multi-dimensional algorithms to optimize item selection and/or resource allocation (Schlieffer, 2005; Shirazi and Soroor, 2007; Beausoleil, Baldoquin & Montejo, 2008).

To build overall user-requested solutions, multi-agent systems offer a range of combinations of engaging intelligent agents. Several multi-agents each capable of mutual interaction and message passing, request (or produce) changes in their common business networked environment, and if programmed correctly they then deliver a best net-business-solution to the requesting end-user. Multi-agents can deliver set of intelligences that:

1. operate across their software environments and deliver decisive actions
2. recognise and set precepts and accumulate relevant information from the environment
3. monitor an event and also collect relevant information about a change
4. set or follow goals, objectives or strategies
5. follow beliefs and handle accumulated information about the business environment
6. plan how to achieve desired business goals
7. set, build, and follow message protocols for agents to follow (and interact) (Padghan & Winikopff, 2004; Hamilton and Selen, 2008).

Thus multi-agent BI approaches may better deliver a customer specific business solution to the requesting user.

Three dimensional Self organising BI maps (SOMs) and Growing self organising maps (GSOMs)

These systems are well explained by Kohonen (1982), Wickramasinghe, Amarasisi and Alahakoon (2004), Shirazi and Soroor (2007), Hamilton and Selen (2008), and Hamilton (2009).

Here, a user request is trail-matched in the three dimensional data packages environment. Where no exact match is deliverable, a best option is selected, or another solution is sought. This option is then remembered, added to the database, and a next like request, is further adjusted and improved, hence, iteratively, the result improves to a closer exact representation of the customer request. Alternatively, as more relevant data is sought and obtained, it is then added to the self organising map. As more slightly different data is added to the system, a growing self organising map is created, and even greater intelligence gathering and synthesis is thus possible.

Smart BI gateways

Figure 2 shows BI delivered via its overarching, demand-driven, interactive Services Gateway Platform housing the business (1) front-end-focussed data integration systems (IDP), (2) customer data capture (DWP) and business matching systems (CSP), and (3) management scenario-testing and gaming approach systems (MTP). These systems interact with the business, the business external connectors, and the engaging customers – at different levels of appeal (Hamilton, 2009).

Further upstream in the back-end business networks business, operational data stores, enterprise data warehouses and data-marts are tapped as required by collaboration, transactions, planning and business information factories. These integrated systems work together as supporting smart networks. They may seek out ‘best user option’ solutions (White, 2005) against specific transactions applications (Searby, 2003) and/or business planning and performance management systems (Ballard, White, McDonald, Myllymaki, McDowell, Goerlich, & Neroda, 2004) and/or business process and performance management systems (Pagano, 2005). Thus, a business integrated, smart network, deploying smart BI systems, potentially offers solutions for the discerning user.

This smart BI solution system encapsulates much of the above tools and moves BI capabilities to a new level. If built correctly it represents a ‘state of the art’ BI system

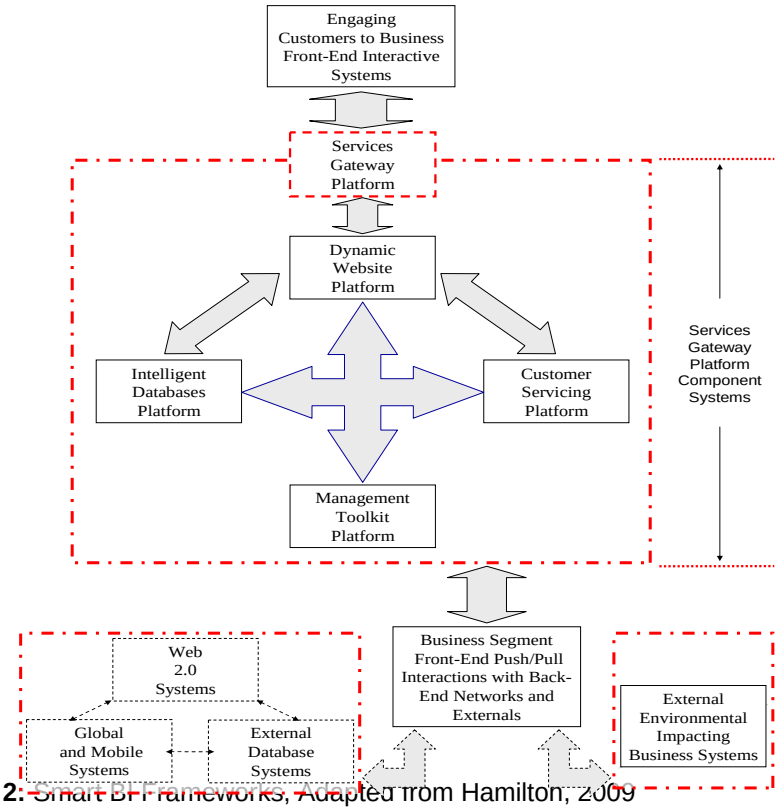

Figure 2: Smart BI Frameworks, Adapted from Hamilton, 2009

ENGAGING A BUSINESS INTELLIGENCE SYSTEM

In a Tropical Tourism BI system, travel may be captured into BI actionable software matrix of location against destination options, as shown in Table 1. In conjunction with Table 2 – which outlines the tourists travel constraints (money, time and activity time), the tourist may input a rated desirability measure, the activity's cost and its time requirement. These may be combined with constraints like: day or night activity options. Thus by balancing and optimizing of customer constraints, activity constraints, funds available and locations it is possible to deliver a customer activity desirability ratings set for each specific customer and their desired targets.

This analysis may be further refined, by first determining an impending tourist's preferred activity types against other options or preference blocks. In this situation, shown in Table 3, relative information concerning each location, and related attributes are presented on a 0 to 1.0 scale, and are held in the business intelligence system(s) as part of a customer driven desirability ratings system.

These focused activity preference (or customer driven desirability) blocks and their attributes may be built into a simple Growing Self Organising Map (GSOM), and then used to generate clusters of locations with similar attributes of significance. Consider a tourist choosing a 'must do' tropical tour activity (rated 10), like a Great Barrier Reef tour. The BI system assesses that the optimal combination to fill the tourist's day, and adds both a city night markets and a dining out activity to this complement the day's activities. It further deduces that this day costs at least $340, and consumes at least 13 hours of activities – leaving 35 hours, $1269 to consume in the future. The tourist then asks how much lunch, breakfast, and connecting travel may cost. The business intelligence system not directly housing this data, then searches its databases and estimates its best-guess answer. It may advise the end-user where such information may be sourced. This simple system involves agents, multi-agents, a central administrator coordination system,

integrated data warehouses, business solution option algorithms, and possibly a growing self organising map that approximates likely tourist desired outcomes. With such a system being constantly updated, and still accepting multiple customer, business, and supplier additions, a dynamic, relevant BI tours system is deliverable.

Table 1: Tourist Destination Activity Desirability

Location	Tourist Destination Activity Options			
	Desirability Scale	Cost ($)	Time (hrs)	Activity-Time (%Day/Night)
Great Barrier Reef	10	220	9	100% Day
Botanic Gardens	3	15	4	100% Day
Outback Tour	0	150	8	100% Day
Rainforest Tour	10	250	12	100% Day
Rainforest Sky-Train	10	50	2	50% Day
City Night Markets	9		1	100% Night
Night Shopping	7		2	100% Night
Dining out	7	120	3	100% Night
Morning Skydiving	4	350	5	50% Day
White-water Rafting	6	140	6	50% Day
Historic Train Ride		35	4	50% Day

Table 2: Tourist Travel Constraints

Total Monies Allocated to Tours and Activities	$1600
Total Stay Time (4 days) – 96 Hours Stay	40
Total Activities Time Planned During Stay	48

Table 3: Tourist Location - Activity Desirability Combinations

Location	Activity Preference Blocks									
	Beach	Historical	Adventure	Wildlife	Entertainment	Water Sports	Science	Botanical	Dining & Food	Educational
Great Barrier Reef	1	0.2	0.8	1	0.8	1	1	1	0.3	1
Botanic Gardens		1	0.4	0.5	0.2		1	1		0.8
Outback Tour		0.1	0.8	1	0.5		1	1	1	1
Rainforest Tour			0.8	1	0.5	0.2	1	1	1	1
Rainforest Sky-Train		0.5	0.5	1	0.5		1	1	0.1	1
City Night Markets					0.5				0.5	0.3
Night Shopping					0.2				0.5	0.2
Dining out					0.3				1	0.2
Morning Skydiving			1	0.2	1		1	0.5	0.5	0.3
White-water Rafting			1	0.4	1	1	1	1	0.5	0.5

Historic Train Ride		0.8	0.4	0.4	0.5		1	0.5	0.2	1

BUSINESS INTELLIGENCE FRAMEWORK DECISIONS

Extending the above BI tourist selection framework systems, a customer targeting framework may be developed. In this framework the most appropriate BI tools may be integrated and programmed to deliver specific business-focused or customer-focused outcomes.

Figure 3 depicts a general BI software selection approach. This approach may be combined with various degrees of customer response requirements, and so may yield the optimal customer or end-user output decision set. This general BI customer-responsive framework engages a range of intelligent software drivers – called 'BI agents'. These BI agents work across tourism-related business segments or fields including: (1) customer relationship management, (2) yield management, (3) overbooking, (4) employee scheduling, and (5) market intelligence (Hamilton and Selen, 2008). These business segments, along with their response zones and outputs, may further help the tropical tour business operator and the tropical tourist select an appropriate travel and activity mix. Each tourism-related business segment behaves differently and so places different requirements on the business systems. Hence, each net outcome may require different levels of BI engagement. The components of the required BI solution are compiled as a net-business-segment-generated, outcomes set. Here, both the business, and/or the tourism-customer receive the combined, differentiated, and optimized solution. For each business segment the BI tools most appropriately used in engaging across this tourism-related business and its BI segments are now discussed.

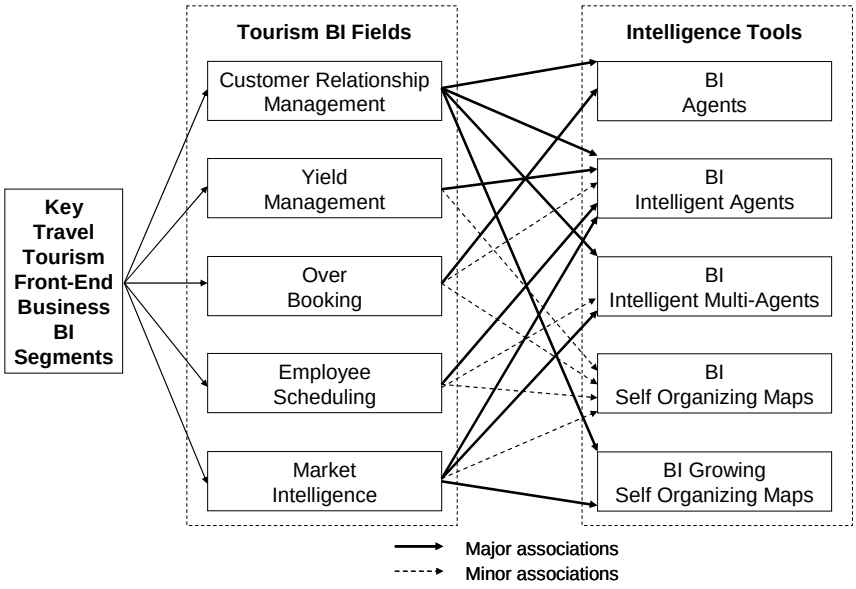

Figure 3: BI Customer Responsive Framework Model

SELECTING BUSINESS INTELLIGENCE TOOLS FOR TOURISM BUSINESS SEGMENTS

BI: Customer Relationship Management

Customer Relationship Management taps business-customer relationships by matching potential goods or services with user requests. If targeted well, sales increases and strong customer perceived satisfaction may be generated (Fluss, 2008). Multiple-agents are most appropriate here as they may be focused on personalised services like sending informative emails, extending special offers to the requesting user, and where possible responding quickly to user enquiries providing the complexity of the request is manageable. Agents may also help in segregating similar information into best selling and most popular products, or establishing the profile of the requesting user, or helping to develop a market positioning picture to target-marketing

campaigns. A GSOM also has value here as the requesting users, the number of users, size and type of market, user expectations and competitors are each likely to change frequently with changes in industry and market mix structures. A GSOM can accommodate and grow with such requirements. Thus agent systems, multi-agents and GSOM approaches offer the likely mix required.

BI: Yield Management
Yield Management targets maximizing profits. It manipulates available capacity against pricing variations to maximize business at differing times and from varying market segments (Badinelli 2000). Yield Management can be captured using intelligent agent frameworks, and at times may also tap into a SOM.

BI: Overbooking
Overbooking allows a tourism business to strategically over-commit its available services in order to minimise losses incurred when a service user fails to take-up an ordered booking. Thus this available user service is lost or waisted. A series of intelligent agents may be engaged to achieve this outcome (Netessine & Shumsky, 2002), and simple SOM linkages may also be useful

BI: Employee Scheduling
Employee scheduling typically links employees to daily rosters, times, and workplace tasks and/or activities. As various factors may contribute to these decisions, intelligent agents in conjunction with SOMs can capture the normal requirements to maximize employee work tasks efficiency, resources utilisation and lowest labour and associated operational costs. On rare occasions a SOM approach may be required to assess human capital. and advise on cost effectiveness and efficiency considerations. In rare cases a multi-agent framework also may be used to balance occasional special and multiple factor decisions.

Market Intelligence
Market Intelligence captures relevant information concerning the business's targeted and peripheral markets. It gathers, analyses, and disseminates this information to relevant sections within the business (Cornish, 1997). The algorithms applying here fit across the gambit of the displayed BI toolkit options. Simple agent solutions may offer daily visitors, multi-agents may sales, and visitors and compute simple ratios. Intelligent agents may add decision making fields to such information like projecting future sales based on past, present and estimated future passenger arrivals and on percentage capture. Rather than a SOM approach, a better solution is a GSOM approach, which allows for approximation, expanding business knowledge and learning and growing database solutions which may be required to accommodate the continuously changing business environment.

CONCLUSION
Business intelligence (BI) in the travel tourism services, industry can be enhanced by suitably deploying appropriate BI tools. BI tools may be used in the capture of tourist desired activities and constraints. They may also be engaged by the tourism business to link business segments intelligently to the tourist's desired activities. Key business segments including: market intelligence, customer relationship management, yield management, overbooking and employee scheduling may be included. The selection of BI tools for each segment is dependent on the levels and complexity of response required. To maximise the potential benefits of intelligence tools available to travel tourism businesses, a combined GSOM – multi-agents approach offers a generally suitable approach and this should be considered across an integrated tourism business network system. By first analysing the desired business requirements and then adding the desired tourism-customer outcomes appropriate BI tools may be selected, task programmed and incorporated into the tourism business's smart data networks. Such selected BI business segment responses should be planned for, and incorporated into a travel tourism business's data warehouse and knowledge management systems. An additional step may be to build relevant tourism business BI tools into a services gateway platform – where the close tracking of business-customer relationships, and the agile response to customer drift are deliverable.

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