



## High tech foodservice: an overview of technological advancements

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## **High tech foodservice; an overview of technological advancements.**

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### **Abstract**

Investment in development of foodservice technology is considered a luxury as the sector comprises predominantly by small and medium size businesses that may not be able to afford the heavy costs involved. However rapid advancements in information technology have allowed dedicated suppliers to foodservice businesses to develop such innovative products or services. Such hardware or software developments enable food and beverage outlets to increase quality of product, productivity and profitability. Often these products may seem existing developments from industries leading the technological advancement arena such as airlines and retail, but this paper reveals that this is no longer the case. Technology is developing at an ever increasing pace and dramatically changes business models in the hospitality industry. The paper aims to illustrate that investment in technological advancement within the foodservice sector is happening in a number of areas and highlights benefits in the areas of quality, cost, speed, dependability, flexibility and employee training.

**Keywords:** technology, restaurant, foodservice, high tech

## 1. Introduction

Food service technology has come a long way since its lowly beginnings back in 500BC (table 1). The exponential growth of such advancement in the Food and Beverage sector reaches a distinct milestone in the 1990's. The introduction of new packaging, sous-vide vacuum cooking and high tech or convenience food has allowed for the development of new highly effective business models. This in turn created an increase in demand for better and more efficient technologies to cope with rising customer expectations and increasing competition. The need to constantly improve margins, and quality brought forth the need of advanced technologies.

Great examples of innovative thinking and use of new technologies are that of Baggers Restaurant (Davis et al 2008) which utilises epos technology in the hands of the consumer and the use of clever engineering that relies on gravity for the delivery of food and drinks to the table, or the case of hungryhouse.co.uk (2009) an innovative way of utilising the internet enabling customers to order take away food online.

Slack et al (2007) argue that in operations management firms compete against five

key areas namely quality, cost, speed, dependability, flexibility. They also do mention training but they do not expand on it as it only contributes to the five areas and cannot be measured directly.

Researchers in hospitality and foodservice related research, have argued the positive effects of the utilisation of technology in areas such as quality (Lee et al 2003; Woon & Sunny 2006), cost control (Riley 2005), speed (Prasad et al 2005), dependability (Davis et al 2008), flexibility (Micros 2008) and employee training (Anon 2008).

The paper focuses on technology that has been in the forefront of foodservice for the past 20 years as well as new technology that has recently been developed and utilised in foodservice operations. Reviewing such technology and comparing its benefits to the six key areas, achieves a contribution to the body of knowledge in the area and enables managers and operators to make a more informed decision when deciding the areas they need to invest in order to gain competitive advantage.

**Table 1. Food service industry; from low-tech to high -tech.**

BC
500 "Ta Dionisiaka" banquets dedicated to the God of wine in Ancient Greece.
100 "the Thermopolium" snack bar sells hot food and drinks in Pompeii, Italy.
AD
1280 Innkeepers in Florence Italy form an association.
1425 The Swan Inn of Lavenham, England, opens.
1633 First Restaurant in the US opened in Boston by Samuel Coles
1809 Nicholas Appert, preserves foods in sealed wine bottles.
1865 Bookbinders Restaurant opens in Philadelphia
1876 Fred Harvey revolutionises foodservice in the rail industry with his chain of restaurants
1919 The National Restaurant Association is formed
1925 Howard Johnson opens first ice cream restaurant in Wolaston, Mass
1940s White Castle, one of the first fast food restaurants opens.
1950s McDonalds, Burger King Kentucky Fried Chicken Follow.
1960s Home delivery grows
1970s Drive through windows
1980s Ethnic foods explode, takeout and home delivery of foods increase.
1990s Advancements in packaging, sous-vide vacuum cooking, convenience and high tech foods.
1997 Yo, sushi Japanese restaurant that uses Robots to serve food opens in London.
2000+: New advancements in Biotechnology, IT and web technologies revolutionise the way restaurants do business

Source: Adapted from Bollaffi &Lulay (1989)

## 2 Methodology

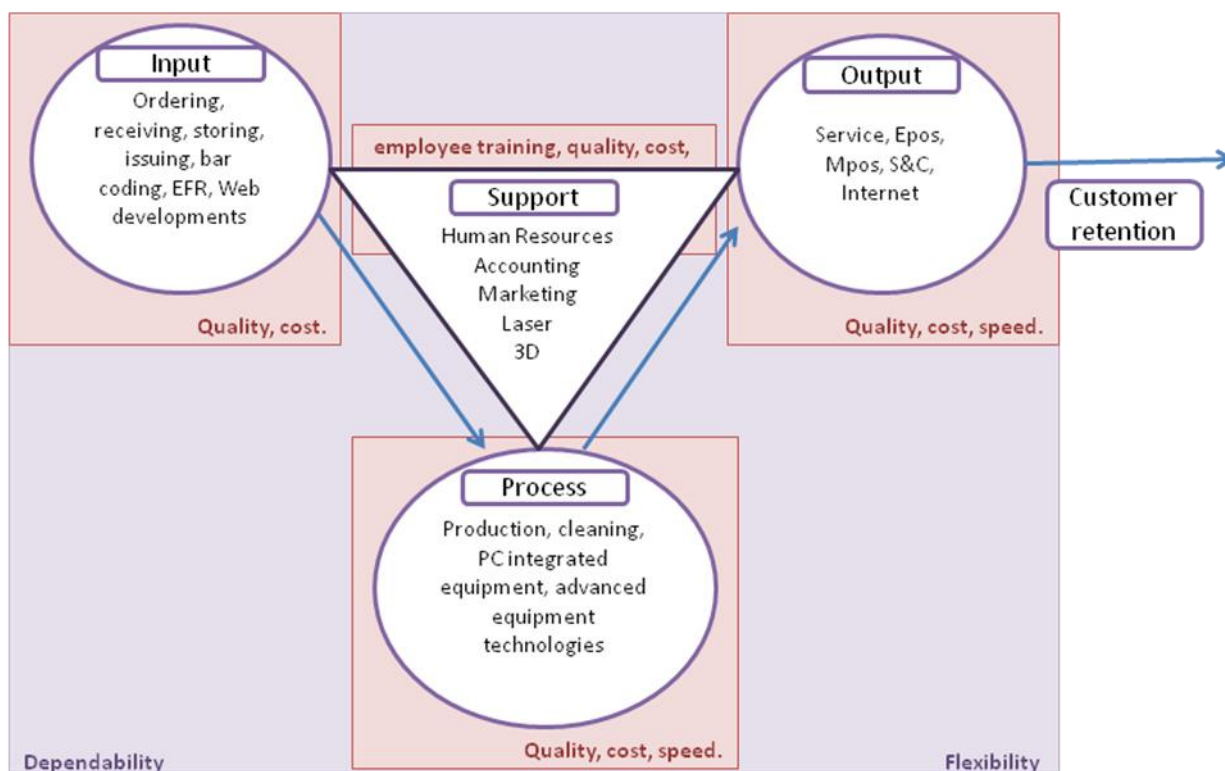
The purpose of this exploratory research was to identify the extend of which technology contributes to the effective management of foodservice operations. .

The goals of the study were to identify:

- technology that remains at the centre of foodservice for the past two decades
- advancements in foodservice technologies
- technology benefits relating to quality, cost, speed, dependability, flexibility, and training.

The author identifies specific technologies as exhibited in industry exhibitions. More specifically during field trips to industry exhibitions over the period of 2003 to 2009 the author conducted unstructured interviews (Clark et al 1998) with exhibitors and collected information and brochures on over two hundred new technology applications. The data was later analysed and triangulated with personal observations (Saunders et al, 1997) of technology commonly seen in London based restaurants as well as technological solutions featured on websites and news articles. Relevant and innovative applications were reviewed in this paper and were categorised thematically using the input - output model (figure 1)

Figure 1 Technological innovation in F&B



The proposed model hypothesises that balanced utilisation of key technologies can result in effective management of the operation and subsequent customer satisfaction and retention.

Technology at all stages of input to output can have implications to employee training and all five areas suggested by Slack et al (2007).

Indeed the opportunities are there at all stages of the input output model for technological advancements to contribute in quality improvements and cost reductions. The increase of speed of service can be seen with relative ease in technologies that are utilised in the process and output stages. Improvements in employee performance through effective training can be better achieved through support technology. Having said that the identification of employee training needs, may become apparent in technology utilisation in any of the stages of the proposed model. For example an epos report may help identify a waiter performance below the operations benchmark resulting in further

training. The other two areas of dependability and flexibility are achieved through the integration of all the available technologies in the operation and that is the reason they are seen as encompassing the proposed input – output model.

The following sections take a thematic approach categorising such innovations by utilising the input output model.

### **3.1 Input**

#### **3.1.1 Ordering and Procurement**

Considering the traditional technologies that are used for ordering food and beverage from a supplier, one could be amazed by the fact that many operators still use facsimile machines or phones to place an order. Facsimile machines were invented prior to the telephone but it was not until the early 1990's that a cost effective fax machine revolutionised procurement in foodservice. Personal Computers took ordering to the next level. The majority of food suppliers today have a highly interactive fully e-Commerce web site (aliantlink.com 2009). Restaurateurs can order when they need the products and as much as they need, eliminating the need for big storage areas. It is increasingly feasible to order new items and change menus to meet consumer needs, much faster than ever before. Cost comparison has been facilitated as prices are readily available on the internet and a manager can cut back on costs by choosing the most cost effective supplier. POS systems can be directly interfaced with the system of suppliers and pre-programmed to order directly once stock is depleted to certain levels. Some operators and suppliers use the Electronic Data Interchange (EDI) where by restaurant computers or points of sale (POS) are directly networked with the supplier's main computer. It provides better security than the Internet and is used in the industry to help distributors, buying groups and manufacturers reconcile the various streams of data. It also allows more accurate tracking of marketing allowance and promotional programs.

Bar coding is the method of placing a coded label on a product that can store information such as price, storage, item popularity. The Universal Product Code (UPC) has been in use since the early 1970s but was only accepted as the "Food service industry standard" in the late 1980s. The Efficient Foodservice Response (EFR) is an initiative that focuses on the foodservice distributor industry and has been developed by twelve trade associations including the International Foodservice Distributors Association (IFDA). IFDA utilises EDI components to facilitate purchasing and marketing within operators (www.FDI.org).

#### **3.1.2 Receiving, Storing and Stock Issuing**

The basic technology that is currently utilised in most operations is the computer technology both in terms of hardware and software that allows the implementation of a basic property management system (PMS) that includes modules of inventory control and issuing. One step further than this 'classic technology', is online procurement which enables the information to be downloaded to software that can track and analyse the inventory and assist with menu engineering. Inventory and cost control efforts as well as product quality can be greatly improved. Barcode systems can be utilised so that the perpetual inventory is kept up to date with minimal effort. Operators that have not yet realised the potential of technology must urgently reinvent their management style in order to survive. By using a hand held bar code reader, the inventory can be logged in and the data uploaded for analysis. The system can log the receiving date and can alert the operator if an item is about to run out of stock or if an item will be expiring soon. Video surveillance cameras can ensure that back doors are opened to delivery personnel only and not to unwanted intruders Durocher (2001). Issuing can be also facilitated, as storekeepers can pull reports to find out which products should be sold first and thus reducing wastage.

### **3.2 Process and Output**

#### **3.2.1 Food Preparation and Production**

EPOS systems can facilitate the management of catering businesses. Technology can facilitate a chef's creative inspiration, it also offers better tools for quality and quantity control and reduced productivity costs. Advances in service technology are not the only part that might help a company's strategy. New technology in production equipment allows ovens to interface with the PMS, allowing for reports on temperatures, humidity gas or electricity bills allowing for a better allocation of fixed costs per product and ensuring that the operator remains true to the current health and safety regulations. Furthermore a Chef can simply program the oven to cook what he wants, when

he wants, as he wants it, reducing labour costs and achieving consistency of product thus meeting consumer expectations. In 1998 McDonalds tested a prototype where a computer – monitored machine dumps frozen fries into a basket that in turn is dunked into hot oil for cooking. The machine then shakes the fries and prepares them for service into bins. Robots prepare drinks and computers instantly convey new orders to robots. The process to deliver an order takes no longer than two minutes. Such technologies have long term operational, financial and organisational behaviour implications. Hertneky (2000) even considers the argument whether waiters and chefs could be made redundant. Technology has reached a point where the customer can input his requests (Smith and Gregory 1996) and robotic machinery can prepare and serve the meal. Production equipment are already interfaced with POS and PCs. More than a decade ago robots served customers in establishments such as the Yo! Sushi restaurant in London UK (Fox 1997). Equipment such as ovens can be linked to a PC for reporting, the equipment are installed with temperature and humidity probes and the PC can regulate these, ensuring the food is cooked to perfection and within the health and safety standards. Digital timers can help Chefs keep track of time in a busy kitchen. This can reduce over cooked food and wastage (Durocher 2001a).

Biotechnology has also had major advances. Genetic material can be modified to cater for a specific functionality. Foods can be health enhanced and ingredients can be produced with the help of biotechnology. Chefs today can find any fruit or ingredient for a recipe through out the year at a lower production cost Klapthor (2000). Packaging technology has contributed to the increase of convenience products with better quality. Today's chefs have more production options without compromising consumer health and safety or food quality. The role of food microbiologists is also very important to ensure health safety. Advances in rapid methodology and identification techniques have enabled food microbiologists to manage food safety risks. Furthermore advances in preservation and process techniques such as irradiation and vacuum packing improve the ability to manage such risks. However the meal experience is not just about food and beverage consumption. It is a complicated experience and the human interaction still plays a big part. Chefs are still needed, as their individuality is what makes a dish exceptional or not.

### 3.2.2 Service

Restaurant service has been changing dramatically as a result of new technology. A challenge that the industry faces is to provide a meal when and where the customer wants it, with guaranteed food safety and nutritional value, offering authentic recipes and customer specific engineered menus.

“Guests give their order to a waiter holding a wireless POS the order is transmitted to the Kitchen, speeding service, reducing errors, and increasing time spent by server staff with guests. The data from the handheld device, now in the restaurant's computer system, pass through an interface to the inventory and supply ordering software. The software breaks down an order into its components – starter, main course, side orders and beverages – to be reordered from the suppliers - The Year is 2002” Bruns (2000:1). The advancements of mobile technology often puts the power in the hands of the consumer enabling greater control over the meal experience before even the meal experience has began. An article by PRNewswire-FirstCall (2006) reports that customers can utilise their mobile phones allowing them to pre-order their meals with American Airlines. Other airlines that have followed suit and offer the service to some of their flights include Japan Airlines, Air Berlin and Northwest airlines.

Wireless point-of-sale systems are ideal for difficult-to-wire environments such as pool areas, casino floors, leisure centres or common areas, as well as historic buildings and properties with large open spaces, providing point-of-activity revenue opportunities and new service offerings. Wireless pen-based terminals integrated with leading-edge restaurant systems can provide food & beverage facilities with breakthrough solutions that optimise efficiency, diminish lines and eliminate waits in a wide variety of hospitality applications.

Wireless customer pads enable customers to give feedback if they are dissatisfied before they leave the restaurant. Guest pagers that light up or vibrate mean that the hostess does not have to hail customers on a loudspeaker system. Pagers can alert waiting staff when orders are ready in the kitchen. Guest initiated pagers alert servers when a table is ready to have their order taken, saving time and preventing unnecessary trips to the table. Restaurant processes such as order taking, payment processing, inventory control, wait-list management, valet parking, frequent diner program interface, and other applications can dramatically increase productivity, reduce costs, and improve customer service, (Smith and Gregory 1996). Table seating software have often been part of the epos system such as the Micros, but increasingly stand alone table seating systems such as the Prohost (2009) are improving revenue by enabling a higher customer satisfaction through speedier error free seating of customers and a higher turnover of customers. The future of such systems in combination with touch screen technology will be that arriving customers will be able to choose their table without waiting if they had not made a reservation and a table was available. If they had made a reservation they could easily find their pre allocated table simply by using their credit card as a method of identification. Similar services already exists for example ClickaheadSeating (2009) allows the customer to confirm their seat up to seven days in advance with parties that are smaller than 6 people. The service can be used via the customer personal

computer or mobile phone. The next level would be to combine the click ahead service with a visual representation of the restaurant tables, allowing the customer to pick the actual table and seats in the same way that airlines such as British Airways allow customers to pre check in and chose their preferred seating arrangements.

The trend to take the service power into the hands of the consumer is now becoming a need for a memorable experience that becomes a Unique Selling Point. From interactive wine lists in hotel bars (Blum 2007) to 3D interactive table menus (Kefrel 2008) to interactive Bar surfaces (iBar 2009).

In addition, the introduction of new technologies in Room Service has also allowed greater flexibility. Room service staff can be supplied with internal phones that allow them to be in constant contact with food, beverage and banquet personnel, while roaming throughout the property (alcatel.com 2009). The productivity enhancements and responsiveness by re-directing staff to deliver and/or pick up food service orders while being mobile are phenomenal. By installing a wireless transmitter, hotels can provide Internet connectivity to sales people who happen to entertain customers in the hotel restaurant or even to guests who may wish to use their laptops (Durochet 2001b).

In University catering there is the possibility for a “*virtual service model*” (Bambenek and Hollywood 2001). Traditionally Universities either operated the catering themselves or have a single contractor. The *virtual service model* uses computer technology to allow for a “virtual meal plan card” that combined with a set of standard management practises and the use of the Internet, multiple food providers can be unified into one system. The system allows students to be fed by multiple providers who operate in the same system. It is feasible to have high street restaurants operate on Campus under University administration. In essence the virtual service model is a network that links the University to the food service providers. Financial connections allow students to use debit cards to pay for meals and organisational connections allow the University to retain control over the system. The system is easily manageable by the University authorities and provides better value for students as vendors compete for the customers. Payment can also be facilitated through the use of credit cards or mobile phones. The fast food chain McDonalds are experimenting with credit card payments in drive-through restaurants enabling a faster transaction (Hutchcraft 2001). Figures suggest that about 32% of fast food operators currently accept credit cards. Many consider the fast food sector pioneers in terms of payment technology in the foodservice industry.

Computer technology is rapidly expanding and it becomes the determining factor in consumer food marketing (Hollingsworth 1998). From the process of food formulating to the packaging and delivery of food staff new technology enable more efficient business processes.

### **3.3. Support**

#### **3.3.1 Recruitment**

Human resources manage a number of data records for a company’s employees so it makes sense to turn to information technology to maintain and efficiently update records. Even the most basic technology, a computer, has resulted in increasing efficiency and lower overheads for the HR department. Human resource software enables employers to capture complete information when hiring, promoting, and terminating employees. In addition, employment reports enable users to access critical data, and the software may include information on employment regulations and forms, sample business letters, and employment policies. One of the major problems the industry faces is recruiting high calibre staff when needed. The use of e-recruitment has enabled managers to manage such processes more efficiently. “*While recruiting via the Internet has its own set of problems, its speed and efficiency has helped personnel officials manage their operations more effectively*” (Conway, 2007).

#### **3.3.2 Performance, Motivation and Reward**

The use of reports from POS systems has enabled management to make decisions by comparing each employee standards to predetermined levels of expected performance. Users need to identify and create their own reports and critical performance indicators. However managers will need to educate staff so that they understand and take ownership of such areas. Establishing these parameters will lead to less friction and stress for both managers and staff. However one may question how management quantifies smartness, professionalism or natural ability in dealing with customers. Although reports alone are not the ultimate solution, they support managers to make more informed decisions.

Staff performance has become much easier to quantify as a result of technology. POS systems can provide information about an employee, how many customers he/she serves per hour, how much revenue he/she generates



how long it took to service a table how much tips tables leave and the lists goes on. Such information can be used to establish whether a member of staff needs more training, needs to be appraised for brilliant work or needs to be evaluated, as they do not seem to match the required standards. The ease of obtaining such information allows for the information to be shared around with the team and that in its self can help motivate staff as they can share what is going on in the work place. Employees may even chose not to access the information but the feeling of empowerment alone makes them feel respected and motivated.

Although labour scheduling programmes have been part of most PMS the utilisation of online labour scheduling is increasingly becoming a reality. Schedulefly.com (2009) is an example of such technology. The company has signed well over 45 restaurant brands which utilise their online labour scheduling system. Such systems allow managers to quickly and efficiently create schedules and instantly communicate them to staff whilst easily calculating labour cost percentages, one of the highest costs in the sector. With certain online systems, employees can even chose shifts themselves contributing to positive staff morale.

Other examples of technology positively affecting staff motivation are air disinfecting and surveillance technology. Ultraviolet (UV) air disinfecting technology is one of the best-known methods of controlling microorganisms Tara-associates.com (2008). It controls airborne pathogens the same way sunlight does, in essence simulating nature. UV operates without negative environmental impact—there are no harmful by-products to the process and it is energy efficient. Such technology also holds 98% of the smell that normal kitchen extractors would produce, a safer and better work environment increases staff morale and in many cases productivity. Sound control technology can not only improve the customer experience by reducing unnecessary noise, it also creates a better work place for the employees.

Video surveillance cameras that survey parking lots allow employees to feel safe when leaving at night. Increasingly video surveillance is linked onto the property management system and through the internet it allows for a centralised security solution that can monitor theft, restaurant operation efficiency. Restaurant Vision (2009) is an example of such integrated technology of the surveillance system and POS terminals.

### 3.3.3 Accounting

New accounting software interface direct with POS systems, enabling credit card authorisation and payment, storing customer information for future use and providing up to date reports for managers. Specialised software can analyse profitability, productivity, costing, and realisation at multiple levels from company-wide to the individual client or staff member. Tax, Social Security, and statistical updates can also be automated and payroll software can maximise payroll processing productivity and enhance profits.

POS and Sales and Catering systems (S&C) have provided new management and accounting tools. Accounting software can print reports that enable the accounting office to spot costs and trends. Managers can visualise better and faster where monies are coming from and tactical decisions can be made faster and safer. Computerised systems identify true food and beverage expenses much faster than with systems that do not utilise information technology, and save time in accounting and food and beverage management.

Time and money saved in accounting processes can be invested in training staff or improving products and services. Companies such as Radisson Edwardian, that have taken time and effort to invest in innovative technology have seen the operational benefits discussed in section 3 of this chapter, from the early days they have installed POS and S&C. On the other hand, there are reports that suggest that new technology might not have an effect on productivity (Sigala 2002). It is not therefore the technology itself that does not provide the solutions, but how people use such technology and what systems are in place to ensure maximisation of the benefits.

### 3.3.4 Marketing

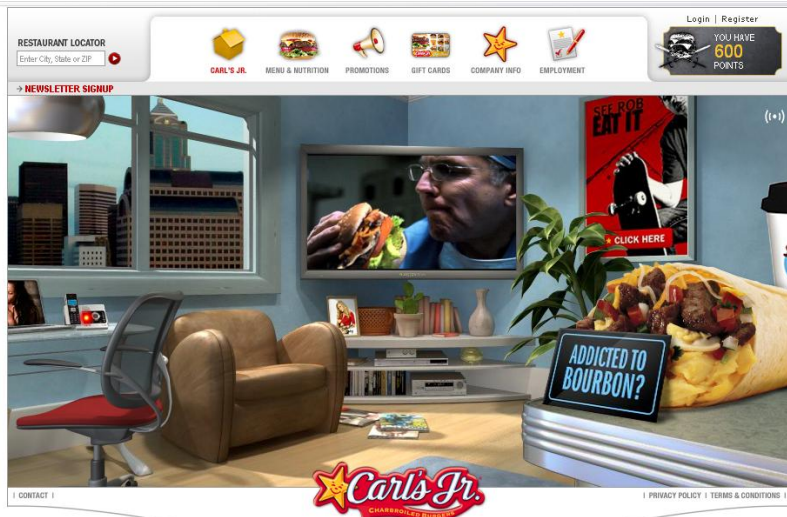
PC technology has enabled the production of high quality menus with the use of a colour printer and relatively low cost software (Durochet 2000). Effective menu enhancements can increase profit margins dramatically. POS enables servers to visualise how many items they have sold and what tips they are making out of it motivating them to sell more menu items. Customer acquisition, retention, turnover and average revenue per meal can be improved with the use of wireless restaurant service. Wireless handsets can be utilised so that a customer's waiting time in a restaurant can be turned into an opportunity to catch up on the news, take advantage of discounts and offers, or simply be entertained with music and video. With such service customers can pre-order thus minimising time spend in the restaurant and enabling higher turnovers of business.

Successful niche marketing involves targeting an audience and penetrating the market. Traditional methods of promotional marketing such as advertising in newspapers, posters, radio and television, can be quite expensive and

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small or medium operators may not be able to afford it. The Internet has enabled smaller businesses to use this new and exciting medium for marketing efforts. For example restaurants of various sizes around the world have seized the opportunity by creating web sites and creating email newsletters. Websites can range from simple information “electronic billboards” sites to more interactive 3dimensional websites (see figure 2) where customers can book seats in the restaurant online to even websites that offer virtual tours of the property (see figure 3)

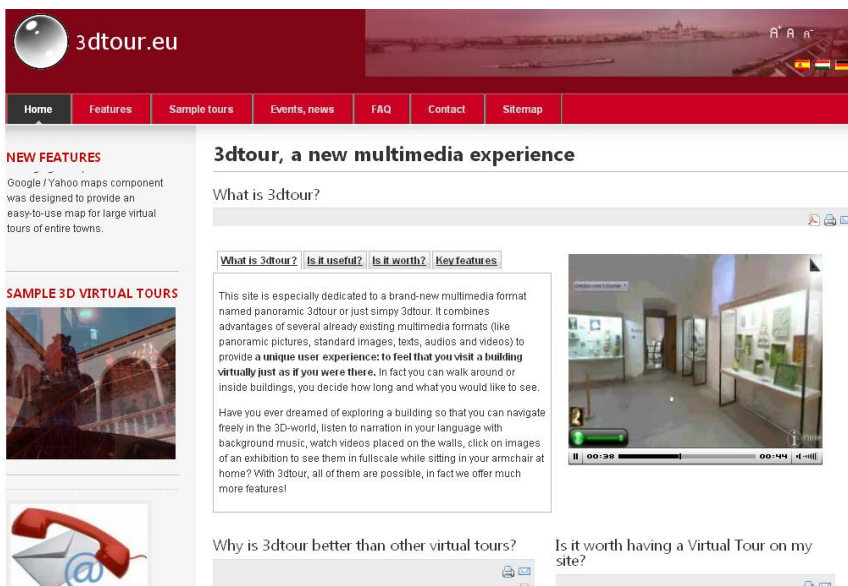
Figure 2. 3D Website designs.



Source: www.carlsjr.com

Innovative and cohesive web sites combined with other online tools such as, mail list, newsletters, and auto-responders, can generate a high degree of visibility for a company that is necessary to increase sales, or business to business contacts.

Figure 3. Virtual tours.



Source: www.3dtour.eu

Whilst gaining new customers is very important for any business, maintaining customer loyalty is critical for foodservice organisations. Customer Relationship Management (CRM) can help retain and analyse customer information and profiles helping efforts of retaining customers. POS systems can also facilitate training servers with better selling techniques. Photos and recipes of menu items can be stored in the POS enabling the staff to understand the products they are selling thus gaining in confidence and better guiding the guest to items that produce higher profit

margins. Even vending machines have received the latest technological “facelift” with companies such as ETT limited introducing fully interactive vending kiosks that utilise holographic and 3D technology (figure 4) that can cut through the traditional clutter of advertising. Both Macdonalds and TGI Fridays are working with ETT in installing some of their technology in their restaurants (Lewinsohn 2004).

Figure 4 3D Interactive Vending Kiosks.



Source: [www.provision3dmedia.com](http://www.provision3dmedia.com)

### 3.3.5 A holistic approach

An example of a holistic approach to utilising technology in a food service environment can be seen at <http://ibuildings.oddllysmart.com/>. As reported on their website the concept utilises iris recognition technology for the security system, high definition and laser technology for its media display units, touch screen EPOS Systems retrofitted with Reverse ATM's which allow customers to place their order and pay for it with no need to interact with staff. For the training of employee's real time interactive technology with two way interactive video conferencing can be utilised. Remote Controlled Signage and Screens enables the operation to retain centralized control over all signage, pricing, and marketing messages. Finger Print Biometric Systems allows for the tracking of employee hand washing & sanitizing. The Building can change colours and exterior look via a lighting system that utilises hologram laser technology. Remote Controlled Equipment Package enables a centralized ability to switch equipment &/or lights on and off. Four turbine-style windmills and an upturned, dish-like solar panel convert wind and sun energy into electricity cutting down on electricity bills and retain an environmentally friendly image. This is not just a dream concept that shows the utilisation of such technology in the distant future. In May of last year Desorbo (2008) reported that Health Food Hut, Inc. signed a 182-restaurant deal with 1 Smart Duck Management Group making the concept a reality.

## 4. Discussion: Using IT strategically and tactically for the F&B operations of the future.

Current technological solutions have ascended all boundaries of information management and systems integration. The points of sale (POS) can be directly linked to integrated central computers and today's manager can download report at the blink of an eye. Chain restaurants find it easier to control their business with new software that allows multiple restaurants to be run by a centralised system located at head office. Systems such as Micros/Fidelio integrate the POS into hotel property management systems (PMS), thus minimising entry time and costs and providing a better service to both the user and the customer (Oliva, 2001).

The strategic and operational aspects of this new technology are quite unique. Information management is facilitated and the process of long-term decision making has been made easier and faster for senior management. Operations also benefit in many ways, from cutting time to improving systems overall, to reducing costs and improving staff motivation and staff morale as well as food and service quality. Information management has been facilitated

enormously by such systems. Hotel companies keep detailed profiles of their customers, so that they know their favourite food or any allergies they might have, special requirements, how much money they tend to spend and other personal information. A production of reports provides ample information for managers. Comparison of such reports provides adequate business intelligence.

Thomas Oliver, Chairman and chief executive officer for Bass Hotels and Resorts expressed how important technology has become in our industry, by suggesting that “*Technology provides the life-blood for the hospitality industry, we need to learn about this rapidly changing environment to understand exactly where we are going in the future*” (Caterer.com 2001).

In the following sub sections, tables 2, 3 and 4 show what are the perceived barriers and benefits from the exhibitors/sales person point of view, utilising the key areas by Slack et al (2007) and verified for the hospitality and foodservice sector by authors such as Davis et al (2008), Micros (2008), Anon (2008), Woon & Sunny (2006), Riley (2005), Prasad et al (2005), and Lee et al (2003).

#### 4.1 Input; technology barriers and perceived benefits.

Looking at the technology reviewed at the input stage of the foodservice business it becomes apparent that one of the major reasons why foodservice operators and managers may chose not to use such technology, is the generally high start up costs. Whatever the cost savings may be in the long run a cash flow starved operation will not chose to implement innovative technology because it simply cannot afford to. Other reasons may be the lack of appropriate expertise or lack of awareness on behalf of management. The experts interviewed at the industry exhibitions would often talk about potential customer’s lack of understanding of the particular technology benefits versus its actual cost. With certain types of technology such as video surveillance there are other added considerations such as ethical issues depending on country of operation and local legislation. Indiscriminate use of surveillance for example may have the opposite effects that were originally intended, resulting in low staff morale and even reduced security, as overreliance on technology allows perpetrators to bypass such technology easily.

New technology will often have unproven benefits and exhibitors tend to be biased sales people therefore the analysis of table 2 would need to be further researched to identify how managers truly perceive each of these technologies. Often a barrier can be the lack of awareness of the technology or the fact that if the competitor does not use it then there is no real need for the technology to be used. This can be true in small medium operators with very small start up or maintenance budgets where such technology may be perceived as luxury when in fact it can be a need for the successful operation.

Table 2. An overview of “Input Technology” with perceived barriers and benefits.

	Technology Reviewed	Possible Barriers	Quality	Cost	Speed	Dependability	Flexibility	Employee training
<b>Input</b>	e-supply	Cost, Awareness	√	√	√			
	EDI. Integrated POS to suppliers servers	Cost, existing technology integration capability	√	√	√	√		
	Video Surveillance	Cost, ethical reasons, employee perceptions	√	√		√		√
	Bar Coding & handheld readers	Costs, lack of awareness		√	√	√		
	Inventory Control & Issuing	Costs, lack of expertise.	√	√	√	√	√	

Although the start up costs may be high, the long term reduction in costs can justify the investment in all cases of technology examined at the input stage. In foodservice the input stage is very important in guaranteeing a good quality of product. For example if what was ordered was not delivered, even if due to

human error the goods were accepted the combination of the technology reviewed could result in identifying an unreliable supplier.

#### 4.2 Process and Output; technology barriers and perceived benefits.

The same barriers seen in the input stage are true for technology that can be utilised in the output stage. The start up expense and the hidden costs such as maintenance costs are often an inhibitor for investment into such technologies. Often unquantifiable perceived benefits do not make strong enough incentives for operators to consider the investment worthy.

Table 3. An overview of “Process and Output Technology”

	Technology Reviewed	Possible Barriers	Quality	Cost	Speed	Dependability	Flexibility	Employee training
Output	Kitchen equipment Interfaced with PMS	Expensive technology, existing technology	✓	✓	✓	✓	✓	
	Computerised Ovens	Costs, Previous experience	✓	✓	✓	✓	✓	✓
	Computerised deep fryer.	Costs, Previous experience	✓	✓	✓	✓	✓	
	Robots	Customer experience, costs	✓	✓	✓	✓		
	Digital timers		✓		✓	✓		✓
	Biotechnology	Perceptions of consumers & management. Green issues.	✓				✓	
	Packaging technology	Costs, training	✓	✓	✓	✓		
	Preservation and process technology	Costs, training	✓	✓	✓	✓		
	POS technology	Start up and maintenance Costs.	✓	✓	✓	✓	✓	✓
	Mobile technology	Costs		✓	✓		✓	
	Wireless PDA	Costs and maintenance	✓	✓	✓	✓	✓	✓
	Online Table seating	Costs	✓	✓	✓		✓	
	Payment technology	Hidden costs			✓	✓		
	Touch screen technology	Costs	✓	✓	✓	✓	✓	
	3D interactive technology	Costs	✓	✓	✓	✓		
	Online ordering	Costs	✓	✓	✓	✓	✓	

The area of biotechnology is one of the most controversial ones, and whilst some operators welcome the availability of ingredients throughout the year it is argued that seasonality is what adds to the quality of great product. Added the often negative media impact on the consumer judgement over genetically engineered foods and the lack of data as to how they may affect consumer health or the environment influences the perception of perceived benefits of operators.

#### 4.3 Support; technology barriers and perceived benefits

There is no major change in the theme of high start up costs with the exception of the finger print biometrics and the video surveillance usage that poses some ethical questions as to how far can employers go in measuring employee effectiveness and professionalism. With remote controlled equipment and signage the issue of security is also important. If perpetrators can remotely hack into wireless systems, web sites and mobile communications managers would consider the implications of a perpetrator gaining access to their remotely controlled systems.

Table 4. An overview of “Support Technology”

	Technology Reviewed	Possible Barriers	Quality	Cost	Speed	Dependability	Flexibility	Employee training
Support	e- recruitment	Costs	✓	✓	✓	✓	✓	
	Online labour scheduling	Costs, data security		✓	✓		✓	
	EPOS	Costs, training	✓	✓	✓	✓	✓	✓
	UV technology	Costs	✓			✓		✓
	Video Surveillance	Cost, ethical reasons, employee perceptions	✓	✓		✓		✓
	Sound control	Costs	✓			✓		
	Accounting software	Costs, training		✓	✓	✓		✓
	CCA	Hidden costs		✓	✓	✓	✓	
	CRM	Costs		✓	✓	✓		✓
	Menu Design technology	Costs	✓	✓		✓	✓	✓
	3D web design	Costs	✓	✓				
	3D Holographs	Costs	✓	✓			✓	
	Web site virtual tours	Design costs	✓	✓				✓
	Iris recognition technology	Costs		✓		✓		
	Laser	Costs	✓	✓				
	Interactive Video Conferencing	Costs	✓	✓	✓	✓	✓	✓
	Remote controlled signage	Costs, security issues		✓	✓	✓	✓	
	Finger print Biometrics	Costs, and ethical issues	✓	✓				✓
	Interactive light systems	Costs	✓				✓	
	Remote Controlled equipment	Costs, security issues	✓	✓	✓	✓	✓	
Energy efficient technology	Start up costs	✓	✓		✓	✓		

#### 4.4 Limitations and suggestions for future research.

The collection of materials and identification of technology specific to the foodservice industry as well as the unstructured interviews with exhibitors had occurred in an organic and informal manner. The author does not suggest that all the available technology at the time of writing was covered. Merely technology that featured again and again in exhibitions (such as PMS, CRM and EPOS technology) formed the core of the review as well as innovative technology that was discovered through secondary research. This paper may serve as a snapshot of technological advancements in foodservice at the time of writing thus providing a starting point for future researchers interested in the topic.

Future research may consider theory that looks at technology and its relationship with both the customers and employees. Other issues that can be considered are legislative commitment, maintaining competitiveness via business intelligence, and retaining operational effectiveness. The paper does offer a starting point for future researchers that wish to examine consumer perceptions and reactions to the effects of such technology to their meal experience. Alternatively researchers may wish to investigate further the cost / benefit ratio of each technology for the benefits of operators.

#### 4.5 Conclusion

The balance of strategic benefits of such advancements in technology in this paper leans towards the positive side. Business intelligence can help enlarge profit margins and reduce costs. Customer information, if used wisely, can ensure loyalty and return business. This is much more cost effective than trying to win over new customers from competition. Owners and management can make informed decisions based on facts, rather than estimates or instincts. There has been plenty of debate about the era of “information or data war”. Indeed if such is the case, survival of operators may well depend on correct use of such technology.

There is a plethora of new technological advancements and applications that can support the foodservice industry both at operational and managerial level. Therefore the difficulty lies in choosing the technology that fits the specific business needs best rather than the lack of availability of such technological solutions. Technology develops at a fast pace but it also becomes obsolete as fast. Businesses must always consider what demands they are facing and plan ahead so that their investment is not depreciated within a short span of time. One must always remember that no matter the technology at hand it is not just about how good it is but how effectively the technology is utilised by the employees. After all the most amazing technology utilised in the foodservice sector is still the human being.

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