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Emerald Article: Capacity optimization analysis for the MICE industry in Las Vegas

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Abstract

Purpose – The purpose of this study is to identify the optimal meetings, incentive travel, conventions, and exhibitions (MICE) capacity for Las Vegas and analyze the over- and under-capacity situation in Las Vegas from 2010 through 2014. The study provides recommendations for Las Vegas's future MICE development based on the capacity analysis.

Design/methodology/approach – A single-period inventory model, which involves cost of over-capacity, cost of under-capacity, and forecasted future MICE demand, was used to identify the optimal capacity in terms of MICE square foot days for each year from 2010 through 2014. The model, which identified optimal capacity, was compared to the planned available capacity for each year to determine the magnitude of over- or under-capacity.

Findings – The cost of over-capacity was found much greater than the cost of under-capacity. The model that identified optimal capacity indicates that Las Vegas will experience severe over-capacity from 2010 to 2014.

Research limitations/ implications – The findings of this study should help researchers and practitioners evaluate the current status of the Las Vegas MICE industry in terms of capacity efficiency. The results suggest that the MICE development in Las Vegas is heading for over-capacity and the industry must downscale its development plan in the near future to avoid severe over-capacity.

Originality/value – For the first time in MICE research, this study develops an inventory model for determining the optimal MICE capacity. The model enables researchers and practitioners to identify and quantify over- and under-capacity in the MICE industry in a scientific way.

Keywords MICE industry, Capacity optimization, Single-period inventory model, Cost of over-capacity, Cost of under-capacity, Conferences, Conventions, United States of America

Paper type Research paper

Introduction

The meetings, incentive travel, conventions, and exhibitions (MICE) industry has been recognized as a significant hospitality market segment over the past decades (Astroff and Abbey, 2006; Kim *et al.*, 2003; World Tourism Organization (WTO), 2006). According to the International Meeting Statistics by the Union of International Associations (UIA), 11,929 international meetings were held in 2009 worldwide (UIA, 2010). The industry consists of multi-sectors of hospitality services, including lodging, food and beverage, catering, convention service, convention facility supply, transportation, tourism, retail, and entertainment (Astroff and Abbey, 2006; Fenich, 2008) and thus bears great importance for the local economy of a destination.

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The MICE industry is regarded as an important contributor to regional and national economies (Dwyer, 2002; Ford, 2011; Spiller, 2002; WTO, 2006). According to a recent study by PricewaterhouseCoopers US (2011), the MICE industry contributes $263 billion in annual spending to the US economy, provides $25.6 billion in tax revenue at the federal, state, and local levels, and creates 1.7 million jobs for the American workforce in local communities across the United States. For Singapore, which relies on MICE heavily for its tourism industry, the MICE business contributes even more to the nation's economy. According to International Enterprise Singapore (2001), every dollar generated by the MICE industry adds another $12 to the national gross domestic product (GDP).

Many researchers have focused on analyzing the economic impacts of the MICE industry on the host destinations (Dwyer and Forsyth, 1996, 1997; Ford, 2011; Grado *et al.*, 1998; Kim *et al.*, 2003; Lee, 2006; WTO, 2006). In the study on the economic impact of the MICE industry on Orlando, Florida, Braun (1992) identified 32 sectors related to MICE and estimated the impact of 1.67 million delegates in 1989 to be more than 65,000 jobs, $457 million in wages, $2.28 billion in output, $88 million in local taxes, and $15 million in state taxes. Kock *et al.* (2008) proposed a Regional Impact Based Feasibility Study (RIBFS) framework for the Orange County Convention Center (OCCC) in Florida. The RIBFS model contains aspects of a traditional feasibility study, input-output analysis, and all monetary market transactions for consumptions in a given time period. Dwyer and Forsyth (1996, 1997) developed a framework for assessing the economic impact and net benefits of the MICE industry on a national economy. They first identified three different effects of the convention and exhibition activities: the direct effect on suppliers, the indirect effect, and the induced effects. Within this framework, Dwyer and Forsyth (1996, 1997) estimated direct spending, economic output, value added, direct employment, and total employment. Kim *et al.* (2003) evaluated the economic impact of international conventions on the Korean national economy in 2001. Their research indicates that the total expenditure of international delegates and convention hosts was approximately $130.4 million. These convention receipts generated $217.3 million in total output, $47.4 million in residents' personal incomes, $114.6 million value added, $11.9 million in taxes, $15.6 million in import as well as 13,702 full-time jobs.

The MICE industry has exerted a great impact on the tourism of a destination. According to the Las Vegas Convention and Visitor Authority (LVCVA), since 1962, Las Vegas has hosted over 94 million convention attendees, who have brought over $101.2 billion to the Las Vegas economy (LVCVA, 2009d). In 2008, Las Vegas hosted 22,454 conventions with 5,899,725 attendees, representing 15.74 percent of the total visitors to Las Vegas and bringing over $7.77 billion to the Las Vegas economy (LVCVA, 2009d). Table I shows the direct expenditures of the MICE attendees from 1997 through 2008. Evidently, the contribution made by the MICE industry to the Las Vegas tourism economy is tremendous.

Since the 1980s, the MICE capacity has been significantly expanded in North America. According to the *HVS* report, MICE facility development in the US and Canada has been continuously underway at an average rate of 3.4 percent annually (Detlefsen and Vetter, 2008). The *EXPO* Magazine 2008 reveals that there are 40 convention and exhibition facilities currently under construction and they would add 7,226,500 square feet of convention space to the North American market by the end of

Year	Number of conventions held	Number of attendees	Direct expenditures ($)
1997	3,749	3,519,424	4,435,310,677
1998	3,999	3,301,705	4,278,384,800
1999	3,847	3,772,726	4,117,599,068
2000	3,722	3,853,363	4,289,389,724
2001	20,346	5,014,240	5,814,790,386
2002	23,031	5,105,450	5,962,850,147
2003	24,463	5,657,796	6,546,775,778
2004	22,286	5,724,864	6,860,512,075
2005	22,154	6,166,194	7,608,151,056
2006	23,825	6,307,961	8,182,818,340
2007	23,847	6,209,253	8,449,208,768
2008	22,454	5,899,725	7,773,774,124

Source: LVCVA 2001-2009 conventions counts are based on an updated methodology that reflects significant growth in the small meetings market in Las Vegas

Table I. Direct expenditures of the MICE attendees in Las Vegas, 1997-2008

2011 (Gamble, 2008). Expansions of convention facilities have been overwhelming in Las Vegas. *The Hotel/Casino Development – Construction Report of September 1, 2010* (LVCVA, 2010) shows that the total convention facilities in the Las Vegas area reached 10.4 million square feet in 2009, compared with 4.16 million square feet in 1997. According to the Las Vegas Convention and Visitor Authority (2010), 178,700 more square feet would be added in 2010. Moreover, while several new projects with a total 5.1 million square feet were proposed by 2009 (LVCVA, 2009b), some of these project were suspended during the economic downturn (LVCVA, 2010). As a result, approximately 418,500 square feet will be added to Las Vegas MICE facilities by 2014 (LVCVA, 2010; Zind, 2009).

The aggressive MICE capacity expansions in Las Vegas and the US have raised the risk of over-capacity and increased competitions among the MICE destinations. Over-capacity could result in great economic loss due to the enormous capital

Year	Square feet available	Square foot days available	Square foot days used	Utilization rate (%)
1997	4,161,547	1,518,964,655	877,431,200	57.77
1998	4,846,316	1,768,905,340	873,048,624	49.36
1999	5,960,987	2,175,760,255	871,278,997	40.04
2000	6,097,939	2,231,845,674	908,579,175	40.82
2001	7,609,826	2,777,586,490	2,009,167,500	72.34
2002	8,891,035	3,245,227,775	1,859,753,250	57.31
2003	8,928,173	3,258,783,145	1,868,973,200	57.35
2004	9,252,026	3,386,241,516	1,693,736,000	50.16
2005	9,622,282	3,512,132,930	2,525,556,000	71.91
2006	9,455,928	3,451,413,720	2,408,707,500	69.79
2007	9,679,527	3,533,027,355	2,356,083,600	66.69
2008	9,889,171	3,619,436,586	2,038,823,200	56.33

Sources: The *Hotel/Casino Development – Construction Bulletin* (LVCVA, 1997-2008, 2009b); CEIR (2001, 2005)

Table II. Utilization of the MICE capacity in Las Vegas, 1997-2008 investment of the MICE facilities, especially during an economic downturn. The low utilization rate of the MICE facilities in Las Vegas, as shown in Table II, may suggest that Las Vegas has been experiencing over-capacity. The average annual utilization rate from 1997 through 2008 was only 57.48 percent.

To grow healthily and profitably, the MICE industry in Las Vegas needs to carefully and scientifically plan for future developments. The purpose of this research is to determine the appropriate MICE capacity for Las Vegas in the next five years of 2010 through 2014. The study will estimate the costs of oversupplying and undersupplying MICE facilities and forecast future demand to determine the optimal capacity for each of the next five years. The magnitudes of over- or under-capacity, if any, of the industry will be identified based on the estimated optimal capacity and solutions will be recommended.

The findings of this study will identify whether the MICE development in Las Vegas is truly heading for over-capacity and how severe the situation is. They will shed lights on how the capacity problems, if any, may be corrected. A capacity optimization analysis should provide useful guidance for Las Vegas to develop its MICE industry in the years to come. Academically, this study will make a good contribution to capacity optimization literature by applying a quantitative model for the first time to the MICE industry in a destination.

Capacity management in the service industry: a review

Capacity management, one of the most important aspects of operating a business organization, refers to managing the amount of what an organization has and uses to perform work effectively and efficiently. Yu-Lee (2002) explains that capacity management is important because it is a significant component of a firm's costs, represents a large amount of a firm's assets, and impacts a firm's ability to manage cash flow, the overall ability to operate and perform, and the organization's brand and brand image. Capacity can significantly influence the quality of products and services, and hence influence customer satisfaction.

Capacity of the service industry is "the highest quantity of output possible in a given time period with a predefined level of staffing, facilities and equipment" (Lovelock, 1992). When service well matches demand and capacity, profitability is usually increased. However, due to the uncertainty of demand and perishability of capacity, service managers continue to struggle with the challenge of managing capacity and demand (Klassen and Rohleder, 2001). The perishability of capacity implies that there is a need for careful planning and management, as idle and insufficient capacity can seriously affect the success of the service industry (Gu, 2003; Kotler *et al.*, 2006).

When demand exceeds capacity, under-capacity occurs. The demand cannot be met because of the limited capacity. Therefore, the firm will lose certain amounts of sales revenue. In other words, the firm will have an opportunity loss. From an operation perspective, solutions to under-capacity include maximizing outputs and revenues subject to the constraints, increasing the relative capacity by outsourcing work to another organization, and increasing the relative capacity by supplementing the capacity with other entities (Kotler *et al.*, 2006). However, it is comparatively difficult for the capital intensive service industry to increase its space capacity to meet demand in a short period of time (Gu, 2003). For instance, when hotel rooms are 100 percent occupied in a period of time, the hotel cannot build extra rooms to meet additional demand in this short period of time. Conversely, when capacity exceeds demand, over-capacity occurs. A part of capacity will be idle or wasted. The fixed costs of excess capacity will be added to existing production and profitability will inevitably decrease. Solutions to over-capacity include reducing existing capacity, seeking additional demand, outsourcing the capacity to meet extra demand, and moving or transferring the capacity (Kotler *et al.*, 2006).

Kotler *et al.* (2006) have found that every major sector of the hospitality and tourism industries has suffered from over-capacity mainly due to the following reasons:

- owners are proud of having the largest capacity;
- practitioners tend to believe that economies of scale will occur as size increases;
- governments encourage investors to build a larger tourism or hospitality infrastructure to create economic growth;
- feasibility studies and industry forecast data are inaccurate or overly optimistic;
- the hospitality and tourism industries believe that the future demand is almost unlimited;
- the industry believes that a growing population, a breakdown of international barriers, and increasing disposable income will correct temporary over-capacity problems;
- tax laws encourage investors to overbuild properties; and
- the industry does not merge revenues management with sales and marketing management.

In summary, limited accurate forecasts of tourism demand and sound feasibility studies often mislead government officials, stakeholders, investors, and practitioners to believe that the demand for the hospitality and tourism industries is unlimited (Kotler *et al.*, 2006).

Undeniably, the MICE industry has been recognized as an important contributor to regional and national economies (Dwyer and Forsyth, 1996, 1997; Ford, 2011; Grado *et al.*, 1998; Kim *et al.*, 2003; Lee, 2006; WTO, 2006). However, because of the strong belief in the industry's great impact on local economies, government officials, investors, and practitioners tend to ignore the demand side and develop MICE facilities aggressively, consequently leading to over-capacity (Sanders, 2002). Especially during the current tough economic time with sluggish tourism and hospitality demand, the industry definitely needs a sound development plan of its capacity based on accurate forecasts of demand and proper estimates of costs and benefits of the MICE facilities.

Single-period inventory model

The theoretical instrument used in this study's MICE capacity analysis is the single-period inventory model that has been widely used in the manufacturing and retail industries for capacity management. Anderson *et al.* (2010) indicate that the single-period inventory model is applicable to operations that involve seasonal or perishable products or services that cannot be carried in inventory and sold in future period; and the demand of seasonal or perishable products is uncertain, but with a probability distribution. There were just a couple of studies applying the single-period inventory model in the hospitality industry (Gu, 2003) and the air cargo industry (Hellermann, 2006).

In the single-period inventory model with probabilistic demand, incremental analysis is used to determine the optimal order quantity. There are two important variables in incremental analysis: the cost or loss of supplying one additional unit that is not demanded or the unit cost of oversupply (Co) and the opportunity cost of not supplying one additional unit that is demanded or the unit cost of undersupply (Cu). By comparing the unit cost of oversupply with the unit cost of undersupply, the incremental analysis indicates that the optimal quantity of supply (Q^*) is at the level when the expected loss (EL) of supplying one incremental unit is equal to the EL of not supplying one incremental unit, or $EL(Q^* + 1) = EL(Q^*)$. Further, the expected loss of oversupply and undersupply can be defined as the probability of the ordering status multiplied by its unit cost (see equation 1).

$$\text{Co} \times \text{P}(\text{demand} \leqq Q^*) = \text{Cu} \times [1 - \text{P}(\text{demand} \leqq Q^*)] \tag{1}$$

The solution for $P(\text{demand} \leqq Q^*)$ can be defined as the cost of undersupply divided by the sum of the undersupply cost and the oversupply cost (see equation 2).

$$\text{P}(\text{demand} \leqq Q^*) = \text{Cu}/(\text{Cu} + \text{Co}) \tag{2}$$

In the single-period inventory model, the ratio of $Cu/(Cu + Co)$ plays a critical role in selecting the order quantity. When $Cu = Co$, the optimal order quantity Q^* should correspond to the median (or the mean for a normal distribution) demand; when $Cu > Co$, a larger order quantity, which provides a lower probability of a stock-out in an attempt to avoid the more expensive cost of undersupply, will be recommended. Contrarily, when $Cu < Co$, a smaller order quantity, which provides a higher probability of a stock-out in an attempt to avoid the more expensive cost of oversupply, will be recommended. In summary, the single-period inventory model tends to warrant the ordering status with lower costs.

Hellermann (2006) used the single-period inventory model to develop the capacity-option pricing model, which estimates the optimal capacity and determines the best pricing and reservation policies for the air cargo industry. Gu (2003) applied the single-period inventory model to estimate the optimal room capacity for Las Vegas Strip casino hotels from 2001 to 2004. In Gu's study, Cu was defined as income before corporate taxes per room night sold; and Co was fixed cost per room night available. From a trend regression model for demand forecasting, the future mean demand for each year and the standard deviation were obtained. This information was combined with the $Cu/(Cu + Co)$ ratio to estimate the optimal room nights available for each year. Gu (2003) found that the Las Vegas Strip casino hotels would experience over-capacity from 2001 to 2003, and under-capacity in 2004.

Similar to the operation of the hotel industry, the demand for MICE capacity is uncertain and highly seasonal and convention and exhibition facilities, like hotel rooms, are perishable. According to the *Meetings Market Report* (Braley, 2008) and the *Annual CEIR Index* (CEIR, 2009), the demand of the MICE industry is usually affected by seasons, holidays, and weather conditions. Further, fluctuations in the economy and competition from rivaling destinations always cause uncertain markets to a MICE destination (Astroff and Abbey, 2006; Fenich, 2008; Isler, 2008). According to a recent study by the Professional Convention Management Association (PCMA, 2009), over 60 percent of meeting planners indicated that the number of events and the number of attendees would decline and the budget of an event would also decrease during the recent recession. Meeting planners are more conservative in booking convention facilities during the recession (PCMA, 2009). Evidently, the MICE industry is facing a challenging and uncertain market in the years to come.

In summary, the MICE industry has similar features of the hotel industry, namely perishable products and highly seasonal and uncertain demand. Therefore, the single-period inventory model should be appropriate for capacity management in the MICE industry.

Methodology and data

The single-period inventory model proposed by Anderson *et al.* (2010) is to deal with probabilistic demand by optimizing inventory level. The assumptions of this model are:

- the operation involves highly seasonal or perishable items;
- the demand of the inventory item is uncertain, but has a probability distribution; and
- only one order is placed for the item in a period and demand is probabilistic.

This study uses square foot days available to measure the MICE capacity and square foot days used to quantify the demand. The future annual demand was predicted by estimating a trend regression line based on annual number of square foot days used (dependent variable) and time sequence (independent variable). Combined with the predicted demand, the cost ratio of $Cu/(Cu + Co)$ was identified to estimate the optimal quantity of square foot days available or the optimal capacity Q^* (see equation 2). In this study, Cu was defined as income before corporate taxes per square foot day sold; and Co was fixed costs per square foot day available. The fixed costs include depreciation, amortization, lease, rent, property tax, and interests. The $Cu/(Cu + Co)$ ratio indicates where the optimal capacity or square foot days available (Q^*) should be located in a normal probability distribution. After the ratio's value is determined, Q^* could be derived by using the equation: Z score $= (Q^* - Y)/\sigma$, where Y represents the forecasted future annual demand and σ represents the standard deviation of the demand. Both Y and σ were derived from the trend regression model for predicting future demand.

For forecasting purposes, regression analysis can use historical data to identify patterns and extrapolate these patterns into the future (Dielman, 2005). An extrapolative regression model requires past demand value as the dependent variable. In this study, the future MICE demand for Las Vegas was estimated by extrapolating a trend regression line with annual square foot days used as the dependant variable and time sequence as the independent variable. The annual square foot days used was the product of the annual number of conventions and exhibitions, reported by the Las Vegas Convention and Visitor Authority, and the annual average square foot days used per convention, obtained from the Center for Exhibition Industry Research. The SPSS regression curve estimation procedure was used to identify the trend regression line that best fits the data set. One assumption for regression models is that the dependant variable is normally distributed with constant variance

(Zikmund, 2003). When employing a regression line to predict future demand Y, the estimated Y is essentially the mean of future demand and the standard error of the predicted Y is the estimated standard deviation from the mean (Zikmund, 2003). Therefore, in this research, the estimated regression model not only predicts the mean of the future MICE demand, but also provides the probability distribution around the mean.

In this study, the cost of undersupply or the income before income tax includes not only income generated from meeting space rental and meeting equipment rental, but also incomes from hotel rooms and food and beverage, etc., related to or induced by the convention and exhibition operations. The data of the income before income tax was derived from the *Las Vegas* Market *Bulletin* (LVCVA, 2009d), the *Annual Las Vegas Visitor Profile: Market Segment* (LVCVA, 2009a), the *Las Vegas Convention and Visitor Authority Comprehensive Annual Financial Report* (LVCVA, 2009c), and the *Annual Nevada Gaming Abstract* (Nevada Gaming Commission and State Gaming Control Board, 2009). To determine income before tax per square foot day sold, or Cu, the aggregate income before tax for the MICE industry in Las Vegas, 2008, the year that provides the most updated data when the study was conducted, was divided by total square foot days sold during the year. The unsold MICE capacity in a given time does not have any salvage value. The cost of oversupply, Co, is thus defined as the fixed cost per unit or per square foot day available. The 2008 data of fixed cost was derived from the *Las Vegas Convention and Visitor Authority Comprehensive Annual Financial Report* (LVCVA, 2009c) and the *Annual Nevada Gaming Abstract* (Nevada Gaming Commission and State Gaming Control Board, 2009). The ratio of Cu/(Cu + Co) is the ratio of fixed cost per square foot day available to the combined fixed cost per square foot day available and income before tax per square foot day sold. Combining the derived cost ratio with future demand and probability distribution estimated from the regression model, the study was able to determine the optimal MICE capacity Q^* for Las Vegas for each year from 2010 through 2014. Over- or under- capacity was then identified by comparing Q^* with the expected MICE capacity for 2010 through 2014.

Findings

In 2008, the income before taxes per square foot day sold, or the cost of under-capacity (Cu), was calculated at \$0.40. On the other hand, the fixed charge per square foot day available, including depreciation, amortization, interests, rents, and property taxes, was estimated at \$3.74. The fixed component of the mixed cost per square foot day available was found to be \$1.24. Therefore, the fixed cost per square foot day available, or the cost of over-capacity (Co), was the sum of the two, or \$4.98. The cost ratio of Cu/(Cu + Co) for the Las Vegas MICE industry in 2008 was thus estimated at 0.0743. The ratio means that the optimal capacity of square foot days available, or Q^*, should be at the level where the probability for demand less than Q^* should be 7.43 percent and the probability for demand more than Q^* should be 92.57 percent. In a standard normal distribution, Q^* should be located at the left-hand side of the mean with a Z value of -1.45. Therefore, if the predicted mean demand Y and the standard deviation σ of the demand are known, the optimal capacity Q^* can be estimated by solving the equation:

$$-1.45 = (Q^* - Y)/\sigma \tag{3}$$

Regression method	R^2	Adjusted R^2	F statistics	Significance
Linear	0.745	0.719	29.177	0.000
Logarithm	0.727	0.700	26.678	0.000
Inverse	0.502	0.452	10.074	0.010
Quadratic	0.794	0.748	17.340	0.001
Cubic	0.840	0.780	14.017	0.001
Compound	0.747	0.722	29.548	0.000
Power	0.754	0.729	30.589	0.000
S-Curve	0.535	0.488	11.494	0.007
Growth	0.747	0.722	29.548	0.000
Exponential	0.747	0.722	29.548	0.000
Logistic	0.747	0.722	29.548	0.000

Table III. Regression curve estimation for the demand prediction model, 1997-2008

Table III shows the different regression curve estimates for predicting square foot days demanded for Las Vegas. Among the 11 regression models, the cubic curve regression model had the highest adjusted R square value, 0.78, but none of its predicting independent variables was significant ($p > 0.05$) (see Table IV). On the other hand, the quadratic curve regression model had the next highest adjusted R square, 0.748 (see Table III), and both its predicting variables were significant at the 0.05 level (see Table V). Therefore, the quadratic model was selected to forecast Las Vegas MICE demand for the five years. The model can be written as: $Y = 297{,}300{,}000 + 322{,}400{,}000X - 12{,}950{,}000X^2$. The predicated mean square foot days demanded for 2010, or the 14th year in the data series, was calculated at 2,272,700,000. Accordingly, the model predicts mean square foot days demanded at 2,219,550,000 in 2011; 2,140,500,000 in 2012; 2,035,550,000 in 2013; and 1,904,700,000 in 2014, respectively. The standard error of the Y estimate is 322,800,000 square foot days (see Table V).

	Coefficient	T stat.	Significance
Constant	878,900,000	1.781	0.113
X variable	−127,200,000	−0.403	0.697
X^2	70,140,000	1.269	0.240
X^3	−4,261,191	−1.521	0.167

Notes: $n = 12$, df = 11, standard error of Y = 301,600,000, model F stat. = 14.017, p-value = 0.001, adjusted $R^2 = 0.78$

Table IV. Cubic regression forecasting model for MICE capacity

	Coefficient	T stat.	Significance
Constant	297,300,000	0.891	0.396
X variable	322,400,000	2.732	0.023
X^2	−12,950,000	−1.466	0.017

Notes: $n = 12$, df = 11, standard error of Y = 322,800,000, model F stat. = 17.340, p-value = 0.001, adjusted $R^2 = 0.748$

Table V. Quadratic regression forecasting model for MICE capacity

For 2010, the predicted mean demand is 2,272,700,000 square foot days with a standard error of 322,800,000 square foot days. Based on equation 3, the optimal capacity for 2010 should be 1,804,640,000 square foot days. The optimal capacity for 2011-2014 was calculated in the same manner. Table VI lists the model calculated optimal capacity in comparison to the expected available capacity for 2010-2014. The declining Q^* or optimal capacity for the next five years is consistent with the declining Las Vegas MICE demand, the square foot days used, since 2005 as shown in Table II. The expected square foot days available from 2010 through 2014 were derived based on the *Hotel/Casino Development-Construction Report* (LVCVA, 2010). The differences between the expected available capacity and the model determined optimal capacity representing the magnitude of over- or under-capacity point to over-capacity. The over-capacity as a percentage of the optimal capacity is also indicated in the table. The difference in number of square feet for the year, which is square foot days divided by 365, is shown in the last column of the table.

Discussion

In this study, the unit oversupply cost, Co, was found to be $4.98 and the unit undersupply cost, Cu, only $0.40. The tremendous gap between the two costs suggests that the cost of providing one additional square foot day of MICE space in Las Vegas has far exceeded the benefit associated with one additional square foot day sold or the unit opportunity cost. Indeed, Las Vegas is in a highly saturated market and the destination is facing a very serious over-capacity situation in its MICE industry (Detlefsen and Vetter, 2008). The tiny $Cu/(Cu + Co)$ cost ratio, at 0.0743, shows that given present market conditions, much greater chance should be given to under-capacity rather than over-capacity because of the highly imbalanced costs ratio.

The severe over-capacity of the Las Vegas MICE industry identified in this study is likely the result of a belief in "Build it and they will come" in the industry (Sanders, 2002) From 1997 to 2008, many new MICE facilities, such as the Las Vegas Convention Center, Mandalay Bay, Venetian, Bellagio, and Palazzo were built and launched into operation. These convention and exhibition facilities added 5.7 million square feet to the existing capacity and have significantly contributed to the city's MICE over-capacity.

The tiny $Cu/(Cu + Co)$ ratio of Las Vegas MICE industry is also a reflection of intensified competitions among destinations and within the Las Vegas destination. Aggressive MICE expansions nationwide have led to not only fierce competitions between Las Vegas and other MICE destinations, such as Orlando and Chicago, but also cutthroat competitions within Las Vegas itself (Wimberly, 2010). To rival for MICE clients, providers have to lower service prices to beat competitors. This has

Table VI.
MICE capacity 2010-2014: optimal versus expected

	Optimal square foot days (Q^*)	Expected square foot days available	Difference in square foot days	Difference in percentage	Difference in square feet
2010	1,804,640,000	3,878,589,280	2,073,949,280	115	5,682,053
2011	1,751,490,000	3,881,509,280	2,130,019,280	122	5,835,669
2012	1,672,440,000	3,892,143,552	2,219,703,552	133	6,064,764
2013	1,567,490,000	3,881,509,280	2,314,019,280	148	6,339,779
2014	1,436,640,000	4,031,341,780	2,594,701,780	181	7,108,772

inevitably cut into profit margin and lowered income before taxes from the MICE operations and thus the much lower cost of undersupply, Cu.

Table II shows a steady declining trend of square foot days used from 2005 to 2008. In 2009, Las Vegas had more than 400 event cancellations and experienced a 13.6 percent decrease in the number of conventions and exhibitions, and a 24 percent decline in convention attendance (Wimberly, 2010; LVCVA, 2010). Shrinking convention budgets have led to declining convention sizes in Las Vegas in recent years. Las Vegas has been struggling with lower utilization of square footage and decreased MICE revenue due to the economic recession (Wimberly, 2010). However, while the reality points to stagnant or declining demand, many hotels and resorts in Las Vegas, including the Wingate by Wyndham, the Hilton Branded Property, the Harmon Hotel and Spa, and the Fontainebleau Las Vegas, are planning to expand their convention facilities for a total of 418,500 square feet in the next five year (LVCVA, 2010). Given the torpid demand and the aggressive expansion plan of the Las Vegas MICE industry, this study demonstrates that the planned available capacity will be at least 115 percent in excess of the optimal capacity for 2010-2014 (see Table VI). The most severe over-capacity will occur in 2014 when the planned capacity will be 181 percent more than the optimal. The wisdom of making those plans for capacity expansions is highly questionable.

Summary, recommendations, and future research

Using the demand trend and aggregate operation statistics of the Las Vegas convention hotels and convention centers from 1997 through 2008, this study developed an inventory model to estimate the optimal MICE capacity for Las Vegas in the years to come and measured the magnitude of over-capacity from 2010 through 2014. The findings indicate that Las Vegas has experienced and will continue to experience severe over-capacity and the worst situation will occur in 2014. Based on the findings, this study proposes the following recommendations for the Las Vegas MICE industry to cope with the over-capacity.

First of all, the industry must reevaluate their expansion plans for the next five years. Any expansion plan should be based on a sound analysis of financial costs and benefits and the future demand. The fallacy of “Build it and they will come” should no longer prevail in the Las Vegas MICE industry. Industry executives and government officials should go back to the reality and weigh the market conditions and the costs involved in MICE capacity development and operation and revise their plans carefully and scientifically.

Secondly, given the tremendous cost of oversupply and the trivial opportunity cost of undersupply and the sluggish future demand, it is high time for the industry to put a brake on aggressive MICE facility expansion. Blindly expanding the facilities disregarding the costs involved and the demand reality will put further financial burdens on firms in the MICE industry, inevitably leading to more business failures and bankruptcies in Las Vegas.

Finally, raising the utilization rate of the existing MICE facilities is the key for coping with the current MICE over-capacity in Las Vegas. Both the industry and the LVCVA should aggressively promote Las Vegas as a MICE destination to gain market shares. It is necessary to raise the citywide MICE utilization rate of 57 percent to over 70 percent, or the industry standard booking rate (CEIR, 2009; LVCVA, 2009c). Promoting Las Vegas for international events is a good way to raise the facility utilization and revenue. According to the *Las Vegas Visitor Profile: Market Segment Version* (LVCVA, 2009a), only 8 percent of the total convention visitors were from outside the US in 2008. The visitor profile also indicates that international convention visitors usually stay longer and spend more than other visitors, thus financially contributing more to the industry (LVCVA, 2009a). While making efforts to get more regional and national conventions and exhibitions, the LVCVA should help Las Vegas MICE industry more aggressively expand convention and exhibition businesses internationally, especially in Asia Pacific countries.

A major limitation of this study is that the cost estimates and demand projection were based on the Las Vegas operation statistics up to 2008, the most recent year with available data when this study was conducted. Since the MICE industry experienced further decrease in terms of number of conventions and exhibitions and revenues in 2009 (Wimberly, 2010; LVCVA, 2010), the downward trend of the demand could be even worse if the 2009 statistics are incorporated in the analysis. Therefore, the conclusions based on the findings in this study only represent a very conservative estimate of the future MICE over-capacity in Las Vegas.

A new study that includes the 2009 data may provide a more accurate assessment of the over-capacity Las Vegas will face in the years to come. The analysis provided in this study is from the perspective of an owner/operator of the MICE industry. Future research may broaden the scope to view the MICE optimization from the local economy perspective and include the multiplier effect of the MICE industry in the analysis. Economic benefits derived from indirect spending may be also considered in planning the optimal MICE capacity.

Future research could apply this model to tourism developments or public investment projects, such as theme parks, recreation centers, sport stadium, and arenas. A capacity optimization analysis based on a financial benefits and costs analysis should be able to provide a more accurate and reliable feasibility analysis for investors and government officials.

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